Geopolitics, inflation and the energy transition — Where do renewables go from here?

Renewable Energy Market Review

January 2023

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Style

Our Review uses a mixture of American and English spelling, depending on the nationality of the author concerned. We have used capital letters to describe various classes of insurance products and markets, but otherwise we have used lower case to describe various parts of the renewable energy industry itself.

Abbreviations

The following abbreviations have been used throughout this Review:

BESS	Battery Energy Storage Systems
BI	Business Interruption
CEO	Chief Executive Officer
CFO	Chief Financial Officer
COVID-19	Coronavirus disease 2019
CRO	Chief Risk Officer
DSU	Delay in Start-Up
EML	Estimated Maximum Loss
EPC	Engineering, Procurement and Construction
ESG	Environmental Social Governance
EU	European Union
FT	Financial Times
GDP	Gross Domestic Product
GL	General Liability
GW/h	Gigawatt/hour
IEA	International Energy Agency
LEG	London Engineering Group
IPP	Independent Power Producer
MFL	Maximum Foreseeable Loss
MW	Megawatt
Nat Cat	Natural Catastrophe
O&M	Operations & Maintenance
OEM	Original Equipment Manufacturer
P&C	Property& Casualty
PD	Physical Damage
PML	Probable Maximum Loss
PPA	Power Purchase Agreement
PV	Photovoltaic
RELD	Renewable Energy Loss Database
UN	United Nations
US	United States
WTG	Wind Turbine Generator
WTO	World Trade Organisation

Introduction

Welcome to this year's Renewable Energy Market Review. At the time of the release of last year's Review, not many of us could have foreseen the impact that the conflict in Ukraine would have, not only on the renewable energy sector but on the global economy as a whole. And yet while the conflict has seemingly prompted a short-term escalation of fossil fuel activity to meet the demand from other regions, it has also undoubtedly accelerated the energy transition towards the renewables sector. Furthermore, investment and capital deployment decisions - at both macro and micro levels - are increasingly being made on the basis of what is ethically correct rather than what is business expedient in the short term.

What exactly has changed since last year? Firstly, geopolitical events and strategic competition between global powers continues to intensify. Ongoing sanctions and realignment of trade will have lasting disruption to the global economy, regardless of the outcome of the current crisis in Ukraine or the recent protests that we have seen in China.

Secondly, two years after the onset of the COVID-19 pandemic, global inflation has approached 10%, becoming a major concern for the global economy. With demand outstripping supply for many commodities, the need to provide energy and power is driving inflation, both directly and indirectly. Costs for project life cycles are varying, with increasing labour costs and shortages.

Thirdly, the Global Supply Chain Pressure Index reached its highest level ever in 2022, according to the US Federal Reserve[1], resulting from multiple shocks from global geopolitical events, pandemics and natural disasters. Indeed, the compounding effects of multiple events and expected increases to severity and frequency of natural disasters may result in losses and impacts that may be far greater than expected, especially with regard to supply chain disruption.

Fourthly, Cybersecurity is developing into a major risk for corporations across their operations with potential for substantial financial cost and reputational damage. The systematic role of natural resource companies makes them targets for politically charged cybercrime.

Fifthly, understanding physical risk exposure from climate risk is becoming increasingly important. Organisations need to quantify their physical climate risk and determine if they need to address this growing concern.

In this year's Review we have dedicated Part One to the impact of geopolitics, inflation and the energy transition on the industry. In particular Margaret Ann Splawn, from the Climate Markets & Investment Association, provides us with her own reflections as a delegate at the recent COP27 and points the way for the renewable energy industry to work towards a more sustainable future. We also include articles that focus on the geopolitical arena, solar PV, hydrogen and floating offshore wind.

In Part Two we offer an array of articles that point to more effective ways of managing renewable energy risk. I do hope you spend some time reviewing our article on how our Renewable Energy Loss Database is helping our clients to make more effective risk management decisions in a number of areas.

In Part Three our Global Head of Renewables, Steve Munday, offers a detailed analysis of the insurance markets for Renewable Energy and identifies why, for the moment, prices continue to drift upwards, if not at the same rate as during the last few years. And in Part Four we take a global tour to review contributions from our colleagues around the world.

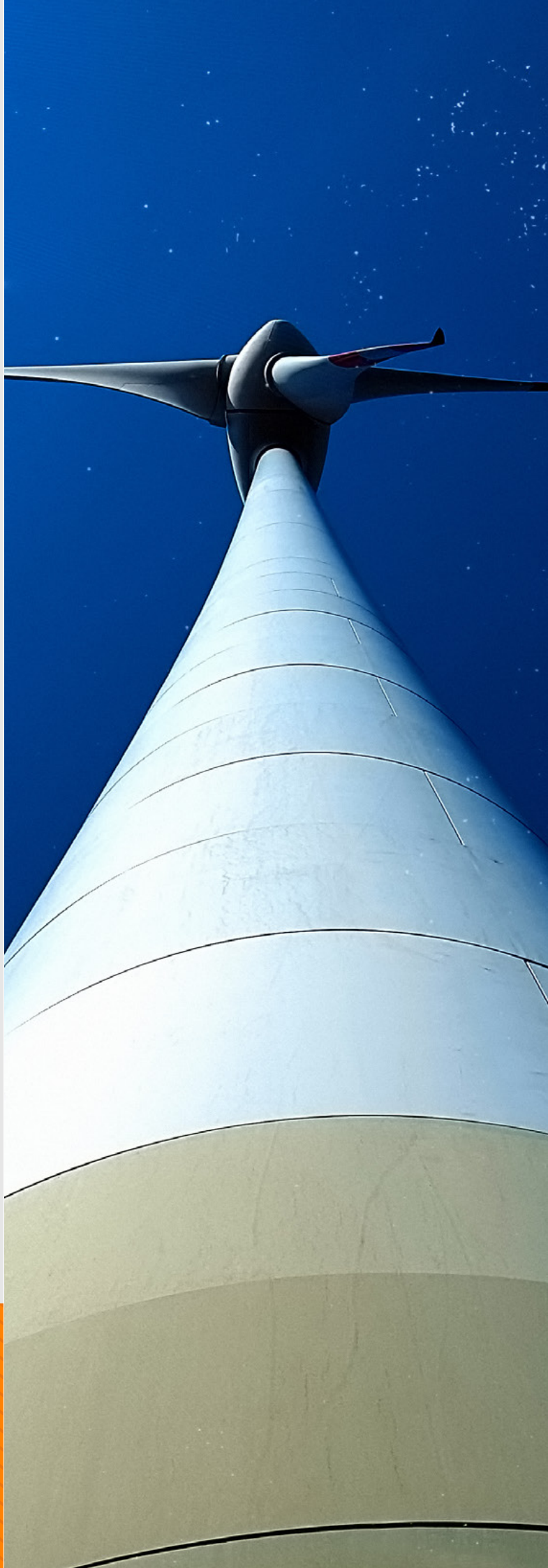
In conclusion, let me say once again that WTW supports a just and equitable energy transition. We in the Natural Resources Global Line of Business are doing this for the renewables industry in many different ways, ensuring that the right resources are delivered to your company regardless of where you are located, so when you get one of us, you get all of us.

We hope you enjoy this year's Review and please let us know if you have any issues that you would like to discuss more fully with us. As ever, we welcome your feedback.

Graham Knight is Global Head of Natural Resources Global Line of Business, WTW.
graham.knight@wtwco.com

[1] https://www.newyorkfed.org/research/policy/gscpi#/interactive

Part One: geopolitics, inflation and the energy transition — where do renewables go from here?



Risk management & ESG: the key issues for the renewable energy industry

Introduction: the energy, money and supply trilemma

Renewable energy can be said to be the current star of the show, given its role at the heart of the energy transformation. Every system, from how we grow our food, transport goods, build our cities and power our lives, is in transition and so electrification has become the key driver of the energy industry.

However, the conflict in Ukraine, global supply shortages, and the COVID-19 pandemic have led to an evolving energy and food security crisis. Surging inflation and the resultant costs of living increases add further instability. As a response to the energy crisis, powering up the transition away from fossil fuels has never had quite so much momentum.

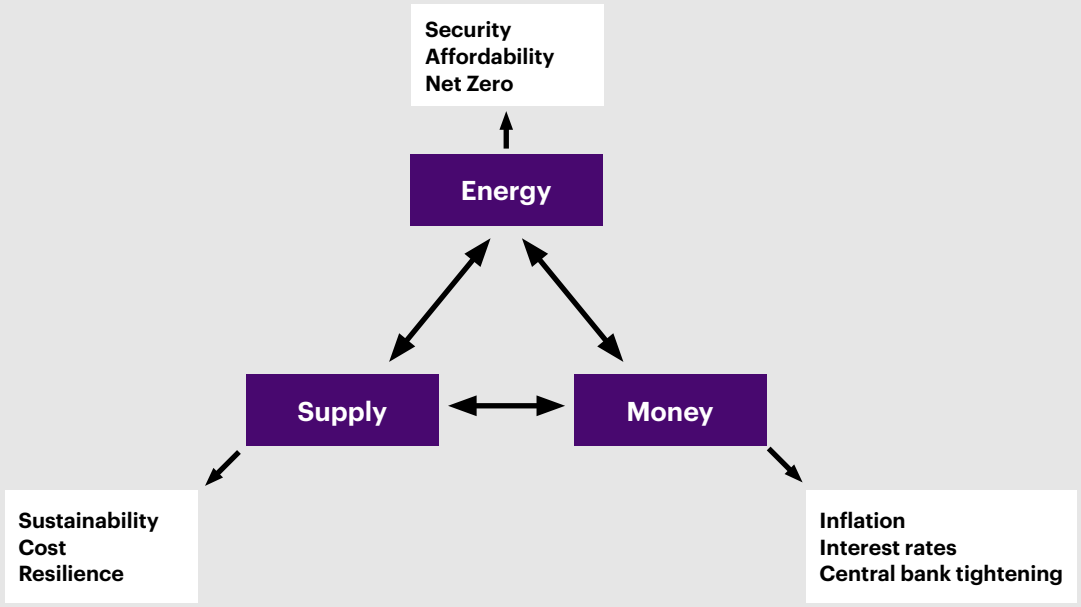
The market is responding. The global energy crisis is propelling renewable power installations, with the world set to as add as much renewable power in the next 5 years as it did in the past 20, according to a report published in December 2022 by the International Energy Agency (IEA)[1].

The macro events and trends that are impacting the renewable energy industry – ranging from geopolitical events to the war in Ukraine, grid challenges, changes to how goods and services move across borders, along with capital pressures and data – make the current business environment a challenging one for risk managers.

So with the renewable energy market in choppy waters, how does a renewable energy risk manager navigate this sea of volatility? There are landmarks to examine, including developments in environmental, social, and corporate governance (ESG) that will impact business operations.

[1] https://www.iea.org/news/renewable-power-s-growth-is-being-turbocharged-as-countries-seek-to-strengthen-energy-security

Figure 1: **The trilemma of energy, money and supply**



This article is designed for renewable energy risk managers. What do they need to consider over the next six to twelve months? Essentially, a trilemma of energy, money and supply (see Figure 1 above).

- **Energy** – how to ensure secure, reliable energy that is affordable and clean? Energy security is now at the forefront of business agendas and needs to be able to withstand system shocks without such current price volatility; it also needs to be in line with Net Zero emissions.
- **Money** – how to deal with rising inflation, higher interest rates, and central banks tightening money supply? Large parts of the global economy and our financing structures, household budgets, and business plans have been signed around very low interest rates. The global economy is moving away from that.
- **Supply** – how to respond to consumer and regulatory demands for more sustainable energy with the supply squeeze? The increased costs of materials, labour, and transport highlight the need for more resilience to manage supply chain, trade, logistics, and geopolitical issues.

Part I: Energy

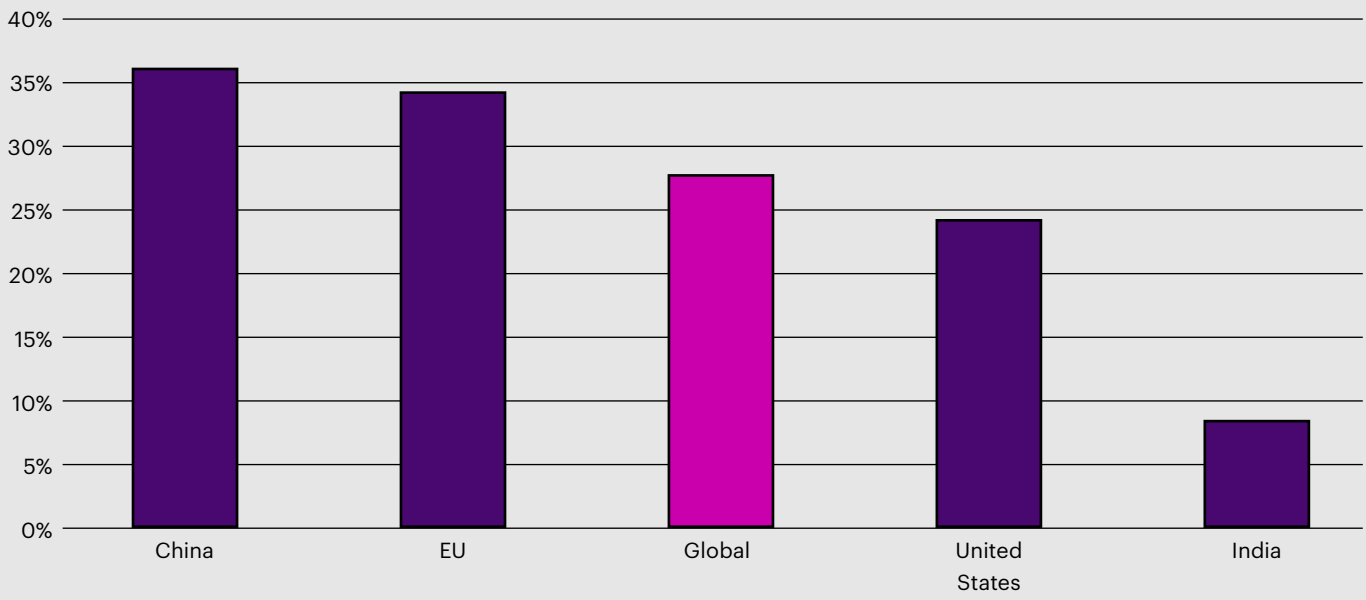
State of the renewable energy market

Let's start with where we are now regarding renewable energy capacity. Prior to the Russia-Ukraine conflict, renewable capacity was expected to increase over 8% in 2022 compared with the previous year[2]. However energy security concerns, caused by the commencement of the conflict in February 2022, sparked a surge in renewable energy development. In May 2022 the European Commission presented their REPowerEU Plan, designed to make Europe independent from Russian fossil fuels well before 2030, in response to the hardships and global energy market disruption[3]. Accelerating the clean energy transition and diversifying alternative energy supplies to reduce Europe's need for energy imports are at the forefront of REPowerEU's objectives.

The spike in fossil fuel and electricity prices brought about by the energy crisis have shown renewable power technologies to be more attractive and highlighted renewable energy's energy security benefits. Countries have reacted and as a result, the IEA now forecasts that global renewable capacity is expected to increase by almost 2400 GW between 2022 and 2027, which is equal to the entire installed capacity of China[4].

[2] https://www.iea.org/reports/renewable-energy-market-update-may-2022/renewable-electricity
[3] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en
[4] https://iea.blob.core.windows.net/assets/64c27e00-c6cb-48f1-a8f0-082054e3ece6/Renewables2022.pdf pg 17

Figure 2: **IEA upward revisions to renewable capacity expansion forecasts from Renewables 2021 to Renewables 2022**



Source: https://iea.blob.core.windows.net/assets/64c27e00-c6cb-48f1-a8f0-082054e3ece6/Renewables2022.pdf pg 17

The IEA's increased forecast of renewable capacity by almost 30% from last year comes from existing policies, market and regulatory reforms and new policies implemented to combat the energy crisis.[5] The most significant policy reforms include the US Inflation Act, the REPowerEU plan, and China's Five-Year Plan, which includes market changes. The EU has been the region that has been most impacted by the energy crisis and has doubled down on renewables to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition[6]. Figure 2 above shows the forecasted upward revisions from the IEA's Renewables 2021 to Renewables 2022.

Energy price rises

Russia's curtailment of its natural gas supply to Europe has caused supply shortages and exposed consumers to higher energy bills. All fuel prices have been impacted, while natural gas prices continue to spike. Coal prices have hit record levels, oil rose to above US$100 per barrel before falling back, and Europe is set to import an extra 50 billion cubic meters of proposed liquified natural gas (LNG) compared to the previous year[7].

What this shows is that the energy crisis has taken over the climate crisis and there is a push to expand fossil gas - however, this could cause global emissions to threaten the 1.5°C warming limit. For example, the CO_2 emissions from all the approved LNG construction projects between 2021 and 2050 blow up the IEA 2022 Net Zero scenario, as shown in Figure 3 overleaf by Carbon Action Tracker[8]. Furthermore, these expansion plans far exceed what's needed to replace Russian gas.

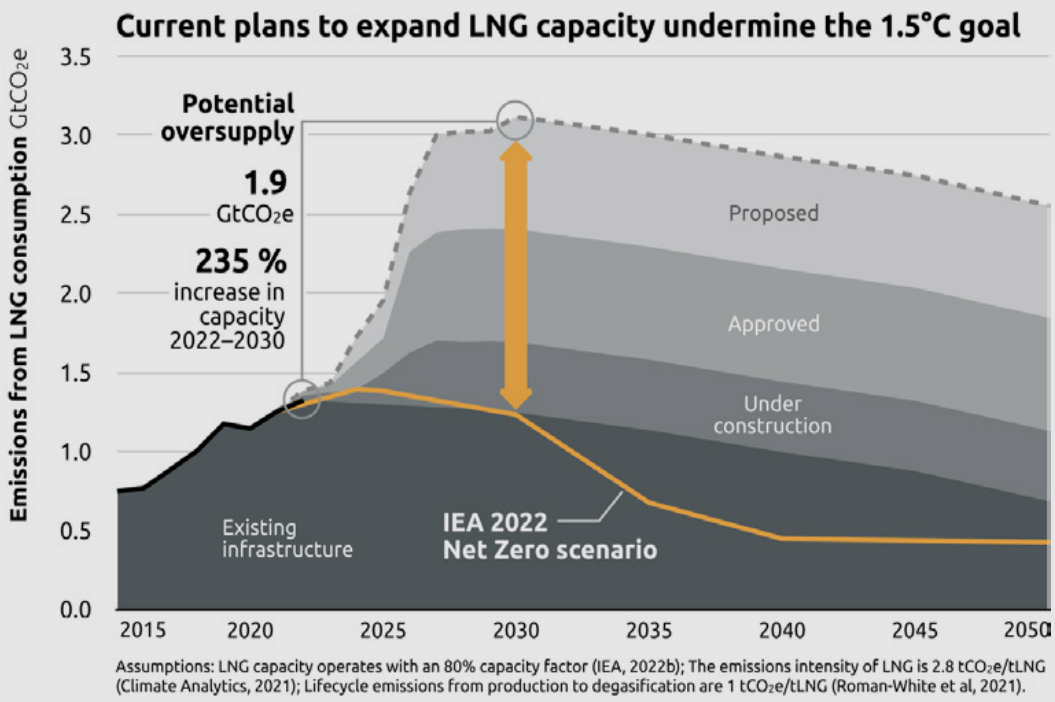
We are not on track for 1.5°C!

Expanding fossil fuel production undermines the 1.5°C warming limit target by the mid-century, as set out in the Paris Agreement (see separate breakout box for a snapshot of Paris Agreement & COP27). Yet the world is currently not on target to meet this 1.5°C goal and there have been no substantial improvements of existing Net Zero pledges since COP26. While policy implementation has progressed, it remains too slow, and the world is heading for 2.4°C of warming under current 2030 targets as shows in Figure 4 overleaf.

However, it will be interesting to see how the more ambitious clean energy policies introduced in response to the energy crisis impact global emissions. For example, the new US Inflation Reduction Act approves more than US$370 billion in spending for technologies ranging from wind turbines, solar panels, electric vehicles and electric heat pumps. Even nuclear generators and clean hydrogen tax credits are included.

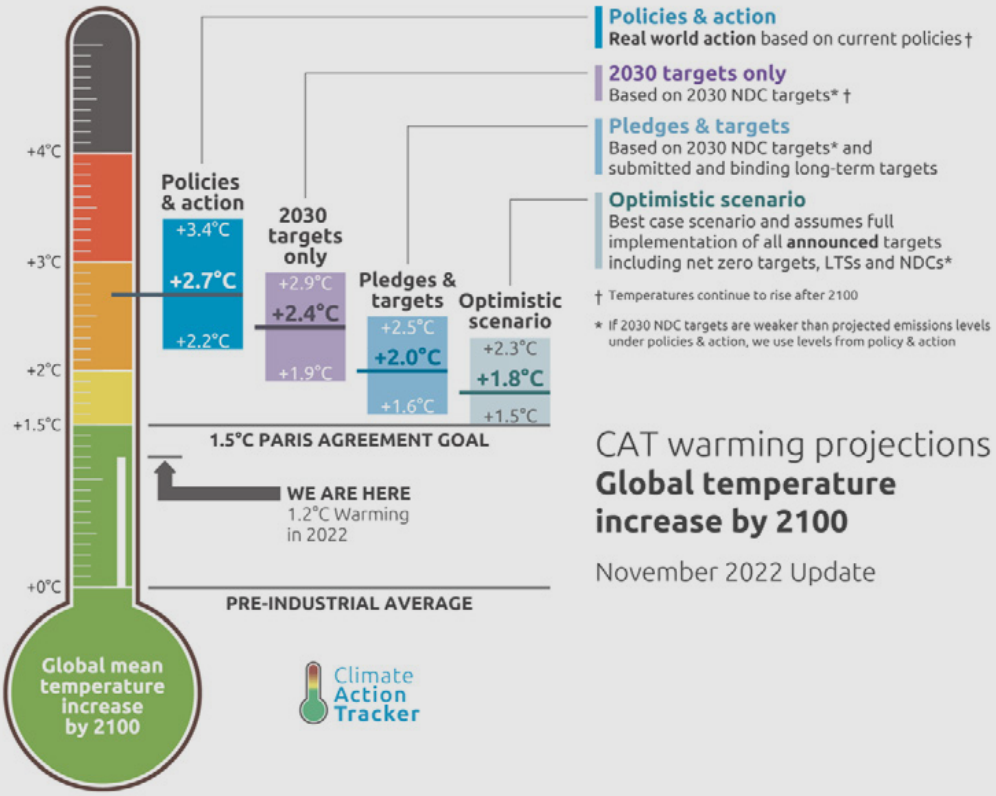
[5] https://iea.blob.core.windows.net/assets/64c27e00-c6cb-48f1-a8f0-082054e3ece6/Renewables2022.pdf pg 17
[6] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131
[7] https://www.iea.org/reports/world-energy-outlook-2022/executive-summary
[8] https://climateactiontracker.org/press/dash-for-gas-a-serious-threat-to-the-paris-agreements-warming-limit/

Figure 3: **Dash for gas poses a serious threat to the Paris Agreement's warming limit**



Source: https://climateactiontracker.org/press/dash-for-gas-a-serious-threat-to-the-paris-agreements-warming-limit/

Figure 4: **Climate policies: limited progress since COP26 in Glasgow**



Source: https://climateactiontracker.org/press/dash-for-gas-a-serious-threat-to-the-paris-agreements-warming-limit/

Net Zero: a conundrum

Countries and companies around the world have been setting Net Zero targets. In 2019, the UK was the world's first major economy to set a legally binding target of being Net Zero by 2050. Since then, more than seventy countries have set a Net Zero target, covering about 76% of global emissions.[10]

Science is the rationale behind Net Zero targets - the science clearly shows that global temperature increase needs to be limited to 1.5° Celsius above pre-industrial levels to avert the worst impacts of climate change.

It's no secret that coal is the single largest source of carbon dioxide emissions from energy, yet analysis by the IEA shows that over 95% of global coal consumption is occurring in countries that have pledged to achieve Net Zero emissions[11]. Furthermore, far from declining, global coal demand has been stable, at near record highs for the past decade. Countries are saying one thing and doing another.

The example of GFANZ

On the corporate side, it's no better. In 2021 at COP26 in Glasgow, a fifth of the world's 2,000 largest companies, representing over US$130 trillion of private capital, had made Net Zero commitments with a pledge through the Glasgow Financial Alliance for Net Zero (GFANZ). Just one year later at COP27 in Sharm El Sheikh, more than a third of the largest companies had a Net Zero target.

While that is all good and well in principle, research by Accenture states that unless companies decarbonise, 93% will miss their Net Zero targets[12]. This means that companies need to reduce their Scope 1, 2, and 3 emissions by almost 90% by 2050, by using less energy and using energy more intelligently from renewable sources. In addition, these companies will need to permanently neutralise the emissions they cannot abate by removing carbon from the atmosphere. They cannot look to buy themselves out with cheap carbon credits that lack integrity.

Companies are making voluntary new Net Zero pledges; however, putting into place practical plans to fulfil those commitments is proving challenging. Environmental claims which are not backed by substantial action are toted as greenwashing; Catherine McKenna, a former Canadian Minister and Chair of the High-Level Expert group on the Net Zero Emissions Commitments of Non-State Entities report, states: "It's time to draw a red line around greenwashing"[13].

And while GFANZ's membership has grown from 160 members in April 2021, to more than 550 member institutions as of December 2022, the alliance is being called into question for not having strong enough rules on fossil fuel financing. The UN High-Level Expert Group's report released at COP27 makes it clear that "Net Zero is entirely incompatible with a continued investment in fossil fuels"[14].

Financial institutions can join GFANZ by joining one of seven sector-specific alliances and cracks are starting to show in its membership. GFANZ has already lost some members, but it was big news when Vanguard Group announced in December 2022 that it is pulling out of the Net Zero Asset Managers (NZAM) initiative, which is part of GFANZ. Vanguard has over US$7 trillion in assets and was among its largest signatories; it cited confusion regarding the applicability of Net Zero approaches to the broadly diversified index funds their investors prefer[15].

Risk managers need for awareness of company decarbonisation plans

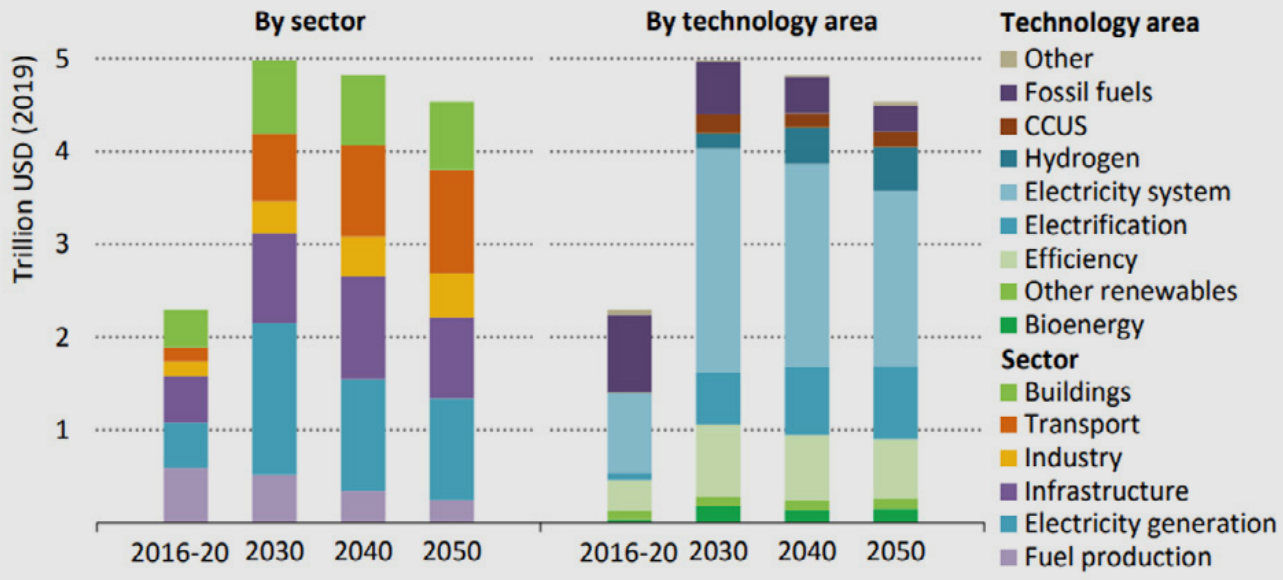
Vanguard is just the start. And even though they are an investment firm and not a renewable energy company, risk managers across all industries must be aware of the targets, promises, and progress their companies are making to decarbonise. This is because proclaiming an intention to reach Net Zero by a given date could potentially result in investigation, litigation, and negative publicity if not managed appropriately. New regulations coming in around sustainable finance are intended to provide guardrails that companies say and act accordingly and renewable energy risk managers need to be aware of these types of market developments.

All this talk of Net Zero requires a fundamental transformation of common business practices with reliable and safe renewable energy. And global transformation requires data-driven solutions in renewable energy and investment at scale.

Far from declining, global coal demand has been stable, at near record highs for the past decade. Countries are saying one thing and doing another.

[9] https://www.nytimes.com/2022/10/27/climate/global-clean-energy-iea.html
[10] https://www.un.org/en/climatechange/net-zero-coalition
[11] https://www.iea.org/news/achieving-a-swift-reduction-in-global-coal-emissions-is-the-central-challenge-for-reaching-international-climate-targets
[12] https://www.accenture.com/us-en/insights/sustainability/reaching-net-zero-by-2050
[13] https://www.un.org/sites/un2.un.org/files/high-level_expert_group_n7b.pdf, pg 6
[14] https://www.un.org/sites/un2.un.org/files/high-level_expert_group_n7b.pdf, pg 7
[15] https://www.esgtoday.com/vanguard-drops-out-of-net-zero-asset-managers-initiative/

Figure 5: **Annual average capital investment in the Net Zero Economy**



Capital investment in energy rises from 2.5% of GDP in revent years to 4.5% by 2030; the majority is spent on electricity generation, networks and electricity end-user equipment

Notes: Infrastructure includes electricity networks, public EV charging, CO_2 pipelines and storage facilities, direct air capture and storage facilities, hydrogen refuelling stations, and import and export terminals for hydrogen, fossil fuels pipelines and terminals. End-use efficiency investments are the incremental cost of improving the energy performance of equipment relative to a conventional design. Electricity systems include electricity generation, storage and distribution, and public EV charging. Electrification investments include spending in batteries for vehicles, heat pumps and industrial equipment for electricity-based material production routes.

Source: https://www.iea.org/reports/net-zero-by-2050, pg 81

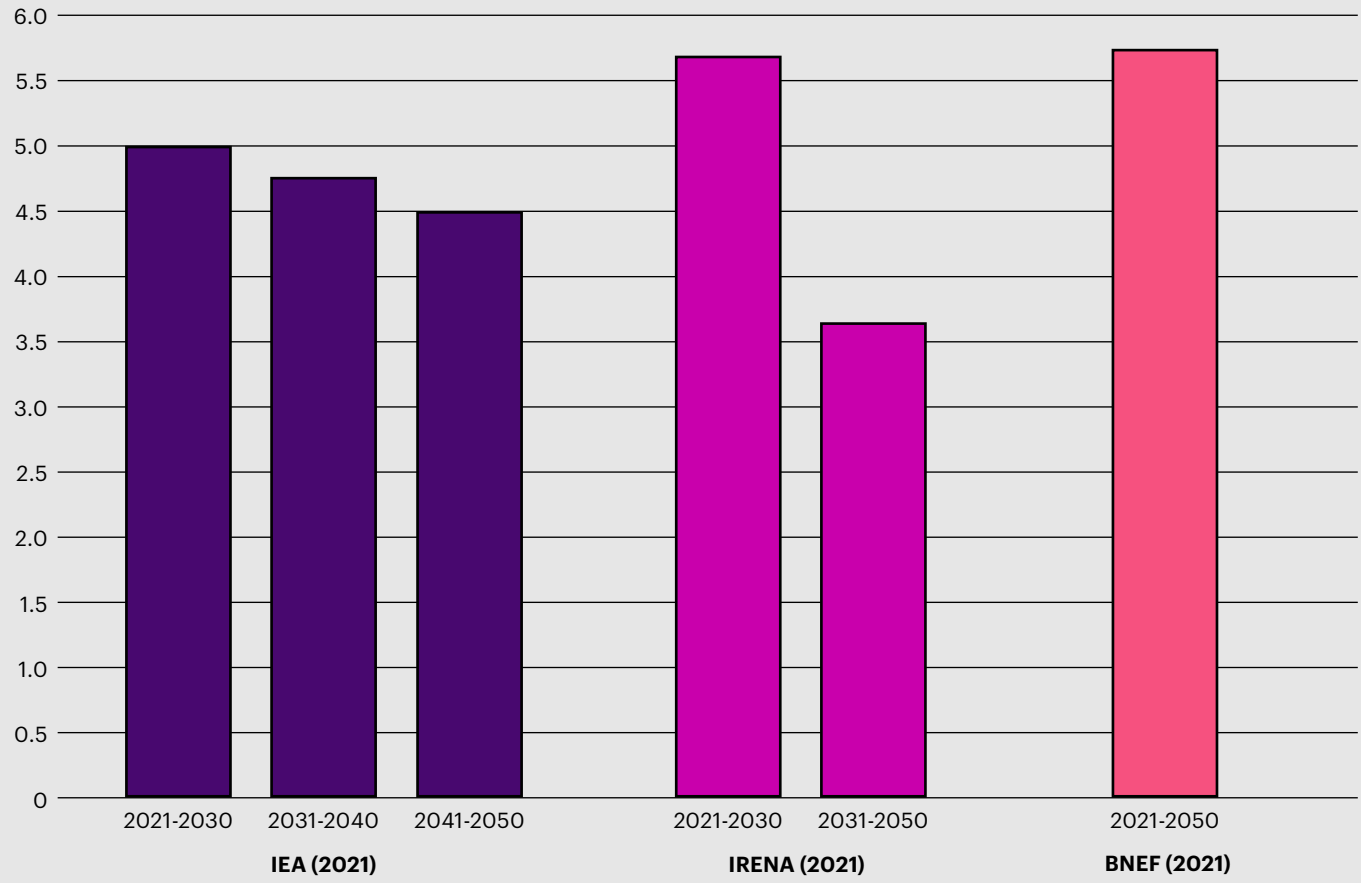
Part II - Money

Global energy investment trends

Let's consider the money side of the equation and start with investment. Global energy investments currently stand at around US$2 trillion per year or 2.5% of global GDP, according to the IEA. The IEA estimates that US$3-5 trillion in annual clean energy investment is needed by 2030 and stay there until at least 2050 to reach Net Zero emissions. Figure 5 above breaks this down into sectors and by technology area; the majority is spent on electricity generation, networks, and electric end user equipment.

Bruegal, a European economic think tank, reviewed the multiple estimates of the investment required to reach climate goals and compared the IEA's estimates with the International Renewable Energy Agency (IRENA) and Bloomberg New Energy Finance (BNEF) as show in Figure 6 overleaf. While the IEA uses an illustrative pathway, IRENA frontloads the required investments to 2030, resulting in US$5.7 trillion per year, then dropping off to approximately US$3.7 trillion per year until 2050. BNEF estimates average investment needed vary between US$3.1 trillion and US$5.8 trillion per year until 2050.

Figure 6: **Average yearly global investment needs in order to reach net zero CO2 emissions from energy by 2050, different estimates (US$ trillions)**



Source: https://www.bruegel.org/blog-post/how-much-investment-do-we-need-reach-net-zero OR Lenaerts, K., S. Tagliapietra and G.B. Wolff (2021) 'How much investment do we need to reach net zero?', Bruegel Blog, 25 August 2021

What each of these estimates highlight is that additional investments in energy and transport will need to be roughly 2 percentage points more of current GDP.

Solar PV and wind power capacity

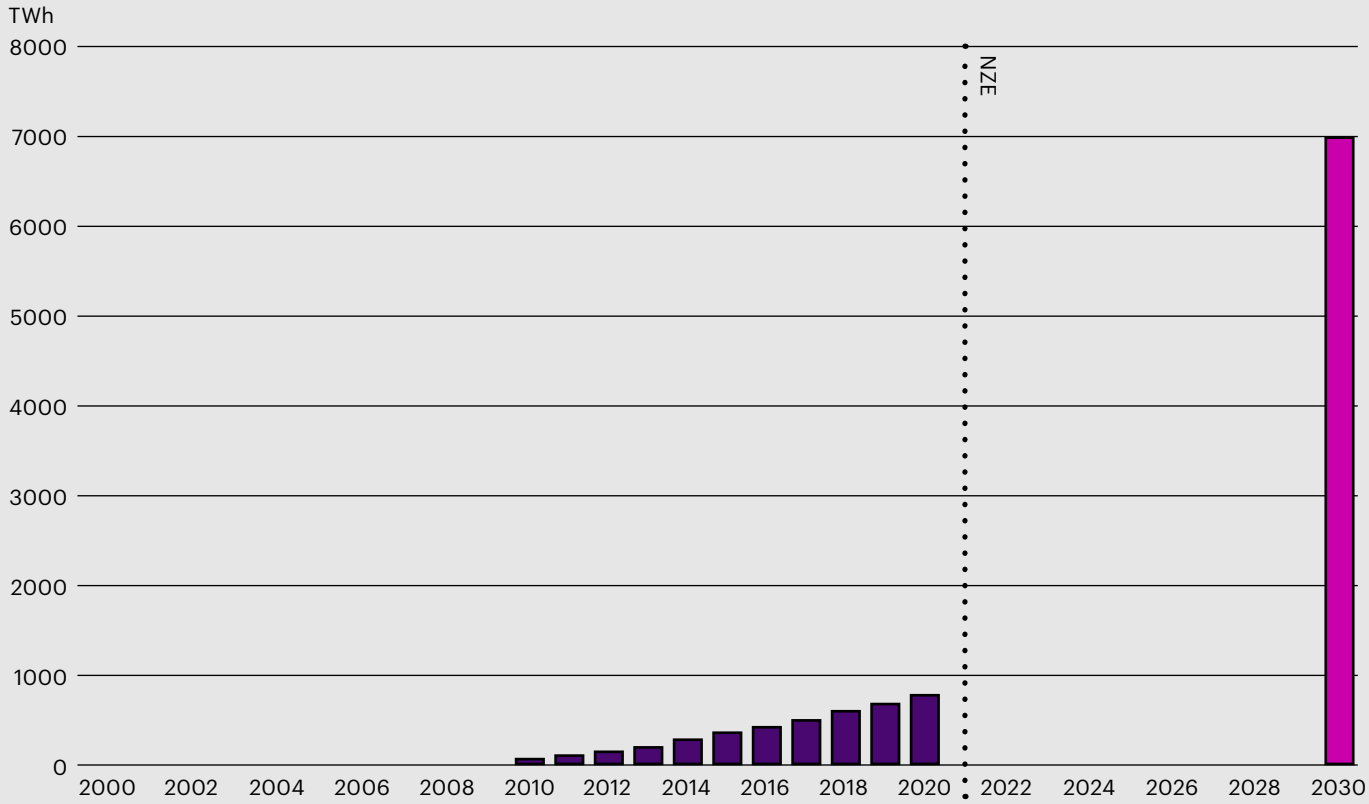
The cheapest options for new electricity generation in most countries are utility-scale solar PV and onshore wind. Global solar PV capacity is now estimated to almost triple over the 2022-2027 period, which will make it the largest source of power capacity in the world, surpassing coal[16]. However, even more capacity will need to be generated for the world to be on track to a Net Zero economy by 2030. In 2021, the IEA set out a "narrow but achievable pathway for the global energy sector to reach Net Zero emissions by 2050" and then updated it in 2022.[17] The updated graphics are used in this article to illustrate the gap between where we are now to where we need to be to reach Net Zero emissions; the first one shown in Figure 7 overleaf represents the solar PV capacity required for Net Zero Emissions (NZE).

Wind generation increased by a record amount in 2021, but like Solar PV, much faster growth is required to get on track for the net zero trajectory, as shown in Figure 8 overleaf.

In 2021, almost 70% of wind generation growth came from China, followed by the United States at 14%, and Brazil at 7%; onshore windfarms represent 93% of capacity and the remaining 7% represent offshore systems[18]. Growth is accelerating in wind power, and policy support from many countries, such as China, USA, the EU and India, is largely driving this.

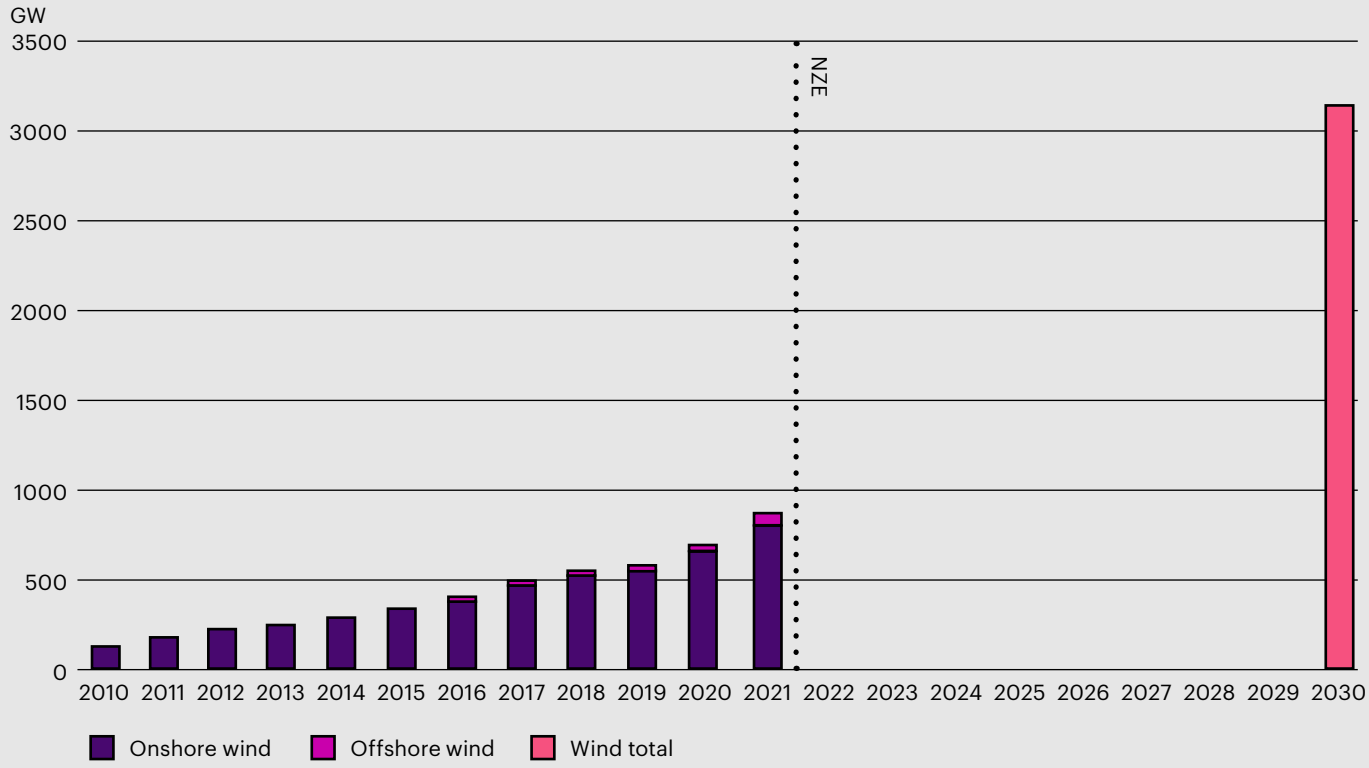
[16] https://www.iea.org/news/renewable-power-s-growth-is-being-turbocharged-as-countries-seek-to-strengthen-energy-security
[17] IEA (2022), World Energy Outlook 2022, IEA, Paris https://www.iea.org/reports/world-energy-outlook-2022 License: CC BY 4.0 (report); CC BY NC SA 4.0 (Annex A)
[18] https://www.iea.org/reports/wind-electricity

Figure 7: **Solar PV power capacity in the Net Zero Scenario, 2010-2030**



Source: IEA, Solar PV power generation in the Net Zero Scenario, 2010-2030, IEA, Paris (https://www.iea.org/data-and-statistics/charts/solar-pv-power-generation-in-the-net-zero-scenario-2010-2030)

Figure 8: **Wind power generation in the Net Zero Scenario, 2010-2030**



Source: IEA, Wind power generation in the Net Zero Scenario, 2010-2030, IEA, Paris (https://www.iea.org/reports/wind-electricity)

Figure 9: **Global hydrogen demand by sector in the Net Zero Scenario 2019-2030**

Source: IEA, Global hydrogen demand by sector in the Net Zero Scenario, 2019-2030, IEA, Paris (https://prod.iea.org/data-and-statistics/charts/global-hydrogen-demand-by-sector-in-the-net-zero-scenario-2019-2030)

The hydrogen buzz

There is so much buzz about the benefits of clean hydrogen; it can potentially help decarbonise hard to abate sectors such as transport, heavy industries, and power generation. Hydrogen is a versatile energy carrier and while solar PV and wind renewables suffer from intermittency, low or no-carbon fuels such as hydrogen are gaining traction in the energy transition.

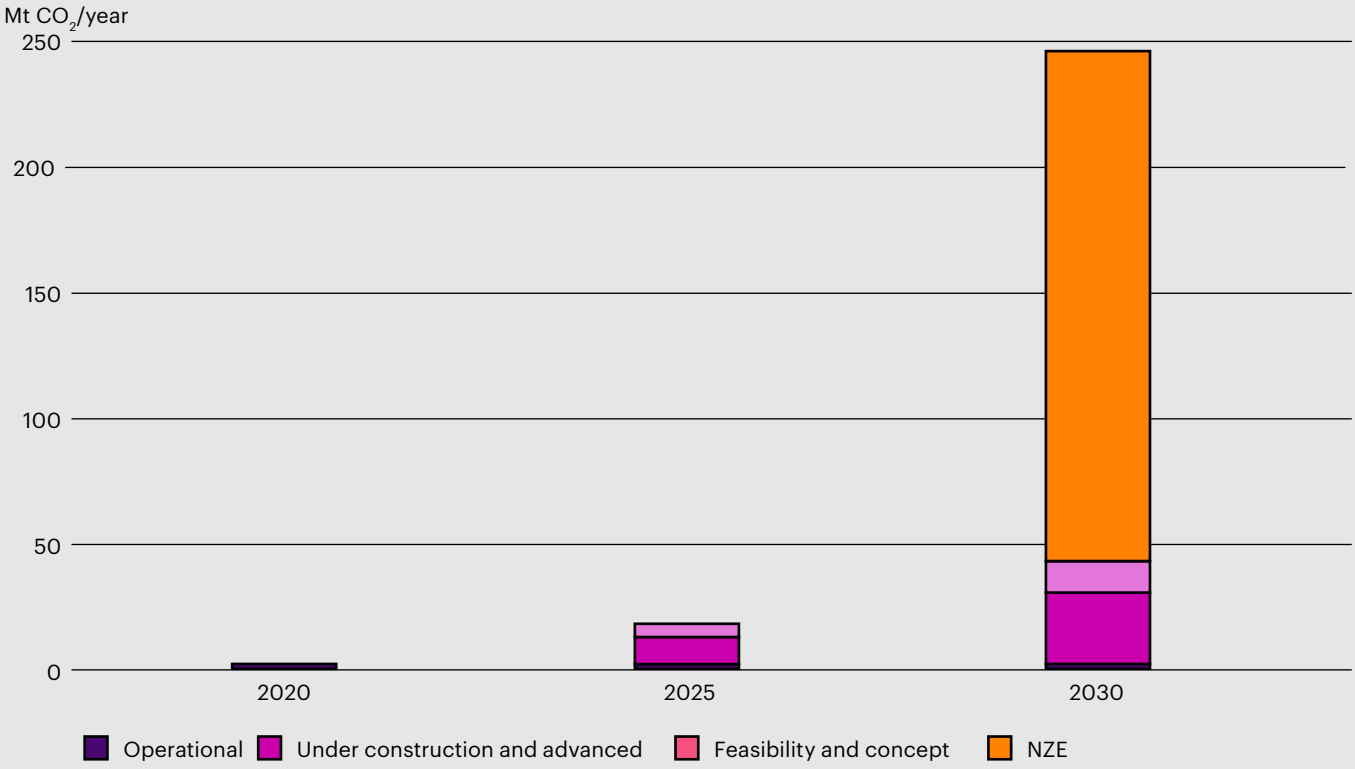
However, not all types of hydrogen are created equally and there is a rainbow of colours, representing a different method of production that generates more or less emissions. Grey hydrogen is produced by combusting natural gas, which emits CO_2 into the atmosphere. Blue hydrogen is produced combusting fossil fuels but has carbon capture, utilization, and storage technology to remove the CO_2 emissions from flue gases. Green hydrogen is produced using an electrolyser powered by renewable energy.

Demand for hydrogen reached 94 million tonnes in 2021 but the production of green hydrogen is only roughly 1% of this figure[19]. This is because the cost of using renewable electricity to produce hydrogen is significantly higher than producing hydrogen from fossil fuels. Furthermore, while the cost of renewable electricity is a key barrier, challenges associated with electrolyzers are another major issue.

Yet the momentum behind low-carbon hydrogen is strong, as policy makers across the globe release their national hydrogen strategies. However, Figure 9 above shows the demand behind current hydrogen demand, along with the production areas it is used for, and the massive gap to getting to the Net Zero scenario by 2030 with hydrogen[20]. Unlocking investment for low carbon or green hydrogen will be key; innovation continues, as researchers in China claim to have produced hydrogen by splitting seawater without the need to desalinate or purify it first, which could be significant in making green hydrogen more affordable[22].

[19] https://www.iea.org/fuels-and-technologies/hydrogen
[20] https://www.iea.org/fuels-and-technologies/hydrogen
[21] https://www.chemistryworld.com/news/water-splitting-device-solves-puzzle-of-producing-hydrogen-direct-from-seawater/4016645.article

Figure 10: **Operational and planned BECCS capture capacity by stage of development vs Net Zero Scenario, 2022-2030**



Source: IEA, Operational and planned BECCS capture capacity by stage of development vs Net Zero Scenario, 2022-2030, IEA, Paris (https://www.iea.org/data-and-statistics/charts/operational-and-planned-beccs-capture-capacity-by-stage-of-development-vs-net-zero-scenario-2022-2030)

BECCS: a solution for the energy transition?

Bioenergy with carbon capture and storage, or BECCS, is a utopian-like solution to deliver a Net Zero scenario; however, it is fraught with controversy around biomass feedstock, which calls into question BECCS's sustainability credentials.

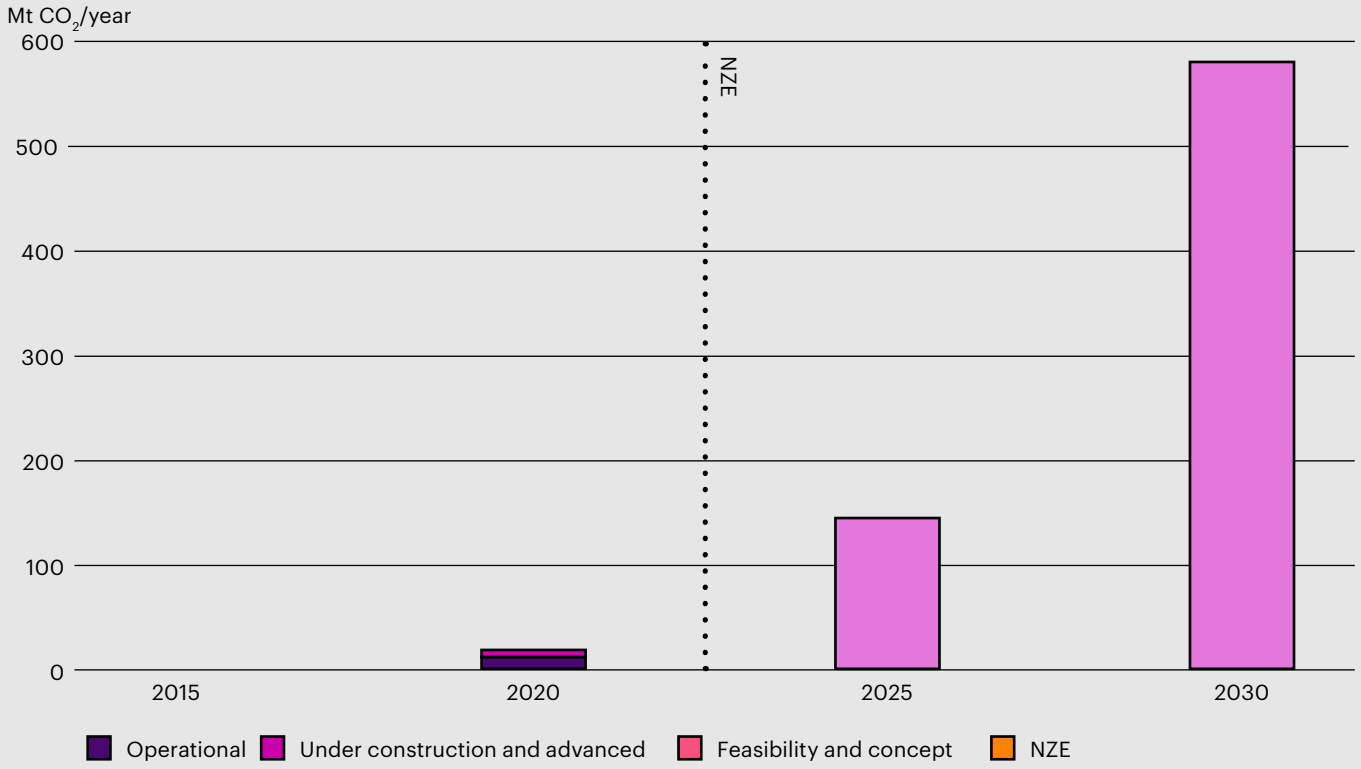
The concept is simple: BECCS plants extract bioenergy from biomass and then can capture and store the energy. The biomass can be converted into heat, electricity, or liquid or gas fuels; the CO_2 emissions are captured and stored in geological formations or embedded in long lasting products, such as cement produced by Carbon Cure[22]. Even with the criticism that growing bioenergy crops can compete with food production and thereby cause more deforestation, the momentum behind BECCS has grown substantially in recent years. There are plans for over 50 new facilities involving BECCS – totally biogenic capture capacity is around 20 Mt CO_2 per year – however, this falls very short of the 250 Mt/year required to reach the Net Zero scenario[23].

More storage required

System flexibility and storage are required to integrate more variable renewable energy on electricity grids. According to the IEA, global installed storage capacity is forecast to expand by 56% in the next five years to reach over 270GW by 2026[24]. This increase in storage will help increase energy security and flexibility is also required from the grid, power plants and demand-side response. However, to meet the storage capacity required for a Net Zero scenario, significant growth will be required, as shown in Figure 11 overleaf.

[22] https://www.carboncure.com/
[23] https://www.iea.org/reports/bioenergy-with-carbon-capture-and-storage
[24] https://www.iea.org/articles/how-rapidly-will-the-global-electricity-storage-market-grow-by-2026

Figure 11: **Total installed battery storage capacity in the Net Zero Scenario, 2015 - 2030**

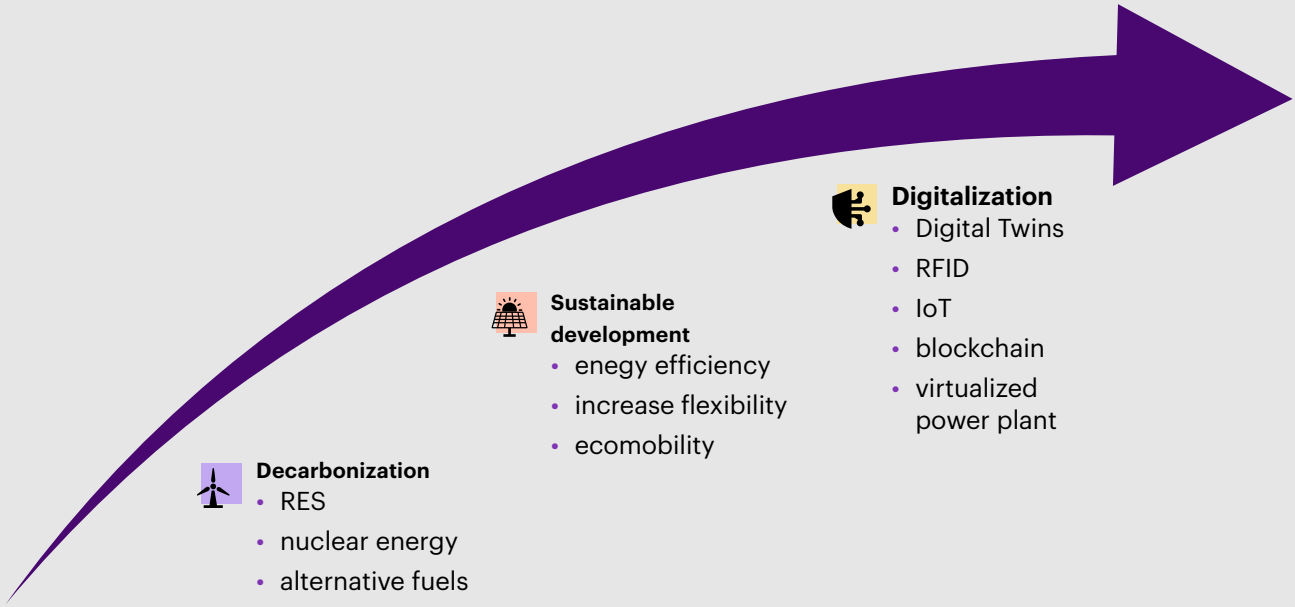


Source: IEA, Total installed battery storage capacity in the Net Zero Scenario, 2015-2030, IEA, Paris (https://www.iea.org/data-and-statistics/charts/total-installed-battery-storage-capacity-in-the-net-zero-scenario-2015-2030)

Grids need to be smart

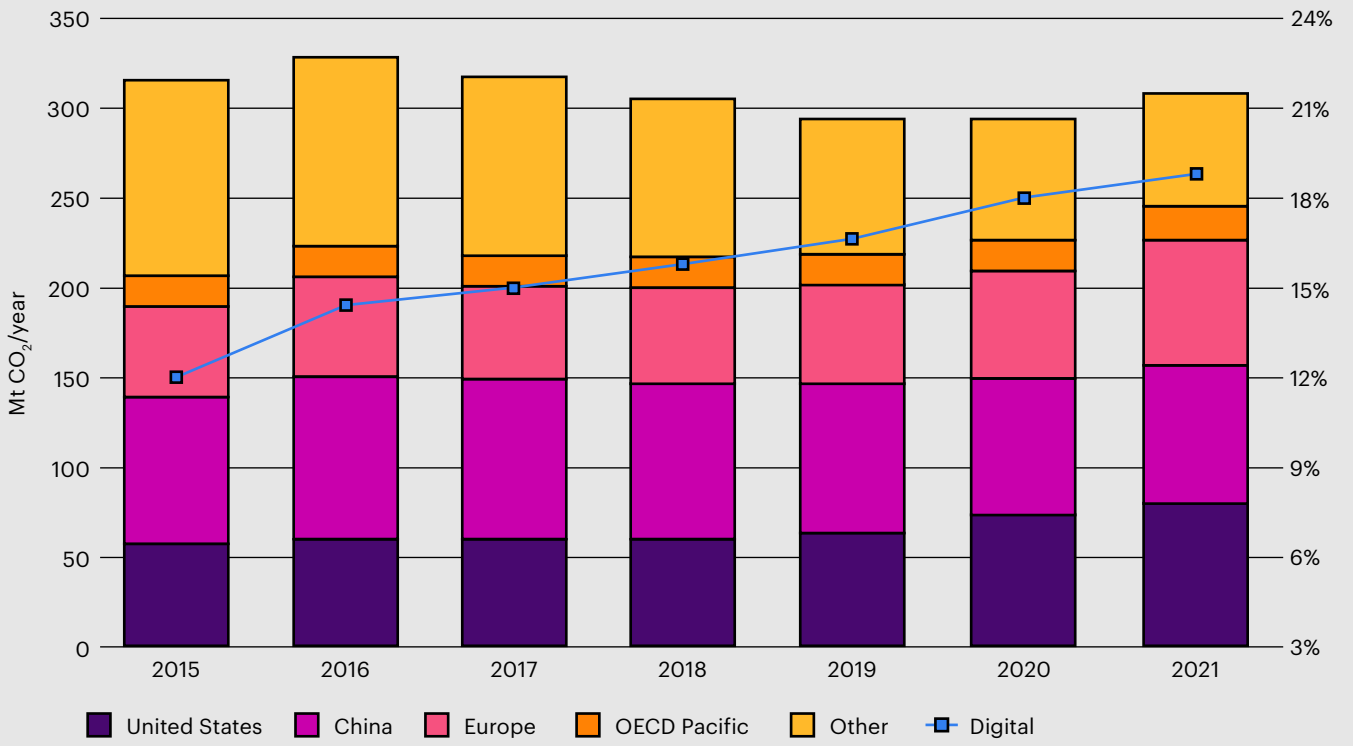
As society massively expands to renewables, grids need to be smarter. Supporting the electrification of buildings, industry, and transport means more investment of a proper development of networks. Distributed generation means having a much more complex and expanded network of generation and plants into smart grids, which are electricity networks that use digital, artificial intelligence and other advanced technologies to monitor and manage the transport of electricity. Smarter grids combine existing with newer technologies, as shown in Figure 12 below.

Figure 12: **Digitalisation, decentralisation, and decarbonisation are the direction of travel of the energy sector**



Source: https://www.mdpi.com/1996-1073/14/7/1885

Figure 13: **Investment spending on electricity grids, 2015-2021**



Source: IEA, Investment spending on electricity grids, 2015-2021, IEA, Paris (https://www.iea.org/data-and-statistics/charts/investment-spending-on-electricity-grids-2015-2021)

However, investment in electricity grids needs to nearly double to around US$600 billion (current investment is around US$300 billion) through to 2030 to correspond with the Net Zero scenario – and to almost triple in emerging markets and developing economies[25].

Of note in this chart is the growth of digital infrastructure, which range from (and are not limited to) smart meters, sensors, automation of substations, and monitoring devices. Digital investment in distribution also includes network digital twins, which are virtual models designed to accurately reflect a physical object or groups of assets, such as a wind turbine or wind farm. Sensors related to vital areas of operation are fitted to the object(s) and produce data about different aspects of performance. (See breakout box *Innovation: Ecological Digital Twin* for an example of digital twin innovation applied to wind farms.)

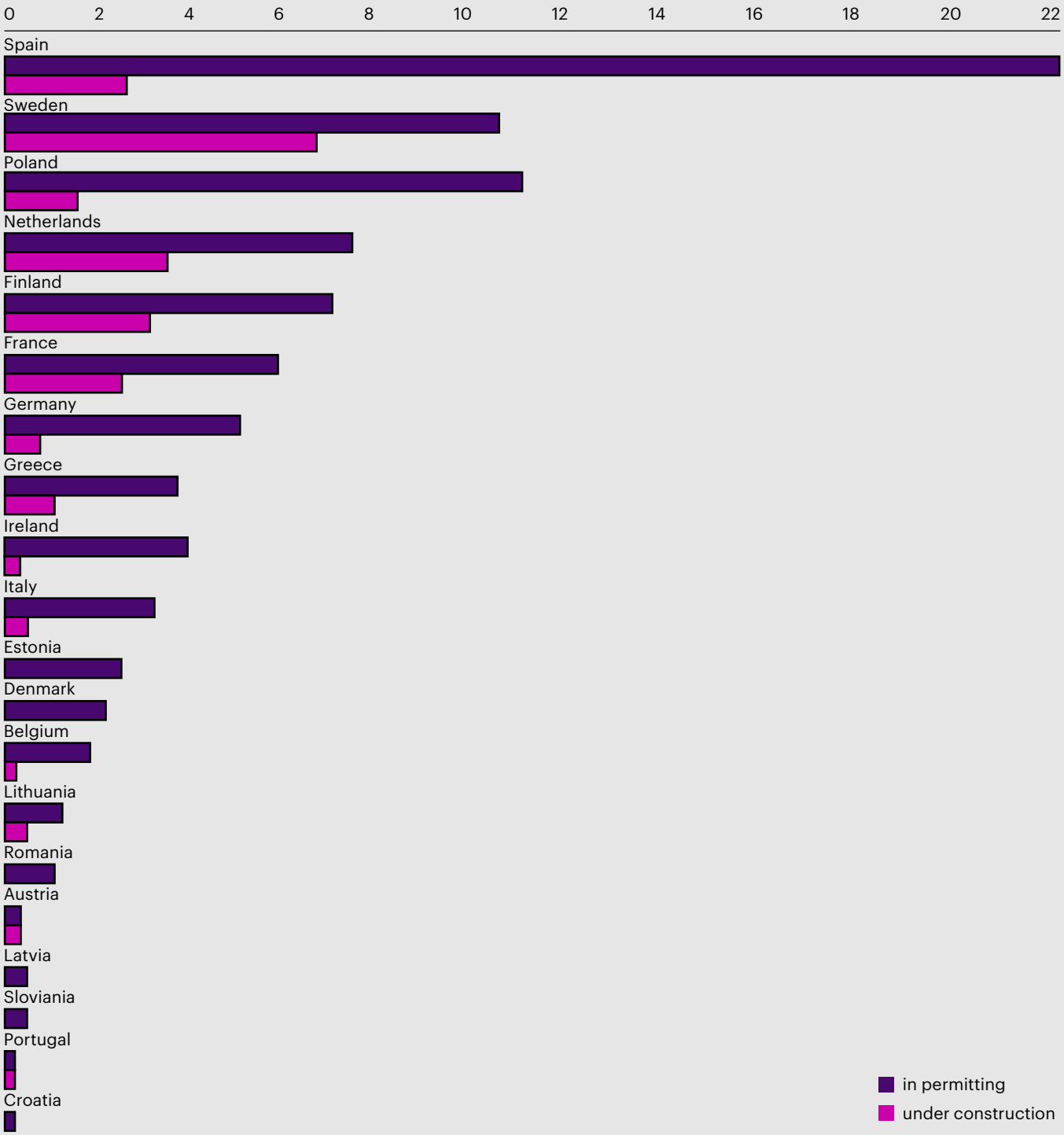
Permitting

Large clean energy infrastructure projects are complex; they require environmental impact assessments, spatial planning studies, and planning authorisations, along with grid connection assessments that need to be completed before any construction can begin. Additionally, legal challenges can delay projects further, to the point where such project lead times can take years.

Given the magnitude of renewable energy required, faster permitting for projects are needed as there is a serious backlog in permitting approvals; for example, Europe has four times as much wind capacity awaiting approval as it does under construction[26].

[25] https://www.iea.org/reports/smart-grids
[26] https://www.en-former.com/en/faster-permitting-cannot-come-quick-enough/

Figure 14: **Wind capacity in permitting and under construction**



Source: https://www.en-former.com/en/faster-permitting-cannot-come-quick-enough/

Europe is not alone, as permitting delays for large scale renewable energy projects are well known in the United States and other countries too. Environmental protection for wildlife, air, water, communities, and larger interest groups is, of course, incredibly important; however, the bureaucracy and procedures can take years – which the world doesn't have, given the urgency to transition to a Net Zero economy.

Permitting obstacles need to be addressed by authorities across the globe and the regulatory landscape for renewables remains fragmented. However, policy action is underway to address slow permitting, as seen in the EU's REPowerEU Plan. In addition, the US Senators backing the Inflation Reduction Act also agreed to push for reforms to speed up the permitting process[27].

Getting faster permitting for renewables is one big barrier - but money is another.

[27] https://www.progressivepolicy.org/wp-content/uploads/2022/09/Americas-Clean-Energy-Transition-Requires-Permitting-Reform-Bledsoe-Sykes-21.9.22.pdf, pg 3

Figure 15: **Global energy transition asset finance**

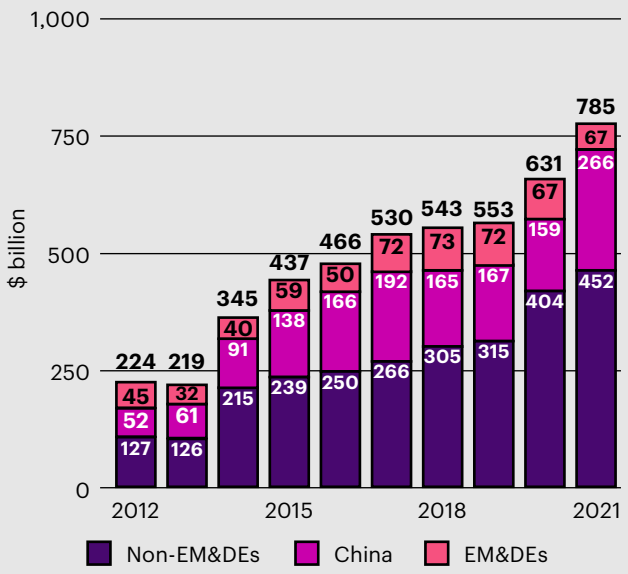
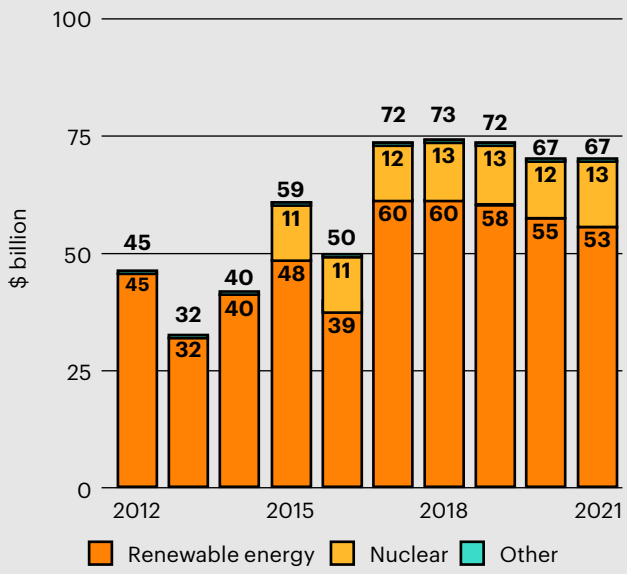


Figure 16: **Energy transition asset finance in EM & DEs**



Notes: Energy transition technologies include renewable energy, carbon capture and storage (CCS), electrified heat, electrified transport, energy storage, hydrogen and nuclear. investment numbers include both equity and debt.

Source: https://about.bnef.com/blog/mobilizing-capital-into-emerging-markets-and-developing-economies/

Where's the money?

After all, who is going to fund these investments for a cleaner world? What's been shown so far in this article is a strong momentum towards increased renewable energy capacity but also a massive gap, both in terms of investment and capacity, to produce the amount of renewable energy needed for a Net Zero world. This is a real crisis that countries must solve.

Yet watching them discuss climate finance - or rather the lack of enough of it - can sometimes feel like being in restaurant having dinner with a large group of people. All feel they have a right to be at the table, yet when the bill arrives at the end of the meal, suddenly many are shuffling around, patting their business suits or peering into their handbags, then announcing they've forgotten their wallet. The task ahead and the resources required to reach Net Zero are enormous. Countless reports and analysis show the estimated costs required, as well as the costs of inaction. Public sources are not enough to cover the scale of investment needed and the private sector will have to be mobilised by public policies that create incentives, appropriate regulatory frameworks, and reform energy taxes[28].

Climate finance is tricky and a contentious issue; nations pledged US$100 billion over 10 years ago to help developing nations but developed nations have yet to deliver this amount. This is an issue and will remain one; with the onset of the energy crisis, it risks being even harder to get climate funding for developing nations.

However, it's not all bad news. Investment in renewable energy capacity jumped 40% in the five years ending in 2021, compared to 2012-2016[29].And the IEA's most recent upward revisions on renewable capacity expansion forecasts are encouraging, even though short for Net Zero.

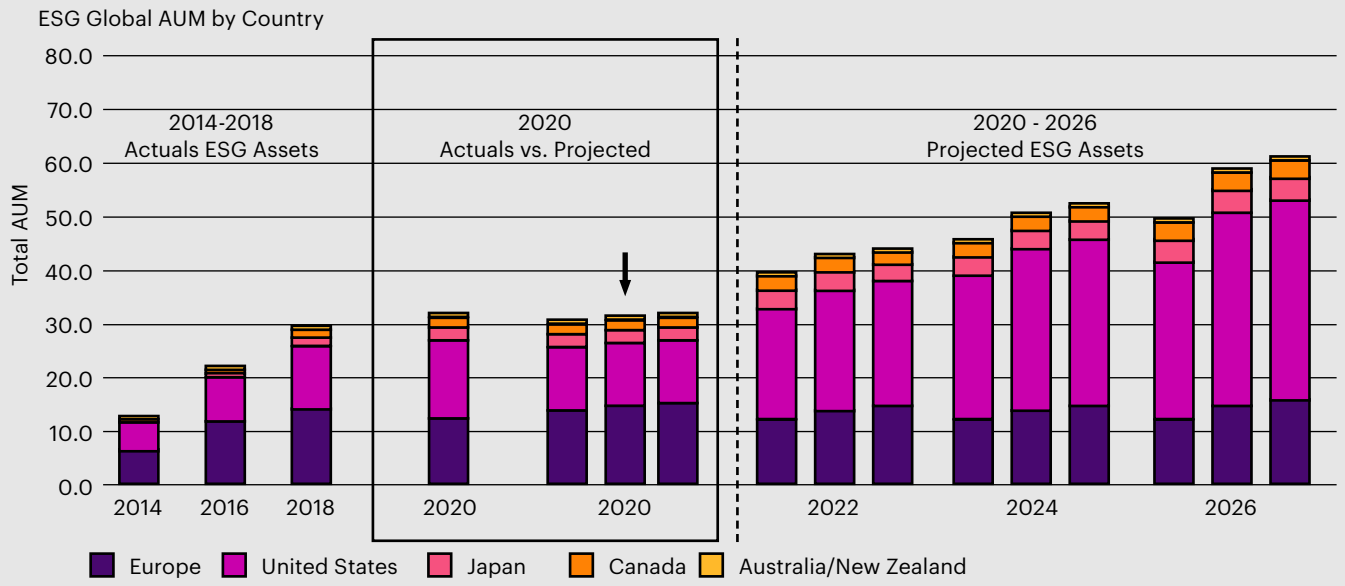
Much of this previous growth came largely from developed economies, where incentives, auctions, and feed-in tariffs fuel investment. However, in emerging and developing economies projects often rely on public finance, a stable policy environment and debt financing, as well as development and climate finance. While many emerging markets have clean energy targets, they can lack effective mechanisms to drive investment. The volume of capital being deployed to transition these countries is currently insufficient and the investment gap between developed and developing economies has widened[30].

Global investment in low-carbon energy technologies grew to US$785 billion in 2021, with much of this occurring in developed economies and China (see Figure 15 above), while energy transition asset finance in emerging markets and developing economies (EM & DEs) remained flat at US$67 billion (see Figure 16 above)[31].

In addition, it's not just mitigation that is required in emerging markets and developing economies. The UNEP gap report estimates rising annual adaptation needs of US$340 billion required by developing nations by 2030[32].

[28] https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf pg 82
[29] https://about.bnef.com/blog/mobilizing-capital-into-emerging-markets-and-developing-economies/
[30] https://about.bnef.com/blog/mobilizing-capital-into-emerging-markets-and-developing-economies/
[31] https://about.bnef.com/blog/mobilizing-capital-into-emerging-markets-and-developing-economies/
[32] https://www.unep.org/resources/adaptation-gap-report-2022

Figure 17: **Total ESG assets**



Source: Global Sustainable Investment Alliance, Bloomberg Intelligence, https://www.bloomberg.com/news/articles/2022-02-03/esg-by-the-numbers-sustainable-investing-set-records-in-2021?leadSource=uverify%20wall

Part III: Supply

Supply chains

It is difficult to respond to consumer and regulatory demands for more sustainable energy with the supply squeeze in the market. There are cost increases of materials, freight, fuel and labour. Weak supply chains, in particular the soaring prices of raw materials with inflation, are biting into renewables profitability. Geopolitical tensions causing supply chain disruptions raises talk about creating supply chains that are closer to home in order to manage them better.

ESG Investments

At the same time, regulatory and consumer demand for ESG compatible investments include the supply chain. How and where materials are sourced, under what labour conditions, and at what level of carbon content is now of greater importance.

The financial sector plays a central role in directing funds towards sustainable development. For example, the private sector can help the energy transition through investments into low-carbon energy technologies and, for the most part, these are considered as ESG investments. Investors have increasingly shown interest in putting their money into more socially conscious companies and turn to companies or funds that follow ESG investing strategies. Green energy is a popular choice and investors are considering non-financial risks posed by problems from climate change, for example in the treatment of workers through the supply chain.

ESG investing is no longer a fad; ESG assets are due to climb to US$41 trillion by the end of 2022 and climb to US$50 trillion by 2025[33]. Bloomberg Intelligence charted out the total ESG global assets under management (AUM) by country and for the first time, the US took the lead from Europe in 2020 (see Figure 17 above).

One could question the accuracy of the data behind the asset estimates, as what exactly qualifies as ESG is not clear cut. However, the growth trend is clear and backed up with the ballooning of the sustainable debt market, sustainable funds, and revenue increases of the biggest ESG fund managers.

Ashwath Damodaran, professor of corporate finance and valuation at the NYU Stern School of Business, claims that it is the lure of marketing the E, S, and G together that is driving capital toward it and calls the whole ESG concept “fuzzy”[34].

Stopping greenwashing

Across the three ESG pillars, there is a mix of quantitative and qualitative data to assess. Quantitative data is easier to assess and report on but comparable metrics for qualitative information is subjective, and this is just one of the many reasons why the ESG ratings and scores of companies can vary so widely. However, ESG news has an impact and claims of greenwashing are growing. In addition, criticisms of ESG investing have only grown louder since the conflict in Ukraine began.

[33] https://www.bloomberg.com/news/articles/2022-02-03/esg-by-the-numbers-sustainable-investing-set-records-in-2021?leadSource=uverify%20wall
[34] https://www.realclearenergy.org/articles/2022/11/22/esg_doing_good_or_sounding_good_866297.html

Regulators are more actively scrutinizing ESG and climate-related corporate behaviors in an effort to stop greenwashing. At the same time, sustainable and climate-related reporting standards are becoming increasingly burdensome. For example, climate disclosure frameworks, such as the Taskforce for Climate Related Financial Disclosure (TCFD), have gone from best practice to industry standard. In some countries, such as the UK and New Zealand, the TCFD is now mandatory reporting.

Turbo-charged sustainability reporting

Mandatory sustainability reporting is about to be turbo charged - and standardized. The Corporate Sustainability Reporting Directive (CSRD), adopted by the European Commission in November 2022, will replace and build upon the Non-Financial Reporting Directive (NFRD). The CSRD requires more detailed sustainability reporting and more than quadruples the number of companies that must comply: 11,000 currently covered by the NFRD to nearly 50,000 that will be covered by the CSRD. The rules will start applying between 2024 and 2028; this will have global impacts, as the CSRD also applies to companies based abroad who have a presence in the EU.

Businesses will have to disclose not only the risks they face from climate change, but also the impacts they may cause to the climate and society – the notion of "double materiality". Reporting will be submitted in a standardized digital format to allow for easier comparison between companies.

Need to measure entire carbon footprint

What this means for renewable energy companies is that they need to get ready by measuring and managing their entire carbon footprint to comply with current and future reporting requirements as per the CSRD. Scope 3 emissions, being the indirect emissions resulting from a company's upstream and downstream activities, will be required to be reported as well. Scope 3 emissions are tricky and difficult to measure; indeed, many companies are not currently measuring them at all. Furthermore, it takes time to figure out Scope 3 emissions so getting a process in place, if a company does not already have one, is critical to get ahead of the CSRD mandates to be compliant and manage this risk.

Data is key

Sustainability (or ESG, depending on how readers see it) is a movement defined by data. Being transparent about the company's progress, its challenges, and its learnings are crucial to its credibility. But how can any progress be tracked without a baseline of sustainability data?

Companies need this data and as a result, they are increasing their investments in ESG data and sustainability reporting technology across the board. Deloitte commissioned an online survey and conducted interviews at publicly owned companies with revenues greater than US$500 million across a variety of sectors for their Sustainability Action Report and found that 99% of companies are somewhat or very likely to invest in more technology and ESG disclosure reporting tools[35]. Furthermore, 48% of participants cited risk reduction as a tangible benefit of integrating ESG within a company's strategy.

Trusted, integrated, and easy-to-implement technology solutions, combined with artificial intelligence and machine learning, can provide insights that spreadsheet tracking just cannot do. Because armed with the right data, companies can predict trends and proactively make changes to help them hit their sustainability targets faster.

What this means for renewable energy companies is that they need to get ready by measuring and managing their entire carbon footprint to comply with current and future reporting requirements.

[35] https://www2.deloitte.com/us/en/pages/audit/articles/esg-survey.html

Conclusion: important steps for risk managers

Renewables will remain the star of the show in the energy transition; however, the trilemma of energy money and supply is here to stay for a while. This means that current issues such as inflation, cost increases, security, and supply chains pose challenges for renewable energy risk managers. Furthermore, increasing complexity in the market makes it difficult to know how and where to increase value.

So, what is a renewable energy risk manager to do? There are important steps that they can take to transition to Net Zero, to assess their own vulnerabilities, and to protect themselves from current and future ESG and climate related risks.

- Firstly, **understand your own ESG and sustainability position**. How are you optimizing your own operations? What's your baseline for emissions?
- Secondly, **take a reactive risk-response view** by looking at your value chain, both up and down stream. Where are the risks? Where are the opportunities?
- Thirdly, **play a strategic role across the company** - build strong relationships from the C-suite to the ESG team. Where can you drive ESG impact through new business models?
- Finally, risk managers should **look to work with other relevant stakeholders**, such as lenders, insurers, and especially their intermediaries. What partnerships can be created with others to drive value?

So do be prepared to act now. Prudent risk management is critical to this process of physical and transition risk.

Margaret-Ann Splawn is a climate policy finance and investment consultant. She is the Executive Director of the Climate Markets & Investment Association, an Active Private Sector Observer for developed nations at the UN Green Climate Fund, and a Fellow of the Royal Geographical Society.

Innovation: Ecological Digital Twin

A major renewables company is partnering with Silicon Valley to create digital twins that could reshape windfarms and the environment around them. Digital twins are virtual models designed to accurately reflect a physical object or groups of assets, such as a wind turbine or wind farm. Sensors related to vital areas of operation are fitted to the object(s) and produce data about different aspects of performance.

Currently, energy companies must collect data on the environmental impact of their projects. A lot of this relies on manual data collection, which can be inaccurate and quickly become out of date.

The consortium worked to create digital twins of offshore windfarms and their local environment, thereby creating what they are calling an ecological digital twin of the windfarm and environment. Technology will be deployed to monitor changes in the atmosphere, reefs, and marine and bird life around windfarms. The type of technology used will include radar, lidar, motion sensors, satellites, and drones.

Digital replicas of sites can be viewed on mobile devices and headsets to help the consortium understand how a development is affecting an area in real-time, in addition to monitoring the ecosystem through the lifecycle of the windfarm to minimize any negative impact. Data from monitoring devises will be stored in the consortium's cloud platform, which can be up to 93% more energy efficient and up to 98% more carbon efficient than on premises solutions.

Ecological digital twins could be a game changer for collecting the data required for environmental impact assessments and used to help validate permitting requirements, along with providing data that can be shared with policy makers, industry, and the public to increase transparency and knowledge skills.

Source: https://news.microsoft.com/en-gb/2022/07/08/sse-renewables-microsoft-and-avanade-are-creating-digital-twins-that-could-reshape-windfarms-and-the-environment-around-them/

Paris Agreement & COP27

Understanding the Paris Agreement is key to understanding current international climate negotiations, which last concluded in November 2022 at COP27 in Sharm El Sheik, Egypt. This is because current discussions on national Net Zero targets, international carbon markets, and climate finance needs are based on articles within the Paris Agreement.

The Paris Agreement is an integrated framework designed to consider the impacts of climate change and accelerate a sustainable transition. Nations make material climate pledges – the so called Nationally Determined Contributions (NDCs) – and progress against them is publicly reported.

Global climate goals are unreachable without global collaboration. However, to stay within our climate goals of "holding the increase in the global average temperature to well below 2°C and pursuing efforts to limit the temperature to 1.5°C" (Article 2, 1a)[1], economies cannot follow the fossil-fuelled industrialised pathway of the 20th century. Energy systems worldwide must move to renewables and other low carbon technologies.

One of the most contentious parts of the Paris Agreement, and hotly debated at COP27, has been the idea of payments for "Loss and Damage". Major historical emitters have blocked efforts to assign monetary responsibility for climate losses and damages. A lot of this is due to legal recourse, which could potentially be back dated. However, a campaign to deal with the most vulnerable areas led to a breakthrough and at COP27, an agreement was reached to create a Loss and Damage fund. The details of exactly how the fund will function and how it will be funded still need to be worked out.

[1] https://unfccc.int/sites/default/files/english_paris_agreement.pdf

The geopolitical arena: will Europe come out of the cold in 2023?

Introduction

2022 has been a very unique and difficult year for many, exacerbated by the macro-political challenges of the conflict in Ukraine which, outside of the commercial ramifications, has been personally so harrowing for so many. This is the first time there has been such a conflict in Europe since World War II, something which many Europeans, particularly those from older generations, never thought they would see again in their lifetime.

The consequences are broad and complex: Was it inevitable? How should countries respond to uphold the values and beliefs of so many, whilst also avoiding any further escalation? One consequence, which is being felt by many of us, is the surge in energy prices caused by the current conflict. While governments rally with short-term support schemes seeking to temporarily ease the burden on consumers, will Europe come out from the cold in 2023?

Security of fuel supply goes to the top of the agenda

One major consequence of the conflict has once again been to bring security of supply of fuel and power generation to the top of the agenda for further discussions. The EU has been acutely exposed as having too great a reliance on Russian gas exports, despite years of domestic power generation investment. In terms of governmental risk management, how did it come to this? Without more action earlier, surely Europe's reliance on Russia was inevitable?

Europe's challenges are certainly significant. While EU governments tackle the problem of energy price rises, hyper-inflation and energy security, what impact has there been on the Renewable Energy insurance market, and the overall energy transition? Is it all as bad as it appears, or could there be reason for optimism to come out of the cold from 2023 onwards?

The insurance market reaction

Even before the conflict in Ukraine, we have seen compounding pressures on the insurance market to do "the right thing". Increasingly tangible ESG obligations, supported by the various COP events (latterly COP27 in Egypt in 2022) marking three decades of activity, have amplified a collective voice sweeping across major insurers to acknowledge and support the energy transition and to be less supportive of heavy carbon-based industries.

Once the conflict was acknowledged, and US and European sanctions started to take effect, the Renewable Energy insurance market appetite for anything with even

the vaguest Russian connections disappeared overnight. The UK and US governments started targeting Russian financial institutions as early as February 22 2022; by March 1, certain Russian insurers had been added to the list of sanctioned entities, along with Russia's central bank, severely restricting the flow of money in and out of the country. Countersanctions by Moscow followed, making it very difficult to move funds between Russia and Europe and so even non-sanctioned Russian entities could no longer insure their projects outside Russia.

Increased appetite for new power sources

Following the beginning of the conflict, the EU strongly committed to phasing out its dependency on Russian fossil fuels. Historical reliance was underpinned by its availability; it made economic sense, and there was a reluctance to weather the storm through a difficult economic adjustment period. And because this approach was sanctioned by EU policy makers, there was an overall preference to kick this thorny issue down the road to be tomorrow's problem. In many respects, the conflict has forced a decision which, whilst being economically painful, has accelerated the desire for deployment of secure, domestic and clean power generation sources.

Growth in European renewables facilities

We are also seeing a rapid growth in renewable energy manufacturing and production facilities in Europe, seeking to have control over their own solar PV panel and Lithium-ion battery production facilities. The EU has indicated that it requires hundreds of GW of new renewable energy power generation deployed by 2030; but the political will has shifted. It seems that it is not for the private markets to respond to this new dynamic to create a secure, clean and reliable energy system for Europe, one that relieves the reliance on oil and gas and their suppliers.

Can Europe achieve its climate neutrality target, secure energy affordability and ensure security of energy supply, all this while decoupling from Russian energy and fighting high inflation? This will be the big question for 2023 onwards.

> **On one hand the conflict and the subsequent energy sanctions against Russia could accelerate that direction of travel; on the other, higher gas prices could threaten energy affordability.**

Effect of higher fossil fuel prices

While the energy market purports to have high morals and views business decisions in a political context, its failing has always been that it's a supply and demand market, heavily influenced by pricing. Higher fossil fuel prices are key to reducing high-carbon energy consumption and incentivising the Net Zero transition.

On one hand the conflict and the subsequent energy sanctions against Russia could accelerate that direction of travel; on the other, higher gas prices could threaten energy affordability, favouring a coal comeback. This is a real concern in the short-term, as governments seek to balance their national interests with that of their voters and consumers.

Governments are making efforts to ensure stable supplies of energy for European households and businesses. While these measures are necessary to mitigate the impact of climbing gas prices, they could jeopardise the EU's lower emission path in the short term as they smooth the economic impact, ultimately slowing some of the drivers for change.

In March 2022, emissions from the EU power sector were already up more than 20% year-on-year, and emissions are likely to keep rising throughout 2023[1]. Amid concerns over further gas supply cuts before winter, Germany and Austria have recently announced they are planning to reopen mothballed coal plants for electricity generation.

Support for Ukraine remains steady

One of the noticeable positives from last year is how the whole western world, and in particular the EU, has remained largely unified in their support of Ukraine, despite facing great challenges on every front. Not all EU members have the same reliance on Russian oil and gas; for some, turning the taps off would have meant disaster for their own economies. However, after months of negotiations, a price cap was agreed. The price cap is intended to weaken Russia's economic base, and significantly curtail its ability to access international capital markets to finance the conflict in Ukraine, while also allowing for a reliable supply of oil to the global market. However, on December 27 2022, President Putin signed a decree that bans the supply of Russian crude oil to nations that abide by the Price Cap from February 1 – July 1 2023. The ban is intended to apply to all stages of supply up to the end buyer. It could be argued that in facing one of its greatest challenges the EU has done well to balance security of supply and fuel availability to all its members and still offer unwavering support to Ukraine.

It remains to be seen as to how long domestic support will remain at the current high level, depending on the number of winters that Europe stays out in the cold and how quickly alternative measures can be deployed.

[1] https://www.schroders.com/en/uk/tp/economics2/economics/will-russia-ukraine-war-disrupt-europes-energy-transition/

Impact on renewable energy sector

So against this gloomy backdrop of rising energy prices, rising carbon emissions and rising inflation, what is the impact of the conflict in Ukraine on the renewable energy sector and is there any room for optimism?

The conflict will undoubtably have significant implications in terms of achieving Europe's climate neutrality targets. In the short term, Europe has reluctantly increased its carbon emissions in order to continue to supply affordable energy to its consumers and firms. However, at the same time Net Zero for Europe looks still achievable, as measures to accelerate the deployment of renewable energy and clean technologies appear to be underway.

One of the greatest challenges facing European governments is energy security, and the conflict in Ukraine has brought this into sharp focus. Changes in government policy are already evident in the UK and across Europe to drive the energy transition, removing some of the red tape for onshore windfarms and exploring all alternatives to fossil fuels. Every dollar increase in fossil fuel prices only serves to make the renewable alternative more attractive, and as countries throughout the world strive for energy independence, we can expect a surge in demand for Renewable Energy infrastructure.

Beyond security of power generation, just as drinking water scarcity may overtake fuel availability, there remains an increasing security vulnerability over the availability of key rare earth and other raw materials, which ultimately could weaken the EU's ability to achieve full security independence and its green targets. However, it is generally only the policy makers who have the ability for long-sightedness; current circumstances would indicate that governments also need the conviction to make hard decisions and changes now, which is not always possible.

Conclusion: a catalyst for change?

Everyone hopes that the conflict concludes very soon, and that peace returns to Ukraine. When scholars look back on this period in 100 years' time, maybe they will see that Putin's actions in Ukraine were the greatest possible catalyst to spur Europe on to meeting its Net Zero targets through its concerns over energy independence. At least this is one positive outcome that may result from the conflict.

Gavin Hampton is Renewable Energy Account Executive & Broker, Natural Resources, WTW London.
gavin.hampton@wtwco.com

Solar PV in the UK: the state of play & what the future holds

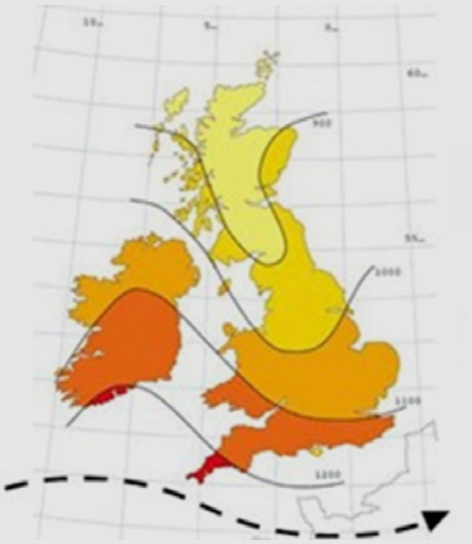
Introduction: the UK's Net Zero transition

As the UK continues its transition towards Net Zero, it is paramount to utilise and maximise the potential of all renewable and sustainable power sources. The UK has a target of reducing greenhouse gas emissions to Net Zero by 2050, a target written into UK law in 2019. However, since this was agreed, the UK has seen year on year increases in carbon emissions, making this target increasingly unattainable. As a result of the lack of a clear strategy, pressure from environmental groups has been growing and in July 2022 the Government was ordered by the high court to outline the exact plans that would help achieve this goal. In October, the Government published a 368-page report; however, critics described it as being "riddled with holes and omissions". Furthermore, in November the Public Accounts Committee (PAC) accused the Government of failing to "lead by example" in reaching Net Zero as it had pledged[1,2].

Alongside the urgent need to transition to renewables from an environmental perspective, the conflict in Ukraine has put a spotlight on the importance of energy security and self-sufficiency. The decrease in supply of Russia's natural gas has not only contributed to rocketing energy prices and the energy crisis but is also a step backwards in increasing the use of coal. Due to fears of an energy shortage through a predicted cold winter, plans to close coal power stations have been slowed and plans to reintroduce fracking considered – although a U-turn was made on this following a public backlash. Furthermore, only weeks after Rishi Sunak, the UK's Prime Minster, spoke at COP27 of his plans for the UK to be the a 'clean energy superpower', the UK has commissioned its first coal mine in 30 years[3].

[1] https://friendsoftheearth.uk/climate/whats-net-zero-strategy-and-why-are-we-trying-fix-it
[2] https://committees.parliament.uk/publications/31433/documents/176296/default/
[3] https://www.theguardian.com/politics/2022/nov/05/sunak-claims-role-as-clean-energy-champion-on-eve-of-cop27

Figure 1: **UK solar radiation map**



Solar radiation map

Scotland: 800-1000 kWh per sq metre

Midlands: 1000-1200 kWh per sq metre

South Coast: 1100-1300 kWh per sq metre

Source: https://www.greenmatch.co.uk/blog/2014/07/is-the-uk-sunny-enough-for-solar-panels-to-work

Solar in the UK – is it sunny enough?

While the UK's suitability for wind generation is well documented, with Onshore Wind consistently topping the Levelized Cost of Energy (LCOE) ranking in the UK, solar PV generation in the UK is often overlooked, with solar PV only contributing 6.8% of the renewable energy mix in the UK. This may be considered a reasonable assumption due to UK's famously drab weather conditions, particularly when compared to bigger solar PV markets in Europe, such as France, Spain and Germany that are typically sunny. Despite this, the UK in fact has an abundance of solar radiation for solar PV generation, generally ranging between 800 kWh per sqm and 1,300 kWh per sqm[4,5]. These upper levels, generally found in the Southwest, are comparable to the traditionally more 'Solar suitable' markets mentioned earlier.

While solar PV is most effective in direct sunlight, it of course works well on cloudy days, which the UK tends to have more frequently. As it stands, solar PV only contributes a small proportion of the electricity generation; however, following a summer of heat waves, which are becoming longer and more frequent, the UK has more than adequate conditions for solar-powered electricity generation.

Solar in the UK - do we have the space?

Another major point of contention for solar development in the UK has been land use. Solar sceptics often highlight the UK being a small island land mass without the capacity or space required for Solar PV sites. However, it is estimated that 29,690 km^2, or 12.3% of the land in the UK, would be sufficient to power the UK entirely by solar PV[6]. And while solar would not be required to be the UK's sole source of electricity, when one considers that only 6% of the UK is actually built up, the argument that there is a lack of land available for solar development in the UK simply doesn't stand up.

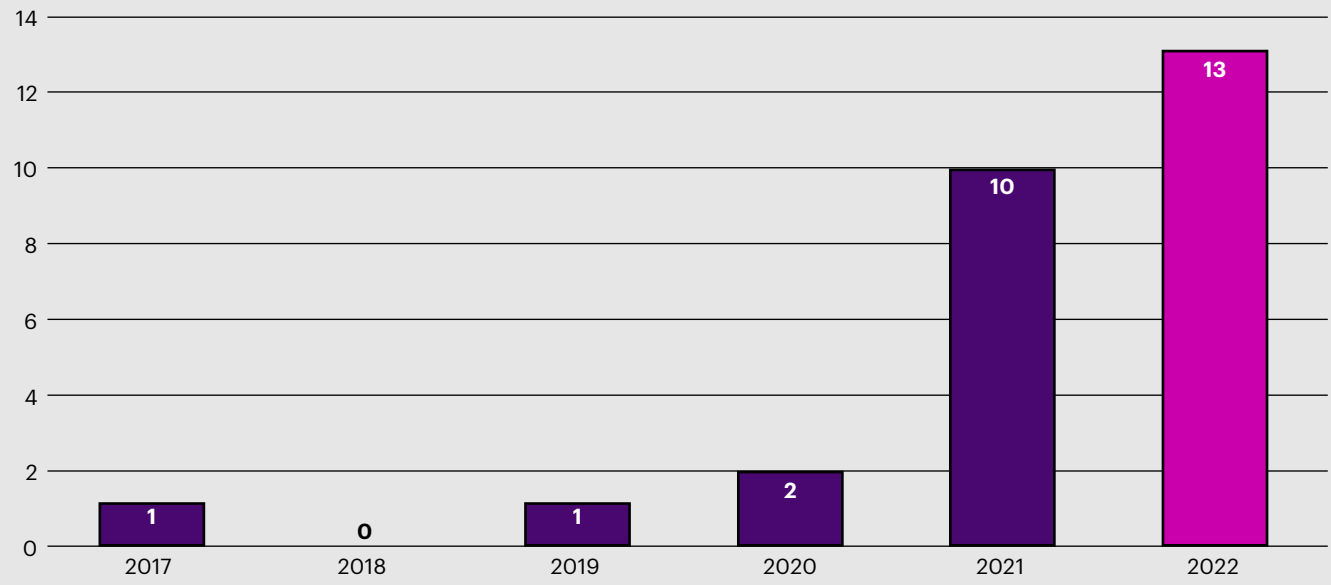
Food or Solar? Or both?

Agricultural land accounts for 71% of the UK's land, which means it is often focused upon by solar developers. Solar sceptics will often argue that food security comes under threat because of solar development, however currently only 0.08% of UK land is used for solar PV and given the huge proportion of land used for agriculture, efficiency increases and a focus on higher yield farming would allow room for both[7]. Moreover, there is also a strong case, and increasingly so year on year, as suggested by the Energy and Client Intelligence Unit (ECIU), that the negative impacts of climate change that farmers are experiencing, such as changing weather patterns and soil degradation, are a far greater threat to food security than solar PV.

Moreover, the debate over solar development's impact on food security appear to ignore innovation within the industry. Agrivoltaic solar farms are an emerging technology that allows plants or even livestock to be farmed in the same field as the panels. This can be achieved by raising the panels further from the ground

[4] https://www.theecoexperts.co.uk/solar-panels/solar-statistics#link-what-is-the-uks-solar-capacity
[5] https://www.greenmatch.co.uk/blog/2014/07/is-the-uk-sunny-enough-for-solar-panels-to-work
[6] https://www.finder.com/uk/solar-power-potential
[7] https://www.gov.uk/government/statistics/agriculture-in-the-united-kingdom-2021/chapter-2-structure-of-industry

Figure 2: **England, Wales & Scotland planning project declinatures, 2017-2022**



Source: https://www.theguardian.com/environment/2022/aug/25/solar-farm-plans-refused-highest-rate-five-years-great-britain

and increasing the spacing between panels to allow light to reach the ground. While Agrivoltaic technology is in its infancy, it does currently pose challenges of higher costs and less certainty in variables. However, as the technology develops and expands it is very likely to play a pivotal role in allowing countries, such as the UK where the use of land is such a hotly debated topic, to reach their Net Zero targets.

Solar PV installations have also become a savvy business decision for farmers themselves and one that is becoming increasing popular largely due to the volatile price of gas. In the middle of a national energy crisis, the cost of gas for farmers and businesses increased by 98% in Q2 of 2022, compared to the same period in 2021, while electricity increased by 45%. Analysis from the ECIU has estimated this will cost farmers without a renewable energy source on site £1.1 billion over the next two years[9].

UK's Solar Plan: what's the target?

In terms of the UK's recent plans, the Government announced in April 2022 that the current 14GW of solar PV installed in the UK could be increased fivefold by 2035 - this would mean 56GW of solar PV installations in the next 13 years[9]. However, the Government stopped short of setting this as a target (unlike with wind), suggesting they need to "consult on the rules for planning regulations of solar projects, particularly on domestic and commercial rooftops". This essentially means that while ambitious figures are being mentioned, the strategy the UK will achieve 70GW of solar PV capacity by 2035 remains unclear – so what progress has been made in recent years?

Full steam ahead... Or not?

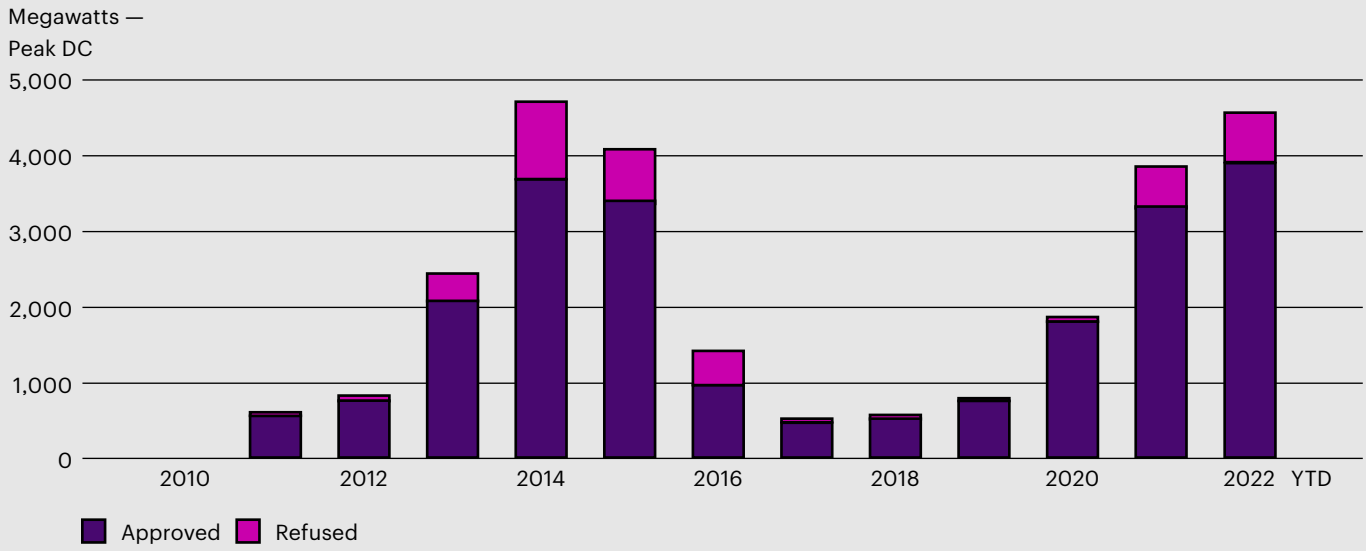
Figure 2 above highlights that planning permission for 23 projects had been declined at the local council planning stage between January 2021 and July 2022. It was reported that rejections were being issued at "the highest rate in five years", and with the average capacity of these projects was 30MW, the potential for up to 0.7GW of solar capacity has been thwarted at the first hurdle due to governmental policy[10].

Despite these reports, further data released shows that a significant reason for the higher levels of rejection is due to the highest level of applications at the same point in any given year.

Data collected by Solar Media Market Research shows that, while there have been more rejections, 4GW of new solar PV capacity has been approved in the UK in 2022, the highest amount since 2014, as highlighted in Figure 3 overleaf.

[8] https://www.solarpowerportal.co.uk/blogs/uk_installs_556mw_of_new_solar_capacity_in_first_six_months_of_2022
[9] https://www.gov.uk/government/news/major-acceleration-of-homegrown-power-in-britains-plan-for-greater-energy-independence
[10] https://www.theguardian.com/environment/2022/aug/25/solar-farm-plans-refused-highest-rate-five-years-great-britain

Figure 3: **England, Wales, Scotland planned solar farm capacity, 2010-22**

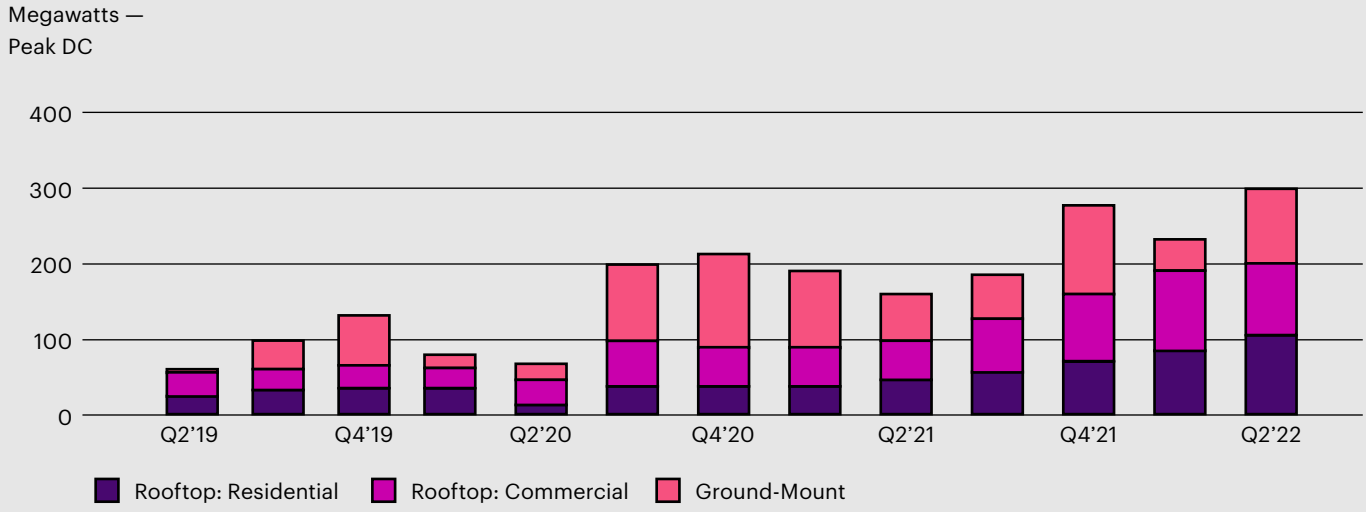


Source: https://www.solarpowerportal.co.uk/blogs/uk_solar_farm_approval_hits_record_capacity_level_in_2022

Moreover, the half year results show that installed capacity has increased by 556MW during the first six months of the year. This is compared to the 0.73GW being installed in whole of 2021, which shows 80% growth compared to the same period the year before[11].

It is extremely encouraging to see this level of growth and the UK's solar PV potential being unlocked. These positive developments are the first significant signs of progress within the 'post-subsidy' era (starting in 2017 when Government subsidies for solar PVs were removed). Removal of Government schemes appear to have made a positive impact on development as, following the closure of the feed-in-tariff and Renewable Obligations Certificates (ROCs) at the start of 2019, all solar developments have been built subsidy-free and, as can been seen from Figure 4 below, there has been year-on-year growth since. It has also been noted that the removal of subsidies may have benefited councils with the removal of deadlines, allowing for more flexibility and reduced risk. The majority of the growth within ground mounted solar sector has come in the form of sites 50MW or smaller that fall under the Nationally Significant Infrastructure Project (NSIP).

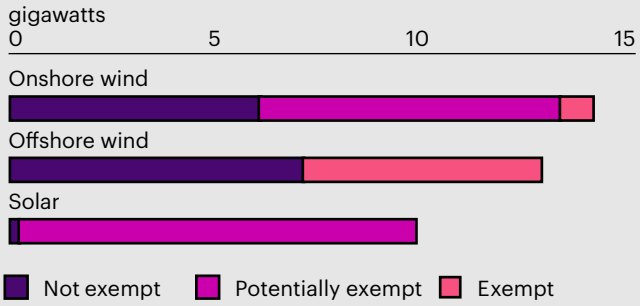
Figure 4: **Solar PV installed by quarter in the UK, 2019-22**



Source: https://www.solarpowerportal.co.uk/blogs/uk_installs_556mw_of_new_solar_capacity_in_first_six_months_of_2022

[11] https://www.solarpowerportal.co.uk/blogs/uk_installs_556mw_of_new_solar_capacity_in_first_six_months_of_2022

Figure 5: **Variable Exemption – UK renewable power generation capacity exposure to windfall tax**



Source: https://www.bloomberg.com/news/articles/2022-12-01/uk-windfall-tax-on-renewables-could-hurt-decarbonization-efforts?leadSource=uverify%20wall

Following this successful start to 2022, the question of land use and restrictions is a discussion that once again has come to the forefront of solar development in the UK. UK land is graded (ranked 1-5), and as it stands 'best and most versatile land' (BMV) is covered by rankings 1-3a. Within these categories, the Government states that development should be avoided on BMV; as a result, the majority of UK solar and the planned capacity is on land graded 3b, with grades 4 and 5 covering hilly or mountainous areas not suitable for solar.

With the UK government discussing solar capacity potentially reaching 70GW by 2035, one might expect a review on planning restrictions and lowering the hurdles for solar projects to get off the ground. As such, there was much surprise and criticism within the industry when a government review of land use, during Liz Truss' brief tenure as Prime Minister, resulted in a policy change to actually increase regulations. The plan presented was to extend the grading of BMV to include 3b graded land and, while it is fundamentally inaccurate to include this low-quality land under the BMV, this would prevent solar development on 41% of land in England, or 58% of agricultural land. It was argued this is would essentially result in a de facto ban on solar development in the UK and was predicted to cost the solar sector up to £20 billion in lost investment[12].

Following the change in UK government in October 2022, there was hope within the industry that this policy would be scrapped. Initially Thérèse Coffey, the new secretary of state for the Department for Environment Food and Rural Affairs (Defra), confirmed they intended continue the plan to increase the restrictions on land available for solar development. The importance of food security was cited as the primary reason, despite 3B land only suitable for a limited range of crops, such as cereal & grass, at a moderate yield[13]. However, following calls from the solar industry and farmers alike to scrap further restrictions on the use of agricultural land, Coffey has announced that the extension of BMV has been cancelled - a decision very much welcomed by the industry and described as both "a great relief" and "a turning point" for the solar industry by Chris Hewett (CEO of Solar Energy UK).[14]

UK windfall tax: how costly could it be?[15]

The introduction of a 45% windfall tax on electricity generators, named the Electricity Generator Levy, is a further key government policy that is set to impact the UK solar market. This policy is to be introduced from the start of 2023 and run through until 2028. The tax rate will apply to any revenues above £75/mWh and is to be implemented in order to protect against "extraordinary returns" of renewable electricity generators.

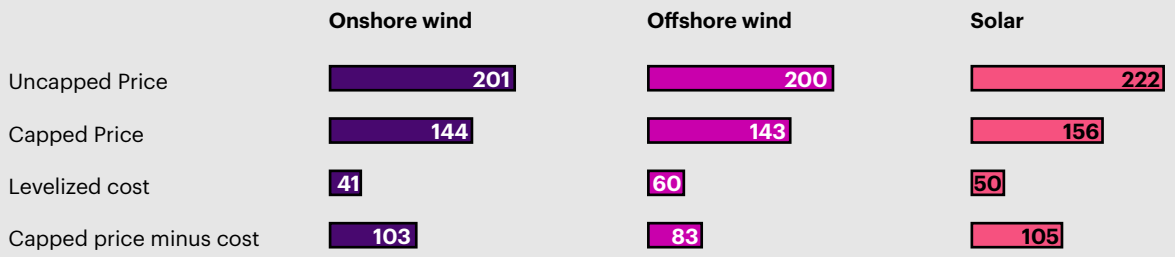
This Electricity Generator Levy is also being implemented to assist the Government in funding the Energy Price Guarantee, which caps the cost of electricity for domestic customers. More positively, the policy is set to exclude projects under Contracts for Difference (CfD), as well as electricity producers who generate less than 100GW hours, or have less than £10 million of annual revenue. However, it does also exclude gas generated energy[16].

Analysists have reviewed how this will impact renewable generators and how much of their production will be exposed to the 45% tax rate. Due to the variable limits based on market rates for electricity, it is confirmed that 14GW of sustainable electricity production will be affected, with potentially 17GW of renewables generation exposed to the 45% tax rate. As such, this widely criticised policy is expected to increase uncertainty with developers and be detrimental to the UK's progress in the energy transition towards Net Zero.

> **The introduction of a 45% windfall tax on electricity generators, named the Electricity Generator Levy, is a further key government policy that is set to impact the UK solar market.**

[12] https://www.solarpowerportal.co.uk/news/solar_sector_criticises_de_facto_wind_fall_tax_over_investment_concerns
[13] https://www.solarpowerportal.co.uk/news/review_of_bmv_land_extension_hampering_rollout_of_solar_set_to_continue
[14] https://www.solarpowerportal.co.uk/news/ministers_rule_out_changes_to_land_categorisation_in_turning_point_for_the
[15] All statistics for this section are from: https://www.bloomberg.com/news/articles/2022-12-01/uk-windfall-tax-on-renewables-could-hurt-decarbonization-efforts?leadSource=uverify%20wall
[16] https://www.solarpowerportal.co.uk/news/solar_sector_hits_out_at_windfall_tax_that_threatens_investment_needed_for

Figure 6: **Still in the money – UK renewable generator prices and levelised costs with windfall taxes, £ per megawatt hour**



Source: https://www.bloomberg.com/news/articles/2022-12-01/uk-windfall-tax-on-renewables-could-hurt-decarbonization-efforts?leadSource=uverify%20wall

However, from a solar PV perspective the impact is far more difficult to predict, as while only 0.1GW of generation will definitely be charged at this new rate, there is uncertainty over the remainder of production. But the sector is cautiously optimistic that, due to the generally small scale of solar projects in the UK, as well as the high proportion of CfD projects, which are both exempt, the impact on revenues could be small. This will of course vary, based upon the market conditions within 2023; however, it should not dissuade solar PV developers from investing in the UK market.

In terms of the LCOE, this additional taxation is predicted to still allow renewable generators to be profitable. However, from a solar perspective, while the LCOE of onshore wind remains lower, it is predicted that solar could become the most attractive of the three prominent renewable technologies in terms of profitability following this legislation. As highlighted in Figure 6 above, the capped price minus costs is estimated to be £105/mWh for solar, £103/mWh for Onshore wind and £83/mWh for offshore wind. While it would undoubtably be preferable not to be implementing windfall taxes on clean energy production, this analysis demonstrating the expectation of continued profitability should be encouraging for owners of operational SPVs in the UK.

While the impact of investment in offshore and onshore wind are expected to be higher, due to the more significant impact on profits, it can be hoped that investors will continue to see the UK as an attractive option. It should also be noted that the EU has also implemented a similar windfall tax, which could mean that while the UK misses out on increasing out proposition to renewables investors, it may not lose out as much relative to its competitors.

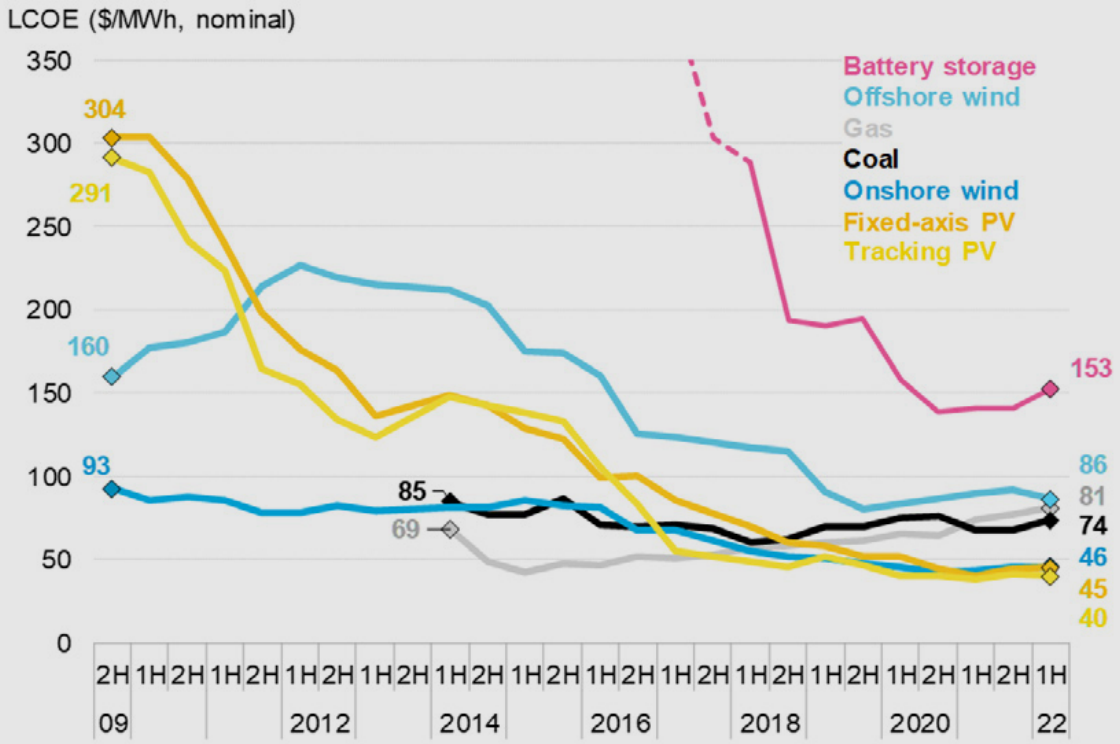
The solar market has also confirmed that the new windfall tax has only resulted in small decreases in asset valuation, which is primarily due to some of the Levy's exclusions. Upon further scrutiny of the policy, market leaders such as Foresigtht Solar Fund are seeing only a 0.8 pence per share price (PPS) drop to a price of 126.4pps, while Bluefield Solar Fund saw a 3pps fall in their price to 141.4pps and Atrato, who specialise in utility scale solar in the UK, announced that they do not believe their work will be impacted by the 45% windfall tax[17,18]. These reactions to the Electricity Generator Levy from major solar players in the UK should serve as encouragement that investment in the sector will be rewarded.

Inflationary pressures

Outside of government policy, a key factor for solar developers is the consideration of global inflationary pressures. Following the year-on-year downward trends of LCOE of solar PV, further emphasised by the 13% drop of LCOE of utility scale solar PV in 2021[19], experts have been making bold predictions that this trend will continue, potentially falling as much as 55% globally by 2030. Research from 2022 shows a 14% increase in fixed axis solar PV to $45/mWh and tracks PV at $40/mWh, which is largely accredited to increases in materials, freight, fuel and labour. It should be noted that, despite this recent rise, it still marks a 86% reduction of LCOE since 2010 in nominal terms.

[17] https://www.solarpowerportal.co.uk/news/windfall_tax_results_in_small_decrease_in_solar_asset_valuation_for_foresig
[18] https://www.solarpowerportal.co.uk/news/atrato_confirms_windfall_tax_will_not_impact_it_as_solar_companies_work_to
[19] https://www.pv-tech.org/global-lcoe-of-utility-scale-solar-fell-13-in-2021-irena-says/

Figure 7: **SGlobal levelised cost of electricity benchmarks, 2009-22**



Notes: The global benchmark for PV, wind and storage is a country-weighted average using the latest annual capacity additions. The storage LCOE is reflective of a utility-scale li-ion battery storage system with four-hour duration running daily cycle and includes charging costs.

Source: https://about.bnef.com/blog/cost-of-new-renewables-temporarily-rises-as-inflation-starts-to-bite/

Further research and comparisons to fossil fuel production shows, that despite these rising costs in renewables, carbon emitting production costs are increasing at a fast rate, meaning the LCOE of solar PV is approaching becoming almost half the LCOE of gas and coal, which stand at US$81/mWh and US$70/mWh respectively. More details of these global LCOE tends can be found in Figure 7 above; however, what is clear is that solar PV continues to be by far the cheapest, as well as the greenest, source of energy despite inflationary and supply chain pressure, as these are factors being felt across all markets.

Conclusion: what does the future hold?

The UK solar market appears to be in a strong position. While it has been established that the UK has the conditions for effective electricity generation through solar PV, as well as the land resource, there have only been increases in development and investment, particularly since 2019. 2022 brought further positive news in regard to the future pipeline, following Round 4 of the Contracts for Difference (CfD) auction which saw the UK solar market secure over 2.2GW of capacity at a price of £45.99/mWh[20]. This auction, the first of its kind since 2015, provides subsidy-free contracts for a further 66 projects in the pipeline across the UK. The UK's planned solar PV capacity has increased nearly 350% from 20GW at the end of 2021 to 68GW by the end of 2022[21].

Despite the windfall tax on renewable electricity generation and the increasing inflationary/supply chain issues, solar PV remains an extremely attractive investment opportunity and the future is bright. 2023 certainly makes to be an interesting year for the solar PV market.

Max McKinley is Account Executive
Renewable Energy, Natural Resources, WTW London.
Max.McKinley@wtwco.com

[20] https://www.solarpowerportal.co.uk/blogs/cfd_round_4_analysis_where_are_the_sites_and_who_were_the_winners
[21] https://marketresearch.solarmedia.co.uk/reports/uk-large-scale-solar-farms-the-post-subsidy-prospect-list/

Future technology disruptor: cutting-edge Japanese technologies for the hydrogen economy

Introduction

The world needs innovation more than ever to mitigate climate change. Now, new cutting-edge hydrogen technology arising from Japan promises to accelerate the transition to a hydrogen economy that represents the best alternative to fossil fuels for decarbonization.

A hydrogen economy has vast benefits and is the only green and sustainable renewable fuel that burns cleanly, generating only water as a by-product. The production of hydrogen is already well-known and established in the energy sector, with the only question remaining being the viability of its mass transportation and distribution. Dreams of a hydrogen economy had been tested and found wanting a decade ago, when the advent of the Hydrogen Fuel Cell Vehicle (FHEV) did not take off. But now we are seeing a number of potential hydrogen technologies, including the bulk transportation of hydrogen using Liquid Organic Hydrogen Carriers (LOHC) or Ammonia, that may spell a revolution in the use of hydrogen. So, let's introduce a cutting-edge technology from Japan's Chiyoda, called SPERA Hydrogen.

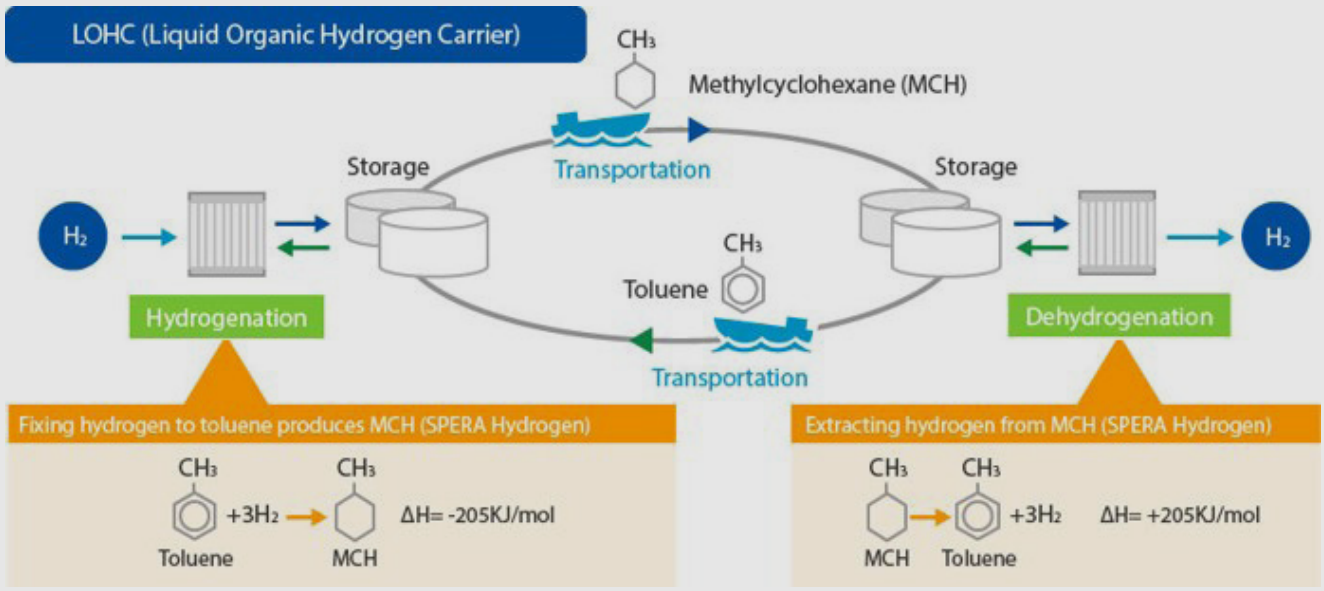
Introducing CHIYODA SPERA Hydrogen™

Numerous studies have pointed to the need for significant capital investment in pipeline, truck and rail transportation for compressed hydrogen that is unlikely to be viable at the early stages of the transition to a hydrogen economy. Alternatively, liquefaction of hydrogen can consume up to 30% of the equivalent fuel energy and requires specialist materials to prevent loss of containment. Finding a viable product transportation and distribution solution will therefore be critical to the proliferation of the hydrogen economy.

To address these challenges, many companies are currently researching novel methods for bulk hydrogen transportation. One promising new technology comes from Chiyoda that started its research back in 2002 to develop proprietary technologies based on LOHC. In 2011, it succeeded in combining and releasing gaseous hydrogen, known as SPERA™ hydrogen, from MethyCycloHexane (MCH), acting as the hydrogen carrier. In this process, a single toluene molecule is used

[1] "Insuring Hydrogen Infrastructure, Construction and Operation, by the International Association of Engineering Insurers" and US Department of Energy, Hydrogen Program. https://www.hydrogen.energy.gov/delivery.html

Figure 1: **The SPERA Hydrogen System**



Source: https://www.chiyodacorp.com/en/service/spera-hydrogen/innovations/

to store six hydrogen atoms by conversion to MCH in a hydrogenation process using a proprietary catalyst and reactor. The main advantage of MCH is its ability to hold 500 times more hydrogen per volume than hydrogen gas to enable efficient transportation. On arrival at its destination, MCH can be dehydrogenated using a high-performance catalyst to release hydrogen and toluene, which is recycled to form a sustainable cyclical process.

SPERA™ hydrogen is readily transported in bulk by truck, rail and sea under atmospheric conditions avoiding many of the hazards of transporting liquefied hydrogen. This technology could unlock the first step towards the hydrogen economy, opening the way for creating a whole new array of infrastructure around hydrogen distribution to end users.

As highlighted in Chiyoda's website in support of Net Zero ambitions, several SPERA™ key features are:

1. SPERA™ hydrogen is easy to handle. It's a stable liquid at ambient temperature and pressure, making it easy to handle like petroleum or natural gas.
2. SPERA™ hydrogen can lower capital investment in infrastructure. As MCH and toluene are both classified into the same category as gasoline under the Fire Service Act in Japan, it is feasible to repurpose the existing petroleum transportation and distribution infrastructure for SPERA™ hydrogen, thereby greatly lowering the need for capital investment.
3. SPERA™ hydrogen can mitigate storage and transportation risk. The mitigation of hydrogen storage and transportation risk via SPERA™ technology is well understood and on a par with the storage and transportation of petroleum.

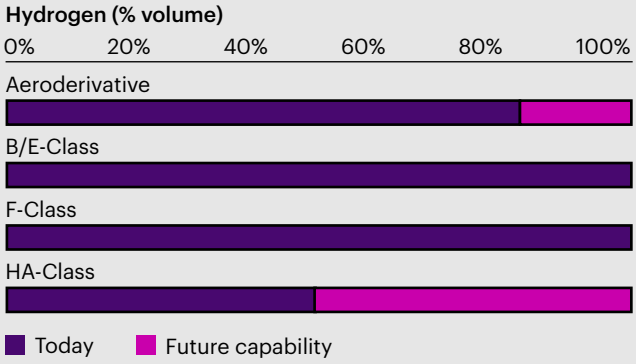
Likely impacts of the hydrogen economy

As new technologies displace the fossil fuel economy, we foresee a number of impacts.

A new shift in power generation

Power from LNG produces greenhouse gases, while hydrogen burns cleanly; the next phase in power generation will therefore be the development and proliferate adoption of hydrogen power generation. Current technology challenges are likely to be overcome within the next few years; major equipment manufacturers are testing increasing hydrogen percentage firing in pilot power plants and the first fully hydrogen power plants are already in operation and more can be expected to come online within the next few years.

Figure 2: **GE's H-class, F-class, B/E-class, and aeroderivative gas turbines are all capable of running on different levels of hydrogen**



Notes: Hydrogen (% volume, actual hydrogen levels may vary based on gas turbine model, combustion model, combustion system and overall fuel composition)

Source: https://www.powermag.com/first-hydrogen-burn-at-long-ridge-ha-class-gas-turbine-marks-triumph-for-ge/#:~:text=Hydrogen%20combustion%20has%20begun%20at,capable%20of%20burning%20100%25%20hydrogen

Exponential shift to Green hydrogen

Grey/Brown[2] hydrogen producers will hasten their shift to renewable Green hydrogen due to ever-present climate change and pressures from the United Nation Climate Change COP annual meetings. This green shift is already unfolding globally as more and more solar, hydro and wind power is used to generate Green hydrogen and can be expected to only increase exponentially with time.

Virtuous green circle

A virtuous circle[3] is defined as a chain of events in which one desirable occurrence leads to another which further promotes the first occurrence and so on, resulting in a continuous process of improvement. Similarly, as the evolution to a hydrogen economy continues, a so called virtuous green circle will start to form, accelerating the shift from fossil fuels to using Green hydrogen to generate power. This virtuous circle will improve the renewable revolution as it surges forward, which will lead to more construction of renewables infrastructure. Ultimately, we will be expecting a proliferation of renewables to generate hydrogen, which will definitely help to mitigate climate change impacts.

The next automotive revolution

With the virtuous cycle in place, the maturity of the hydrogen economy may undoubtedly result in the next automotive revolution by the wider adoption of HFEV.

This technology is not new; however, the infrastructure to supply hydrogen is presently not readily available. Once the hydrogen economy is established, HFEV technology will be able to establish its roots, since its efficiency and range is almost on par with internal combustion automobiles.Asia: the new hydrogen frontier?

In Asia, the forward-looking Singapore government[4] is investing in the hydrogen economy as it seeks to diversify its heavy reliance on natural gas that is vulnerable to supply chain disruptions. Presently, it is planning to source renewable power from Australia and Sarawak through the subsea transmission of electricity from large scale solar farms. In addition, it has numerous memorandums with Japanese partners on SPERA™ hydrogen as well as other potential hydrogen technologies. Having a varied and resilient energy mix will help Singapore to secure control of its future energy and power needs, while meeting its stated climate obligations.

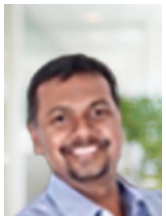
Another country seeking to upturn its status quo in its energy mix is Japan, where the government has formulated a plan to expand its renewables industry. In this respect, by creating a hydrogen economy[5] it will complement its solar and wind power resources in the long-term. Moreover, Japan plans to stay at the forefront of the hydrogen revolution as it leverages and invests further in research which is now bearing fruit.

[2] Grey hydrogen is created from natural gas, or methane, using steam methane reformation but without capturing the greenhouse gases made in the process. Brown hydrogen is produced by gasification, where carbonous materials are heated into a gas.
[3] Merriam Webster dictionary
[4] New $540m 'hydrogen-ready' gas power plant to be built in Singapore — with no plans to actually use H2. https://www.rechargenews.com/energy-transition/new-540m-hydrogen-ready-gas-power-plant-to-be-built-in-singapore-with-no-plans-to-actually-use-h2/2-1-1288033
[5] Japan ministry of Economy, Trade and Industry, "Tapping Hydrogen's Energy Potential", https://www.meti.go.jp/english/policy/energy_environment/global_warming/roadmap/innovation/thep.html

Conclusion

Many technologies that are dependent on the hydrogen economy, including the first HFEV, have been developed on the premise that many known hurdles will eventually be overcome. Now that we are at the beginning g of 2023, it is clear that the time for hydrogen has arrived. Global production of hydrogen is already shifting from 'Grey' to 'Green' hydrogen as costs drop, accelerating investments. The new SPERA™ technology is just one of numerous technologies that will appear over the short-term to solve hydrogen transportation problems and usher in a new greener era. Proof of concept has already been achieved and, with governmental commitment, we can foresee the hydrogen economy growing quickly and becoming a part of everyday life.

Alex Lua, CPEng, PPSE is Lead Natural Resources Risk Consulting Engineer, WTW Asia.
alexander.lua@wtwco.com



Kumar Rajasegaram is a member of the Risk Engineering team at WTW Asia.
kumar.rajasegaram@wtwco.com

Navigating the seas of hydrogen risk: key factors to consider

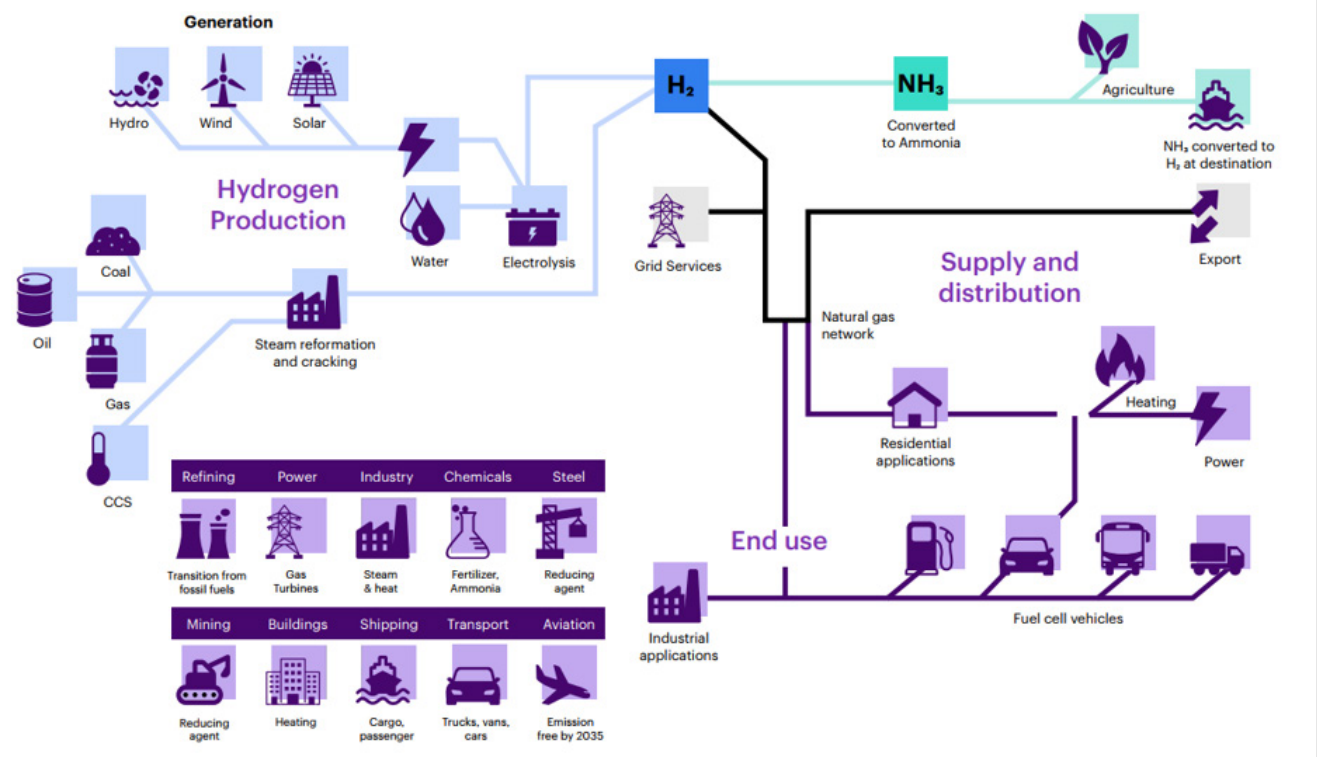
Introduction: the supply & demand imbalance

Sanctions against Russia have created a restriction in the supply of natural gas to Europe without any abatement in demand; this is being seen by many as a catalyst for innovation and investment into renewable energy solutions. With a strong global focus on hydrogen, could this make a meaningful contribution to balancing the supply & demand issues experienced?

We are all acutely aware from COP27 that any change in the energy system doesn't happen overnight, and that transitioning the energy infrastructure takes time. We must then question what level of delivery is realistic in the short, medium and long term to strengthen the energy security of supply for impacted nations, in a stable, equitable, consumer or government-led energy transition.

We are now challenged with not only increasing, but also changing, the technologies used for delivering grid electrification. We are confident that hydrogen is poised to play an increasingly important role in the energy demand for heavy industrial applications such as steel, cement, aviation, and shipping, which are inherently more challenging to decarbonise, due to the large quantity of fast-deployable energy which is required in these industries. While renewable energy will have its part to play being integrated into the new Green hydrogen infrastructure, there are limited technologies which can be deployed to directly replace traditional hydrogen carbons. The hydrogen ecosystem, and the diverse applications, is shown in Figure 1 overleaf.

Figure 1: **The hydrogen ecosystem**



Source: WTW

Fuelling the future

At COP27 Jonas Moberg, CEO of the Green Hydrogen Organisation commented that "Green hydrogen is one of the bright spots of this COP"[1]. Organisations and nations are racing to develop Green hydrogen strategies attracting strong interest from the international investment community, for example:

- Oil company Cepsa is to invest €3bn in 2GW Green hydrogen project in southern Spain[2]
- Michael Matheson has unveiled a £25 billion hydrogen plan for Scotland[3]
- India plans to introduce Green hydrogen mandates for heavy industry after passing enabling legislation[4]
- Scatec and partners are to develop a large-scale green ammonia facility in Egypt[5]

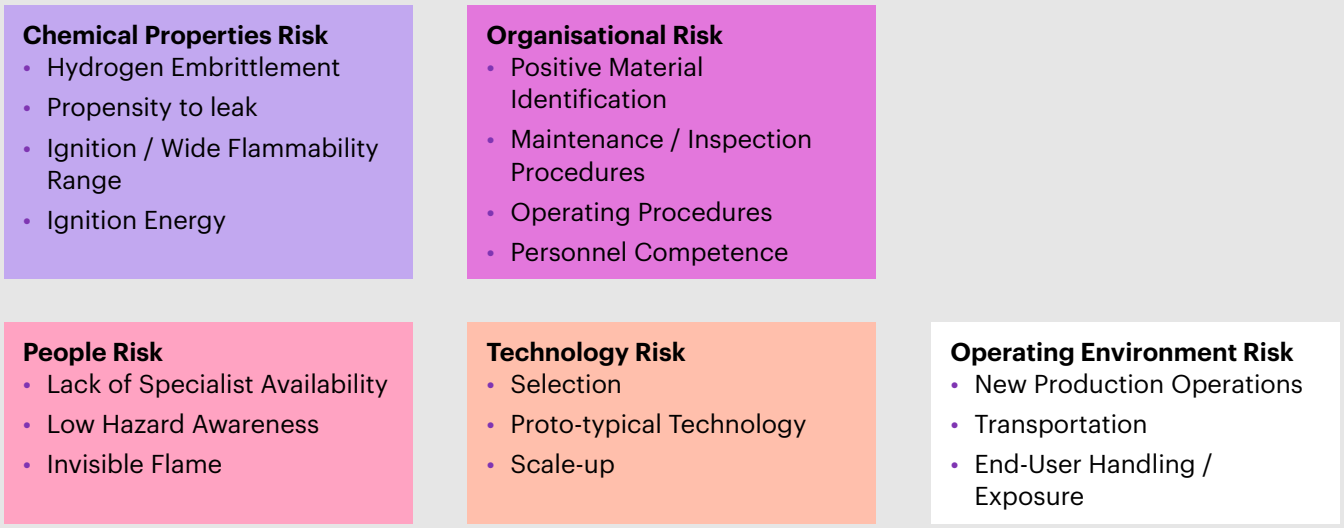
On the technology front, Alex Lua's article elsewhere in this Review explores cutting-edge Japanese technologies for the transportation of hydrogen and what this means to this industry. Beyond the well-established and proven electrolysis technology, the hydrogen industry is investing heavily and looking at how this technology can be integrated to replace generation sources, especially for carbon intensive industries.

Individual governments are now considering their own domestic strategies and actively planning and delivering national hydrogen technology hubs to focus the research, development, innovation, transportation, and commerciality of a hydrogen-enabled future. There appears to be no end to the ambition for hydrogen, with many projects being planned or in development, connecting renewable energy generation both onshore and offshore. Some concepts, including hydrogen production offshore, utilise seawater electrolysis which could create a new frontier for affordable green hydrogen[6].

With changes and new technology applications comes risk; the insurance industry will have a critical role to play to supporting the Green hydrogen sector to navigate the seas of hydrogen risk.

[1] https://www.energymonitor.ai/tech/hydrogen/cop27-green-hydrogen-is-one-of-the-bright-spots-of-this-cop-jonas-moberg-ceo-of-gh2/
[2] https://www.hydrogeninsight.com/production/oil-company-cepsa-to-invest-3bn-in-2gw-green-hydrogen-project-in-southern-spain/2-1-1364762
[3] https://www.heraldscotland.com/politics/23191997.michael-matheson-unveils-25-billion-hydrogen-plan-scotland/
[4] https://www.hydrogeninsight.com/policy/india-plans-to-introduce-green-hydrogen-mandates-for-heavy-industry-after-passing-enabling-legislation/2-1-1373860
[5] https://scatec.com/2022/03/10/scatec-partners-with-the-sczone-the-sovereign-fund-of-egypt-the-ministry-of-electricity-and-renewable-energy-to-develop-a-large-scale-green-ammonia-facility-in-egypt
[6] https://www.azocleantech.com/article.aspx?ArticleID=1607

Figure 2: **key hydrogen risk factors**



Source: WTW

Key factors in the hydrogen risk landscape

The process of hydrogen production will undoubtedly involve the concentration of hazardous and reactive chemicals, large electrical installations, rotating equipment, and the production/storage of flammable gasses. The corresponding loss drivers are likely to be fire, explosion, large electrical equipment faults arising from transformers and AC/DC convertors, power interruptions and rotating equipment failures from turbines, compressors and pumps. Generally, the overall risks for hydrogen operations are more sensitive to the operating environment than conventional fuels but many traditional risks remain, with heightened sensitivity due to the novel nature as deployment grows nature.

Hydrogen risk evolution

These key risk factors are further exacerbated as the industry grows from current use states into the future operating environment, as evidenced by Figure 3 overleaf.

Insurers and hydrogen

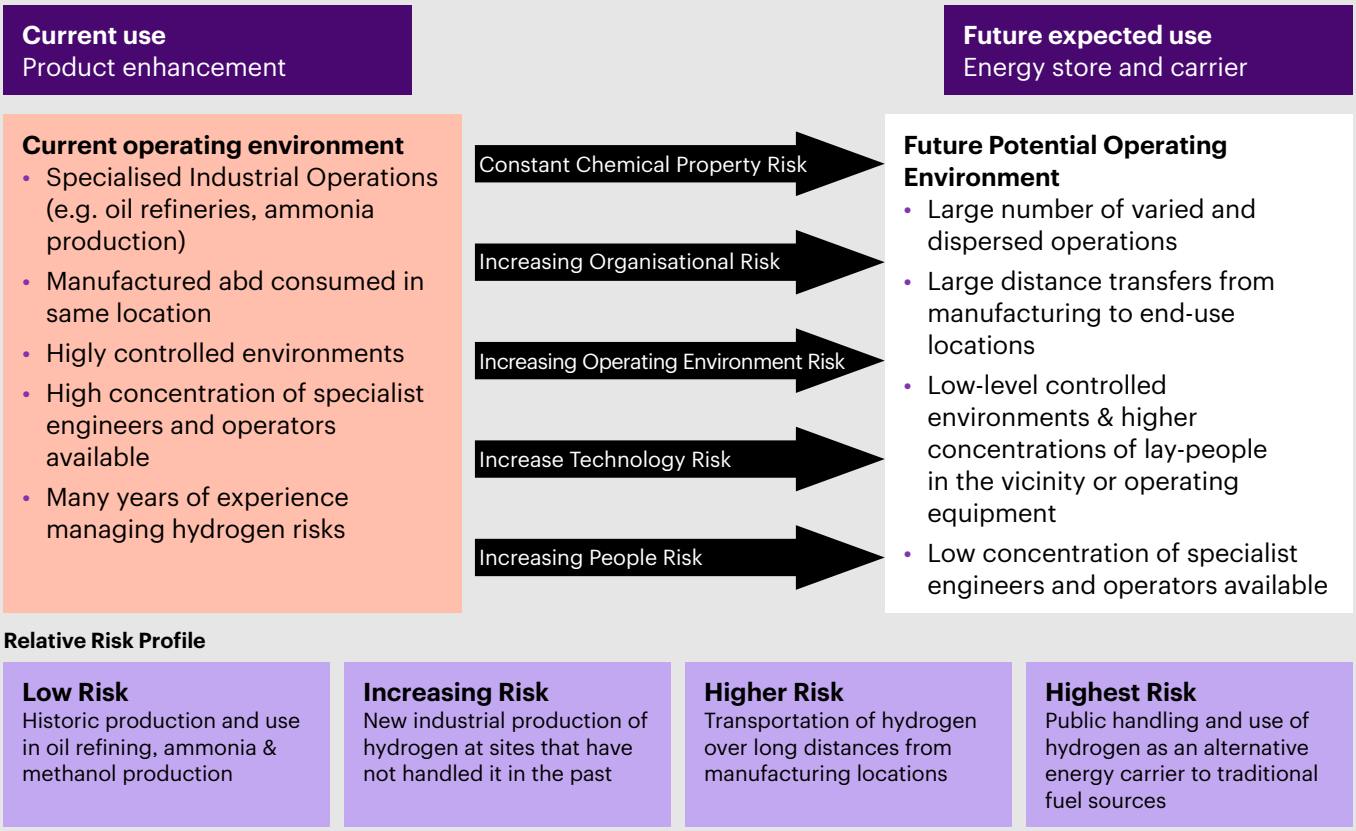
Green hydrogen has become a hot topic in the insurance market over the past twelve months as insurers race to understand the technical risks issues and align their insurance capital to support risk transfer in the sector. One of the challenges they have faced is how the risk fits in their underwriting portfolio. Energy & Power insurers tend to be product and class-driven, often split into Upstream, Downstream and Renewables. Is hydrogen as a class best suited to the Upstream, or Downstream sectors, both of which have a strong understanding or different parts of the technologies, assets and processes?

As a clean, low-carbon technology, Renewable Energy insurers will also have good technical understanding of hydrogen risks. They will relish an opportunity to contribute, particularly as they grow accustomed to the increasingly complex green electricity technologies being developed. However, they have a greater focus on Fire and Machinery Breakdown than the Explosion risk with which Upstream underwriters are more familiar and comfortable.

To address this question, WTW conducted a survey of over 25 major global insurers in the market to understand their appetite for underwriting hydrogen across the colour spectrum, identifying the key "seats of authority" to make decisions. This exercise and its subsequent analysis showed that for Green hydrogen there is generally an air of caution, due to the new nature of the technology. Most insurers are willing to review risk submissions to see where and how they could support; it is clearly recognised that many of their clients are going into this area, and they need to play a role to support this development. Several insurers are figuring out where best the risk sits, aligned to with the various technologies harnessed with the hydrogen rainbow, while others have formed dedicated teams to address the sector. It's not simply a question of Upstream, Downstream or Renewables, but this knowledge and access points are key to unlocking the available insurance capacity.

Certainly, there is a need for greater collaboration, both across the insurance market and the hydrogen industry itself. The closer that insurers and brokers can get to the technology the better, as will lead to the more innovative solutions needed. Effectively matching insurance capacity to project risk, during both the construction and operation phases of the facility, will be key to de-risking a project and driving bankability in the sector.

Figure 3: **the evolution of hydrogen risk**



Source: WTW

Developing a hydrogen risk and broking hub

Beyond building an understanding of the insurance market's approach to hydrogen, some risk intermediaries (working with all clients associated with the developing industry) have formed inter-disciplinary teams to provide client-focused risk advisory and insurance transactional solutions for this sector. The goal is to deliver intuitive hydrogen risk solutions in response to the range of regulatory, investor, consumer and operating pressures faced by the industry across the entire lifecycle.

The benefits of this are:

- Holistic project risk support through the development, construction, and operational phases of the project lifecycle
- Expert support for the contractual risk matrix and project debt financing
- Data and analytics underpinning the risk engineering solution
- Specialist sector insurance knowledge helping to achieve the lowest overall cost of risk
- Access to a connected, global network supporting the client's local interactions in all territories for this speciality industry sector

Helping to become the technology of the future

The race is on develop the hydrogen ecosystem; while the technology itself is not new, the applications of it are. Projects are exponentially increasing in size and complexity, so maximising the solutions available from the insurance industry are going to be critical for buyers to support the successful delivery and support the goal of a Net Zero society.

Risk intermediaries should be aiming to facilitate efficient and effective risk advice and innovative solutions for this industry, providing global finance with the confidence to invest in these projects which are supported by companies in all parts of the Upstream, Downstream and Renewable Energy sectors. We believe that hydrogen will be one of the answers to balancing the current geopolitical supply & demand imbalance, contributing to future-proofing a secure green electricity production sector, particularly for heavy industries with high load capacity demands.

Myles Milner is a Renewable Energy Account Director & Broker, Natural Resources, WTW London.
myles.milner@wtwco.com

Floating offshore wind: commercially viable?

Introduction

Floating offshore wind (FOW) is on the brink of exponential growth; with significant technological advances occurring in recent years, it is positioning itself as an essential third pillar of wind generation. FOW could allow access to around 80% of global offshore wind generation as projects are viable in deeper waters, whereas fixed-bottom offshore wind is limited to water depth of around 60m[1]. As we venture further offshore, the wind is typically stronger and more consistent, making it an attractive prospect.

The global opportunity for FOW is significant, with key targets including China, Japan, Norway, France, South Korea and the UK. The global pipeline is set to hit 58 GW by 2030; however, currently there is only 0.32GW in operation[2]. All projects currently in operation are either prototypes or demonstration projects, with the largest development to date being the 50MW Kincardine project off the northeast coast of Scotland.

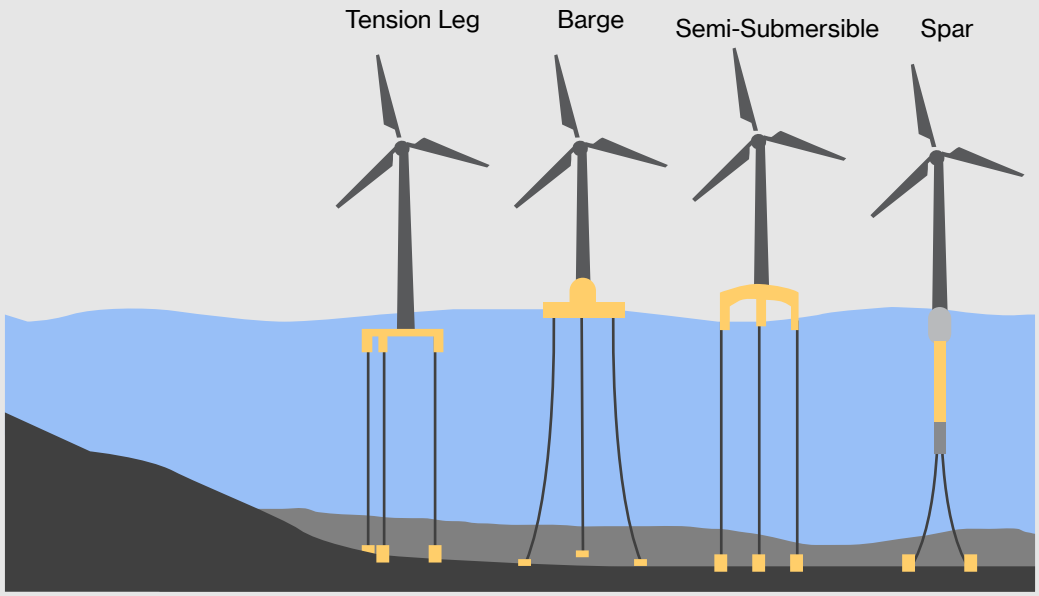
So, the question remains: will FOW become commercially viable, and will it become a competitive alternative to other energy sources?

Port infrastructure

Ports are fundamental to FOW development - they are a key part of the supply and logistics chain needed for substructure fabrication, turbine manufacture, turbine construction, storage of spares, wet storage and maintenance support. Ports will need to expand their land, reinforce quays, enhance their deep-sea harbours and carry out other civil work in order to meet offshore wind targets. There is currently no single port that has the capability to carry out all the functions required.

[1] https://www.sciencedirect.com/science/article/pii/S1364032122002258
[2] https://gwec.net/wp-content/uploads/2022/03/GWEC-Report-Floating-Offshore-Wind-A-Global-Opportunity.pdf

Figure 1: **Types of floating wind platforms**



Source: https://acteon.com/blog/floating-wind-mooring-options/

WindEurope recently reported that Europe needs to invest €6.5bn in its ports to allow delivery of planned offshore wind expansion for 2030[3]; it has been estimated it will take five years to pay back these investments, although they will assist in reducing overall FOW costs.

With many ports around the world currently not having the required infrastructure, many offshore locations are often far away from a suitable port. This makes operation and maintenance activity more difficult to perform and increases the cost and time for repairs. In contrast to fixed bottom turbines, floating wind turbines are assembled onshore or in dry dock, then towed out to sea. The tow journey is therefore extremely weather dependent, so with increased distance comes increased cost and risk.

The Port of Port-La-Nouvelle, in the south of France, is currently undergoing major expansion work. The port is ideally located for the Mediterranean FOW market; indeed, the first part of the port's expansion has been dedicated to the FOW industry. The site has been designed specifically for the construction and assembly of floating wind turbines, including a reinforced 250 m quay, a 11m water depth and 7 hectares of technical area[4]. The port will be key in the construction of two 30MW pilot projects in France, EolMed and EFGL, consisting of six V164-10.0 MW turbines.

Supporting the transition from oil and gas

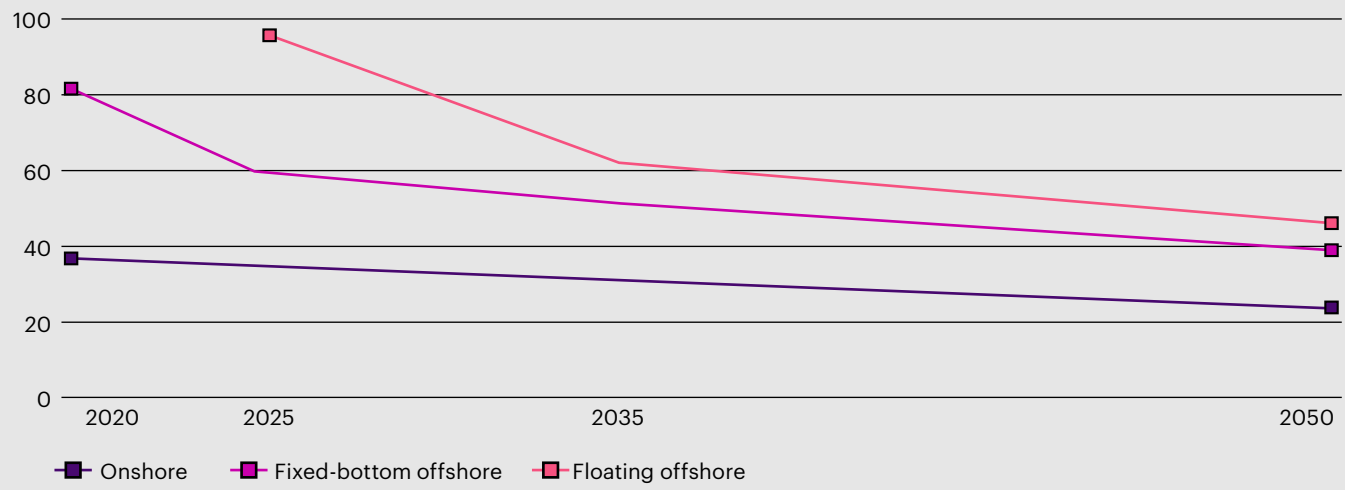
The floating wind industry can build on the experience and engineering already used in oil and gas offshore construction. There are several crossovers between the two sectors; through collaboration, technical knowledge can be transferred to aid in the development and overcome challenges. Additionally, there are similarities in the supply chain requirements of the two industries, such as transporting equipment and carrying out construction and maintenance in deep sea areas in harsh conditions. As a result, many major oil and gas players are now investing in FOW.

Cost and technology obstacles

Following successful demonstrator projects, there are still a number of challenges which need to be overcome for commercial scale projects to be successful. The evolving technologies have meant we have seen many different floating platforms and new designs continue to emerge regularly. The most successful designs include barge, semi-submersible, spar and tension-leg platforms (see Figure 1 above) which are tethered by mooring lines and anchored to the seabed. A unique challenge for FOW is taking the dynamic aspect of the platform into consideration; the mooring of the turbines to the seabed and the dynamic power cables add new layers of complexity. Currently cable losses make up a large proportion of offshore wind insurance claims, making it a key risk factor within the industry; indeed, over the course of 12 years we have seen over US$500 million of cable losses be recorded onto WTW's Renewable Energy Loss Database.

[3] https://www.windpowermonthly.com/article/1717335/windeurope-ports-need-%E2%82%AC65bn-boost-eu-offshore-wind-goal
[4] https://www.euroports.com/floating-wind-turbines-in-the-port-of-port-la-nouvelle/

Figure 2: **Levelized cost of energy in $/MWh**



Source: https://www.power-technology.com/analysis/floating-offshore-wind-prepares-to-go-commercial/

The current cost of FOW fabrication is another major challenge. The first floating wind farms have a levelized cost of energy above US$200 per megawatt hour (MWh), where-as fixed-bottom offshore wind is around US$50/MWh. However, it has been estimated the cost of floating wind could drop to below US$100/MWh by 2025 and even lower by 2050 to around US$40/MWh[5]; the main cost implications come from the extensive electrical cabling needed.

Figure 2 above shows the estimated drop in the cost of energy of FOW in comparison to fixed-bottom offshore wind and onshore.

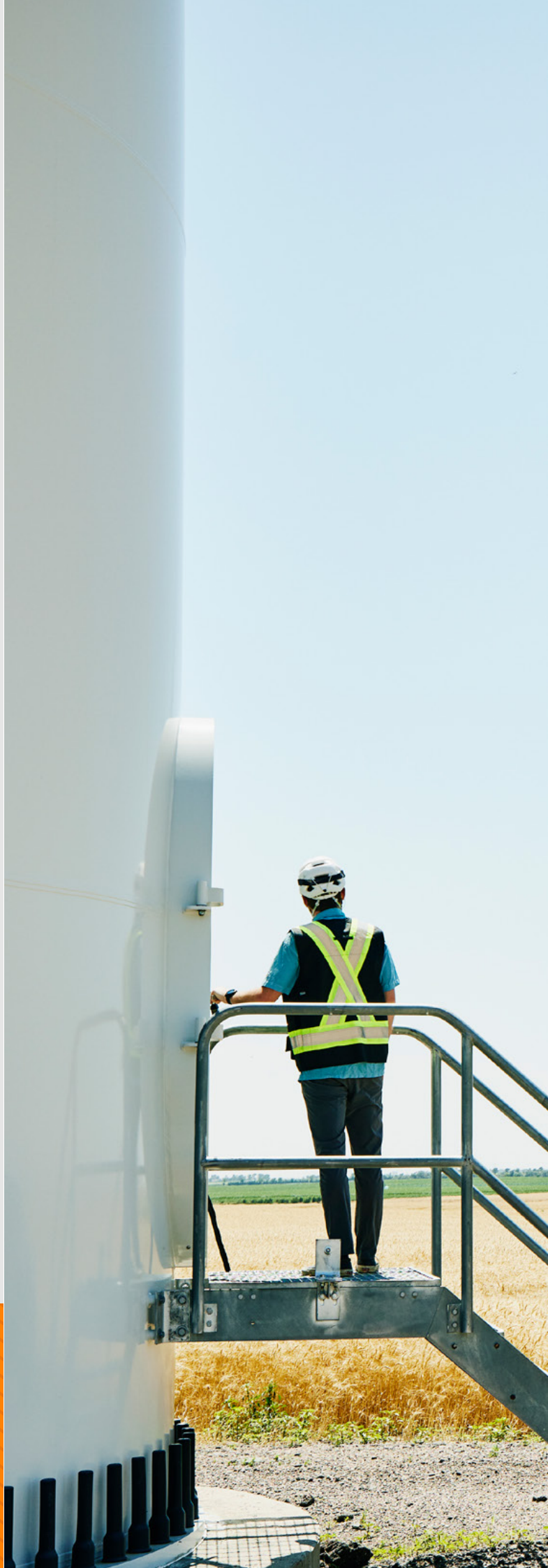
Conclusion

The FOW industry has a number of obstacles to overcome, including emerging designs, insufficient port infrastructure and the current high costs of deployment. It is essential for the industry to ensure that all possible steps have been taken, both to minimise risks and maximise the chances of successful future projects. Should the industry successfully negate these challenges, then FOW may provide a sustainable and long-term alternative to traditional fuel sources and play a major part in race to Net Zero.

Alice Sketcher is a Renewable Energy Account Executive, Natural Resources at WTW London.
alice.sketcher@wtwco.com

[5] https://acteon.com/blog/floating-wind-mooring-options/

Part Two: managing renewable industry risk



The power of data: using WTW's Renewable Energy Loss Database

Introduction

"The goal is to turn data into information, and information into insight." — Carly Fiorina, ex CEO of Hewlett-Packard

In a world of information overload, there is a real need and requirement to be able to base clear and concise decision making on accurate and relevant data.

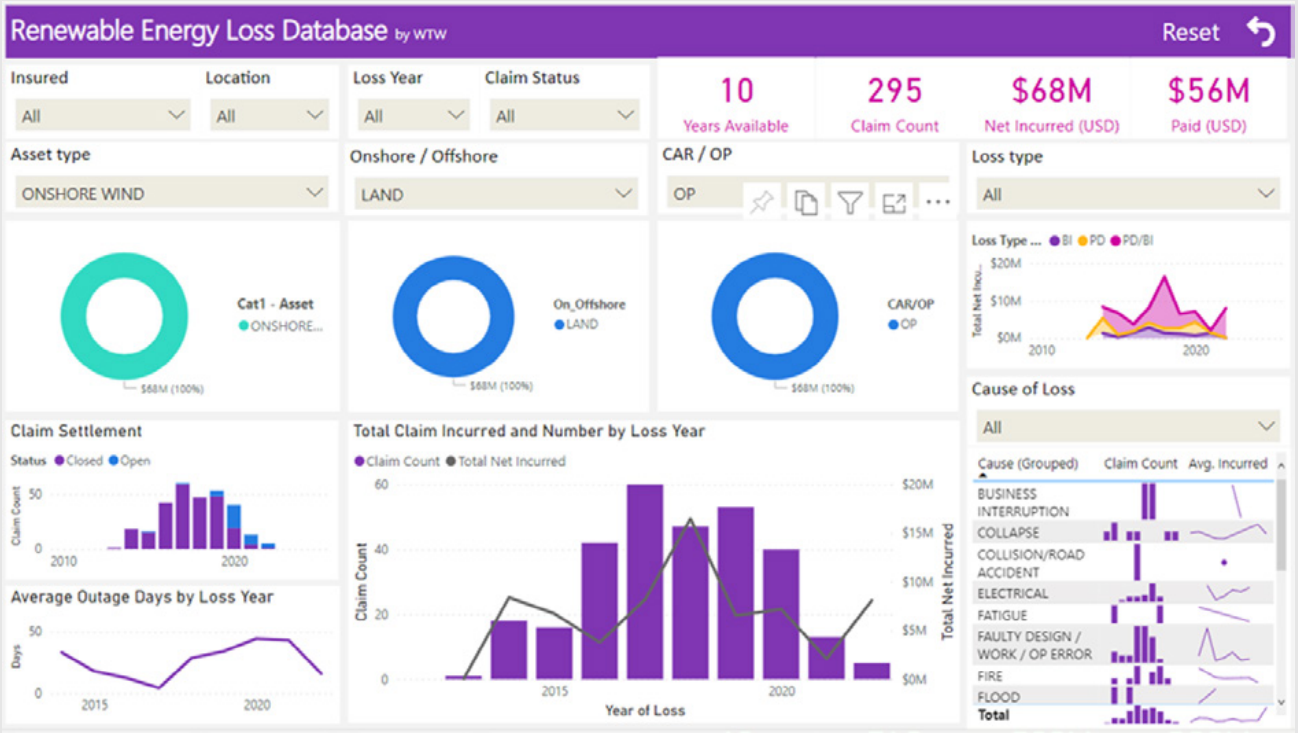
It is too easy to read reviews, check social media platforms and rely on hearsay to influence decision making processes; while this is not certainly all bad, there remains an ongoing realisation that "real" data remains one of the main drivers of business growth and development. From an insurance perspective, how does relevant data influence the buyer and the seller in the transactional process?

The renewable energy industry continues to grow at a staggering rate, as countries remain committed to delivering on their environmental promises. Risk profile and risk engineering processes provide clear and demonstrable data on which to make key business decisions, but there also remains a strong emphasis on loss trends and loss ratios when assessing and profiling a risk.

The value of claims data

Accurate and detailed claims data can provide not only a snapshot of frequency of losses, but also where, how, and why losses occur. This claims data can then be used as a key tool to help structure insurance programmes and provide meaningful insights to EML studies.

Figure 1: **Operational wind turbine losses, 2012-22 (global view, illustrative purposes only)**



Source: WTW Renewable Energy Loss Database (RELD)

For example, Figure 1 above shows operational wind turbine losses extracted from the WTW Renewable Energy Loss Database (RELD) and provides a snapshot of the scale of onshore wind losses across the insurance marketplace.

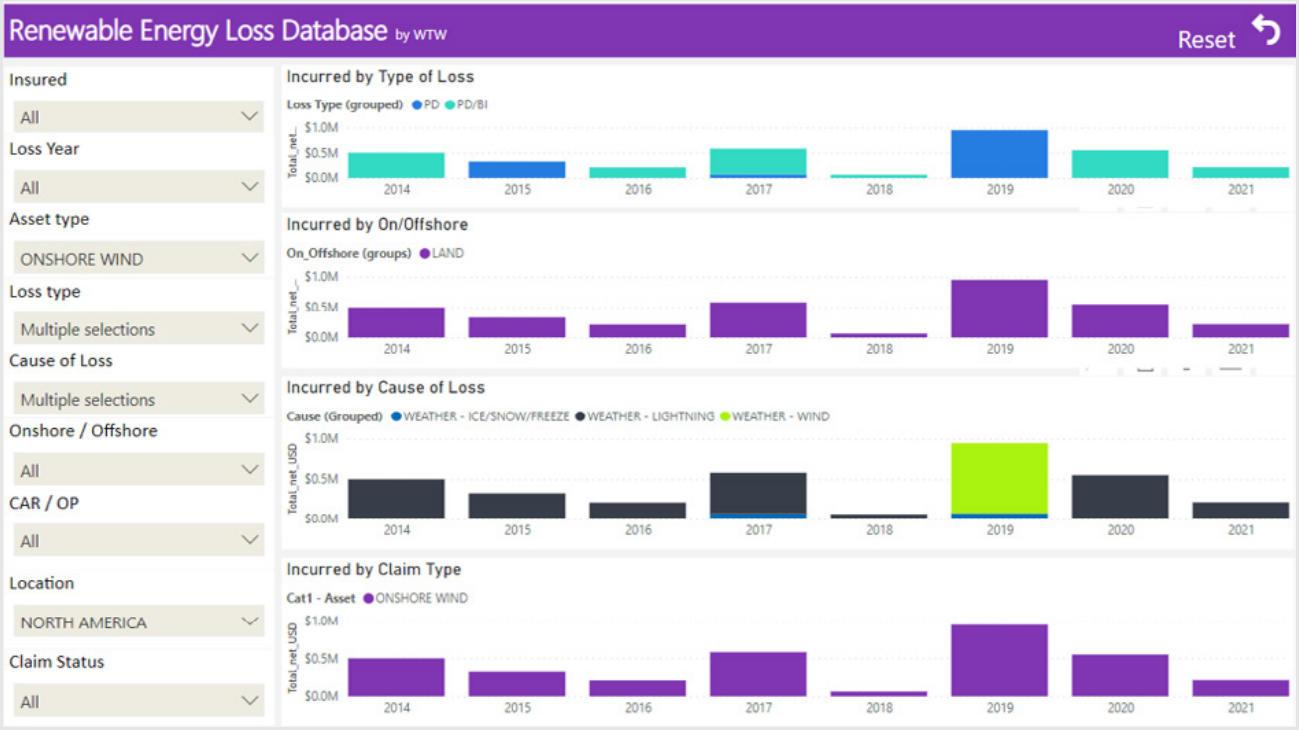
What it begins to identify are some highly informative insights into causation trends, as well as indications of downtime or outage following an insured incident. If we were to examine these claims further, we may in fact be able to identify additional contributing factors such as supply chain delays and availability of spares. Having the ability to analyse this type of data can help the business in planning for such events.

Risk mitigation

Detailed data obtained through the claims investigation and adjustment process enhances risk mitigation considerations – understanding causes of loss, implementation and/or upgrading of lightning protection systems or improving the logistical management of spare parts and consumables. Conversely, insurers may look at similar data and loss trends to determine deductible levels or to apply more restrictive cover or warranties within insurance programmes.

Similarly, identifying onshore wind losses by cause gives the ability to evaluate loss trends -irrespective of technologies. This is of particular interest when looking at Nat Cat or weather-related causes where it can be seen that, based on WTW's experience, lightning remains the dominant cause of losses in North America as per Figure 2 overleaf.

Figure 2: **Onshore wind losses by cause of loss, 2014-21 (North America view, illustrative purposes only)**



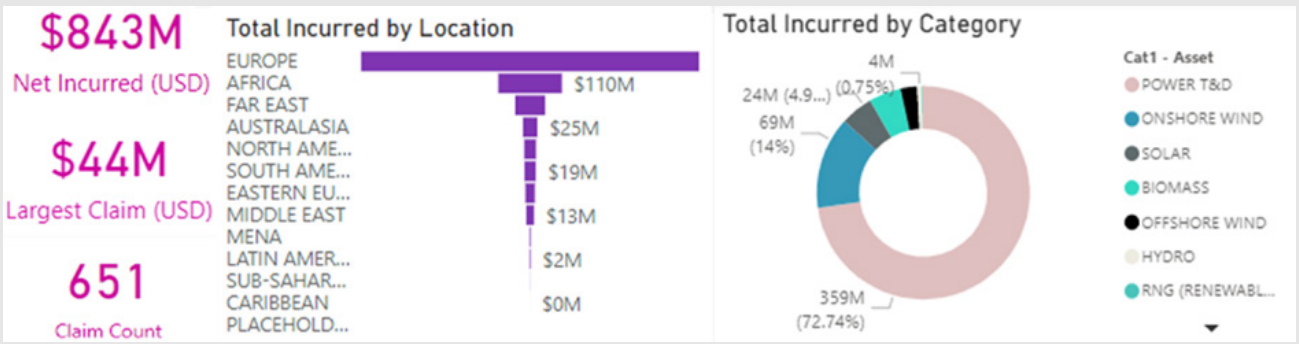
Source: WTW Renewable Energy Loss Database (RELD)

Using RELD in risk optimisation

As we have seen, RELD collates and brings impressive clarity to over US$800 million of PD/BI loss data from across the industry over the last thirteen years. A further extract from RELD is shown in Figure 3 below. The US$800 million figure includes at least US$34 million worth of fires in solar farms, US$37 million of broken wind turbines and over US$500 million of problems with power transmission and distribution.

Claims such as those outlined by RELD are unavoidable, but it's possible to control the impact they have on a business. By making informed decisions about limits and deductibles, companies can ensure that they have adequate cover and, at the same time, avoid ceding too much money to insurers.

Figure 3: **Renewable Energy Loss summary, 2012-22 (illustrative purposes only)**



Source: WTW Renewable Energy Loss Database (RELD)

The Risk Optimisation process

Through a process called Risk Optimisation, companies can make better decisions as to their risk retention and insurance strategy. The optimisation process, or the 'analytical journey', is best understood in three sequential steps: Describe, Predict and Optimise.

Progression through these steps represents increasingly valuable opportunities and decisions for clients to take. While Describe involves comparatively surface-level benchmarking and analytics based on past claims data, Optimise is deep decision-making process, based on a detailed analysis of the risks to which a company is exposed. The intermediary step, Predict, follows extensive risk modelling and is an opportunity for companies to re-evaluate tactics with regards to their current insurance strategy.

Risk Optimization case study

For illustrative purposes, consider an entirely hypothetical company, ABC Geothermal (ABC). ABC have regularly invested in their risk management function, and they've incurred a loss every other year for the last ten years. While many of these losses have been attritional, some have been rather large. As a fledgling start-up, opting to insure the full value of their assets and aiming for the lowest possible deductible was a great strategy. However, as the company matures, questions are being asked as to whether this is the wisest strategy going forward.

It's possible that, over this period, ABC's insurance structure has become sub-optimal; recognising this, ABC sets out on their analytical journey. Recall that the first step of the journey involves describing a company's current situation via benchmarks and basic analytics. ABC might pose themselves questions such as:

1. How much has the company paid in the past and claimed back?
2. How much does an insurance programme (such as the company's peers' programmes) cost?
3. What level of insurance cover are similar companies buying?

Questions like these are reactive, and often asked in response to large claims or bad loss years. Answers to these questions will provide ABC with a first indication of the need for deeper analysis.

Looking into the future

Having determined the scope of their analytical journey, ABC decides to move on to the second step. Working with the brokers, actuaries make use of historical data to predict how the coming years could look under the current insurance strategy. Figure 4 to the right gives ABC an indication of their losses in typical, bad and catastrophic years. Rare events such as those highlighted below are more frequent than most people imagine - it's all to do with perspective. Take the lottery as an example; the chances of winning are incredibly low, but there's still a winner every other week! A highly unlikely event will happen, given enough chances or a long enough period of time.

Figure 4: **Predictive forecasts in typical, bad and catastrophic years (illustrative purposes only)**

Amount in $ million

Return Period (Years)	Percentile	Gross Losses
1 in 2	50.0%	5.5
1 in 5	80.0%	12.0
1 in 10	90.0%	19.1
1 in 20	95.0%	32.1
1 in 100	99.0%	125.8
1 in 200	99.5%	218.9
1 in 1000	99.9%	747.3
	Mean	11.9
	Std Dev	40.4

Source: WTW

Due to the global nature of insurance, something somewhere is guaranteed to go seriously wrong every year. So, what does this mean for ABC, given the renewable energy industry's diversified nature, with hundreds of players spread across the globe?

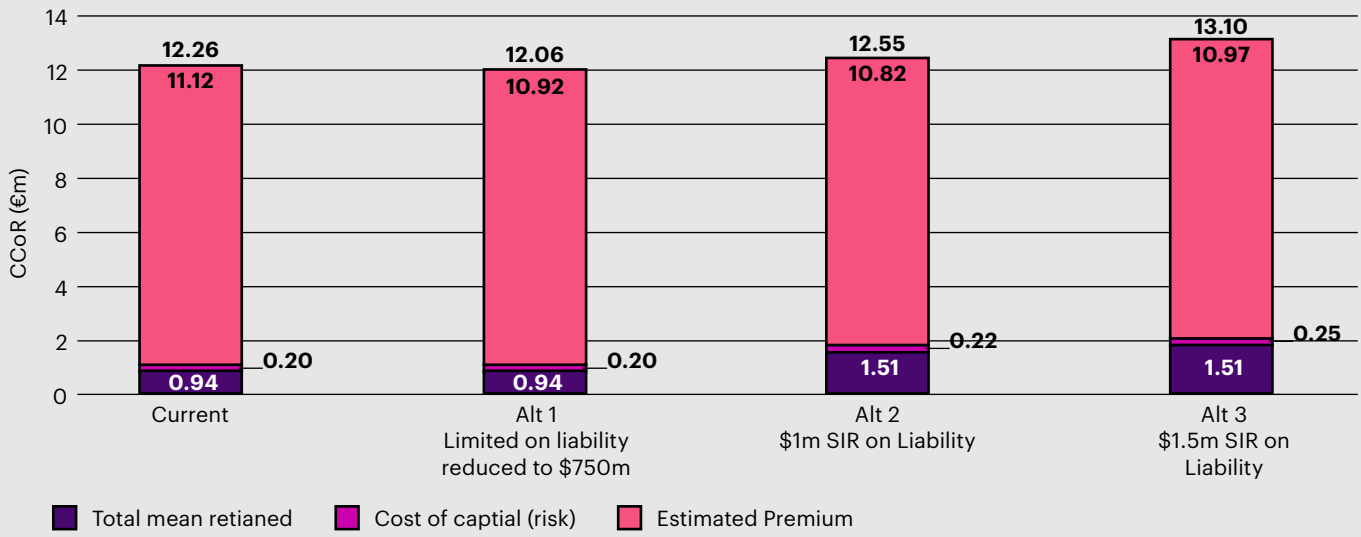
A '1-in-200' event can be thought of as the sort of catastrophe that is seen on the news (i.e. not directly affecting the viewer) every other year or so, involving maybe a widespread forest fire or a bad hurricane. Highlighted in green in Figure 4 above are the projected losses if such an event were to impact ABC. If this is compared to the 1-in-1000 chance loss, the worst-case scenario, such a loss is vanishingly rare - as likely to occur as a "generation-defining event" such as Chernobyl or COVID-19.

Leveraging the insights

Knowing what their organisation's specific odds are, ABC can leverage these insights to make sure their risk transfer is appropriate, maximising the value they get from it and protecting the company from external shocks. They will know whether they ought to lower their retention, whether they can lower their limit, how likely they are to exceed it and, ultimately, whether or not they're paying too much for their current policy.

> **Due to the global nature of insurance, something somewhere is guaranteed to go seriously wrong every year.**

Figure 5: **leveraging the insights by comparing overall costs of risk (illustrative purposes only)**



Source: WTW

The "Efficient Frontier"

Finally, we come to optimisation: maximising the gain across ABC's risk portfolio. Here, we can take advantage of the insurance market's slightly disjointed nature; the cost of risk is variable from one line of business to the next, which leaves scope for arbitrage. If a company is willing to look at their portfolio in a holistic way, then they can take on risk where it's expensive and give it up where it's cheap.

A risk optimisation piece can be conducted across all lines of business. The approach at WTW, for example, is via the Connected Risk Intelligence tool. In broad terms, CRI plots up-to-date insurance strategies across industries.

An example graph is showcased in Figure 6 below, with the cost of the strategy along the horizontal axis and the remaining risk along the vertical. Ideally, ABC wants to move from deep within the data cloud to take their place on the so-called 'Efficient Frontier', highlighted in green. Portfolios on the frontier are optimal in that they offer the best possible cost-to-risk ratio. Increasingly, risk intermediaries are successfully pushing clients in the wider Natural Resources industry towards it, enabling significant reductions in cost of risk.

Figure 6: **establishing the Efficient Frontier (illustrative purposes only)**

Source: WTW

Using RELD in analysing inverter losses

Preventing inverter claims

An inverter is one of the most important electrical components in a renewable power generation plant, converting the raw electricity generated from the system from DC (Direct Current) to AC (Alternating Current). This enables an efficient transmission and distribution flow through the electrical grid system to the end consumer use.

So what are the common problems that arise from inverters? Through our claims incident Type and Frequency tracking for our claims in the Renewable Energy industry, we have experienced a noticeable increase in the frequency of loss incidents involving inverters, which has been corroborated by our discussions with Renewable Energy loss adjusters and insurers. There is a general consensus that the number of incidents appear to have increased over the last few years; but given that this is essentially a basic, commonly used piece of equipment for all wind and solar renewable energy installations, why is this happening and how can future losses be prevented?

The key areas of focus are:

- Common issues
- The use of RELD
- Prevention techniques

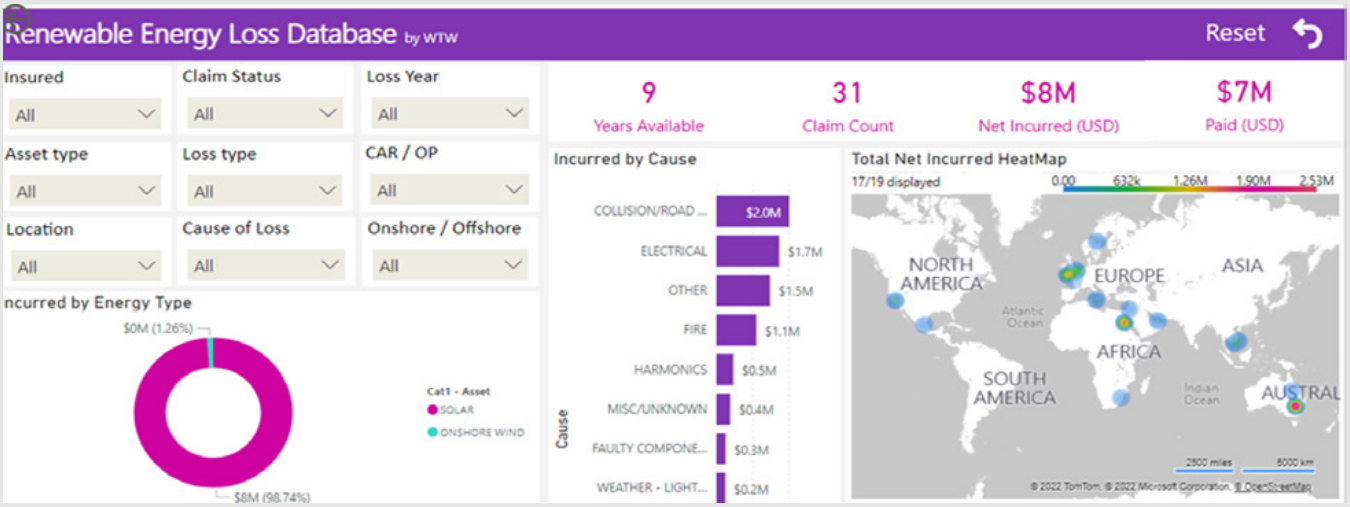
Common inverter issues

The most frequent and well recorded issues which appear to be causing claim incidents for inverters relates to fires. The foremost and most likely reason for this is faulty and defective original components, or component degradation and breakdown within a few years of installation which then short circuits the electrical system, inducing a fire which consumes the inverter unit and potentially its surrounding property. IGBTs (insulated-gate bipolar transistors) are the dominant concern when it comes to components; these are the core power modules that ensures that the voltage is switched from AC to DC. Within the inverter there is a bank of these IGBTs and they are considered the functioning 'heart' of the inverter system. This means that when this component fails, there needs to be significant mitigation techniques to be applied.

Another key concern is that of workmanship error. While the individual components may have their own performance problems, the competence of the individual who assembled the inverter is equally important. Inverters are assembled and constructed in full form when shipped to the consumer, meaning that the inverters should leave the manufacturer's factory as complete and closed units. On arrival as the construction site, the inverter unit only needs to be physically installed with the switchgear, then tested & commissioned into the facility.

This installation is always performed by qualified electricians - frequently by the inverter manufacturer's own workforce - as it is accepted that any defective workmanship can cause electrical arcing, which will result in a fire. The installation of any inverter unit(s) will come with a detailed installation handbook, making it easy for any qualified electrician to install. The responsible lead electrician may be communicating to his team with varying experience or different languages; even a minor deviation to the installation guidelines, such as errors in nuts being over or under tightened, or the correct level of slack not being followed, would go against O&M advice. This signifies the importance of ensuring that appropriate and competent personnel are hired to fit their equipment. If possible, companies should ensure that the inverter unit manufacturer is overseeing all elements of installation and testing.

Figure 7: **WTW inverter losses, 2012-22**



Source: WTW

Using RELD

So how can RELD data can be utilised in a focused way for our clients in managing their inverter risk? Figure 7 above shows all WTW's recorded claims for inverters, which total US$8 million, 98% of which emanate from solar assets.

When the data is interrogated and discussed further with our in-house Renewable Energy Risk Engineers, it becomes clear that one reason for failure incidents is that solar assets are being placed into areas where the climate is hot, causing the inverters to overheat. Furthermore, a number of incidents extracted from our database involved a faulty thermostat that may have caused the inverter to overheat. Additionally, the opening and closing mechanism on the ventilation shafts were found to be getting clogged with dirt and grease, causing them to not function properly. This prompted us to discuss with our clients the extension of the inverter O&M process to include the inspection of thermostats and regular cleaning of the mechanical ventilation. This would create a simple, inexpensive solution to total loss by overheating and fire, with the associated downtime of a long-lead item. Out of the 23 claims we have logged, 11 of them have caused, or been caused by, a fire within the inverter. As can be seen in Figure 7 above, Australia has the greatest frequency, which aligns with market sentiment.

Fire prevention approach

Referring back to mitigation techniques, a fire prevention approach must be considered by companies to avoid increased damage to the assets where fire propagation may occur. This can turn a relatively small claim into a complex one, caused by a domino effect through stacking inverters together in a single electrical switch room. This leads on to why automatic fire suppression is so crucial, as not only does it quickly detect and suppress fires, but it also has the ability to trip the inverter offline before the fire can spread to the balance of the assets.

Contractors also need to take additional measures to combat fire, particularly within solar parks where the best fire mitigation results from an early detection and speed of response. Because of the shortage of reliable data, the solar industry potentially underestimates the risk of fire to and from both the inverter and the solar farm as a whole. However, with the introduction of RELD we believe this data gap can now be closed and the risks for both buyers and insurers minimised.

Conclusion: the value of data

Ultimately, having access to clear and concise claims data can help to influence business decisions around technology, suppliers, and design. It can also help shape the discussions around the structure of insurance programmes, the level of cover and the ability to challenge terms offered by insurers.

Of course, it is well understood that for any meaningful statistical output, the key driver has to be accurate input, based on determined parameters. For example, in RELD collating financials net of deductibles gives a more accurate picture when assessing loss ratios; identifying premium spend compared to incurred losses or categorising causes helps to identify trends.

However, perhaps just as importantly, access to and availability of detailed claims data allows a buyer to look beyond their own experience into the wider industry sector and see the bigger picture. To paraphrase the American statistician W. Edwards Deming, it is generally recognised that the ultimate purpose of collecting the data is to provide a basis for action or a recommendation.

Collection and collation of data is therefore just the start of a process – a process that ultimately can shape insights, strategies and decisions.

Chris Ling is Head of Renewables Claims, Natural Resources, WTW London.
chris.ling@wtwco.com

Felix Rennie is Associate Director, Risk &Analytics, WTW London.
felix.rennie@wtwco.com

Brooke Beales is Account Executive, Renewable Energy, Natural Resources, WTW London.
brooke.beales@wtwco.com

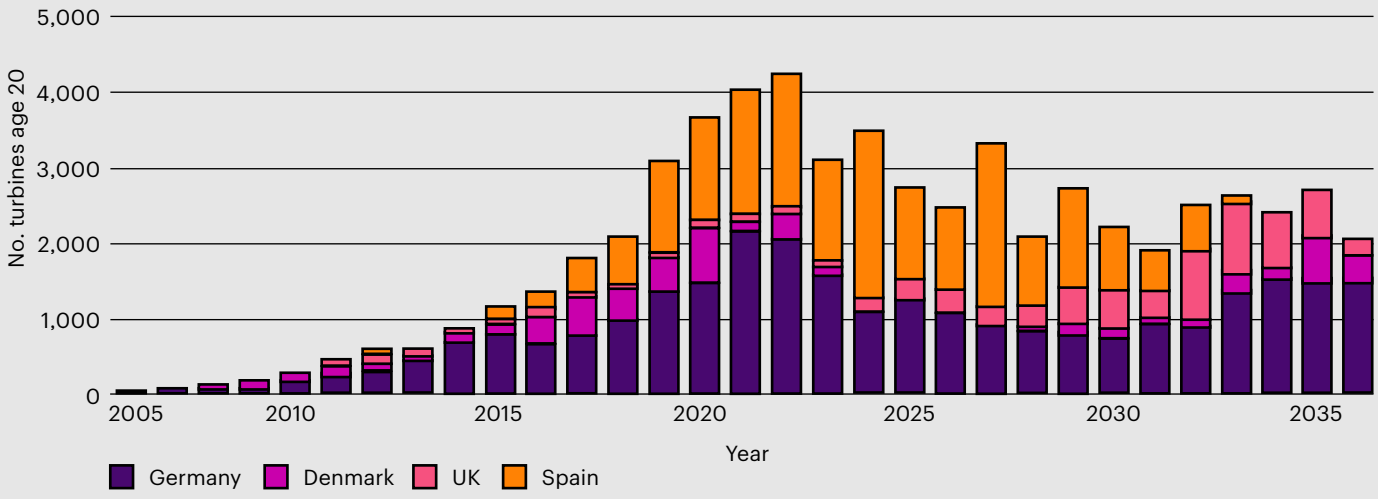
Wind power: extending beyond the design life

Introduction

As wind farms age, owners need to make decisions regarding either the extension of the operational life of its plants or their complete decommissioning and repowering. In addition to the commercial factors affecting these decisions, technical aspects must also be considered to ascertain the risk associated with the prolonged operation of an aging fleet.

Assuming a typical design life of 20 years, it is expected that 86 GW of wind generation capacity will be decommissioned across Europe by 2030 if operational lives are not extended[1].

Figure 1: **Number of onshore wind turbines reaching 20-years of operation annually in Denmark, Germany, Spain and the UK**



Source: L. Ziegler, E. Gonzalez, T. Rubert, U. Smolka and J. J. Melero,"Lifetime extension of onshore wind turbines: A review covering Germany, Spain, Denmark, and the UK," Renewable and Sustainable Energy Reviews,vol. 82, no. 1, pp. 1261-1271, 2018. https://www.sciencedirect.com/science/article/pii/S1364032117313503

[1] By Paul Dvorak, September 29, 2017, "An Owner's guide to wind turbine life extension", 10th Annual Wind O&M Europe 2018 Conference https://www.windpowerengineering.com/owners-guide-wind-turbine-lifetime-extensions/

Commercial considerations

While repowering wind farms using novel technologies offers higher energy yields and financial revenues, the increasing cost of capital, difficulties in securing a land lease, planning permissions, grid licenses and a drop in the level of subsidy available to Onshore/Offshore projects all encourage owners to consider extending the operational life of their existing fleet.

One immediate benefit of extending the operational life is the reduction in levelized cost of energy (LCOE) and an increase in revenue over the plant's lifetime; however, the life cycle cost remains approximately unchanged, with some variation in the operational expenditure (OPEX). This assumes that no major part of the plant requires replacement, and only minor refurbishments and maintenance are necessary.

The average cost of extending the operational life of an Onshore Wind farm is approximately 100 KEUR/MW, whereas the cost of repowering is approximately 1 MEUR/MW.

Technical considerations

Conventional commercial wind turbines are typically designed and certified for 20 years of operation; these specifications include those for major structural components of the turbine such as blades, towers, foundations, yaw rings, pitch bearings and drive train components.

Typically, the structural components of turbines are subjected to cyclic fatigue loads; the reliability and failure probability of such components therefore increases as the turbine approaches the end of its design life. For instance, rotating bearings in turbines are designed based on 90% reliability, implying that the probability of bearing failure before the end of the designated 20-year design life is 10%[2]. Moreover, the blade exterior (including leading edges) requires ongoing and thorough life maintenance. However, the structural elements are designed to last for the intended design life (i.e. 20 years).

Towers are designed based on class loads on Onshore Wind turbines. However, Offshore Wind towers are designed based on the design of the offshore foundation and site-specific metocean loads, as well as according to an iterative process executed by the foundation designer and turbine original equipment manufacturer (OEM).

Onshore turbines can have gravity or pile-based foundations. Furthermore, they are normally designed based on the interpretation of the climatic class loads on the tower bottom and according to the EUROCODE design standard.

Offshore foundations are often monopile or jacket types, designed in conjunction with the turbine tower using site specific metocean loads. It is expected that a lesser degree of conservatism is considered in the design of the offshore foundation in compared to older onshore foundations, due to accounting for site-specific loading in the design process.

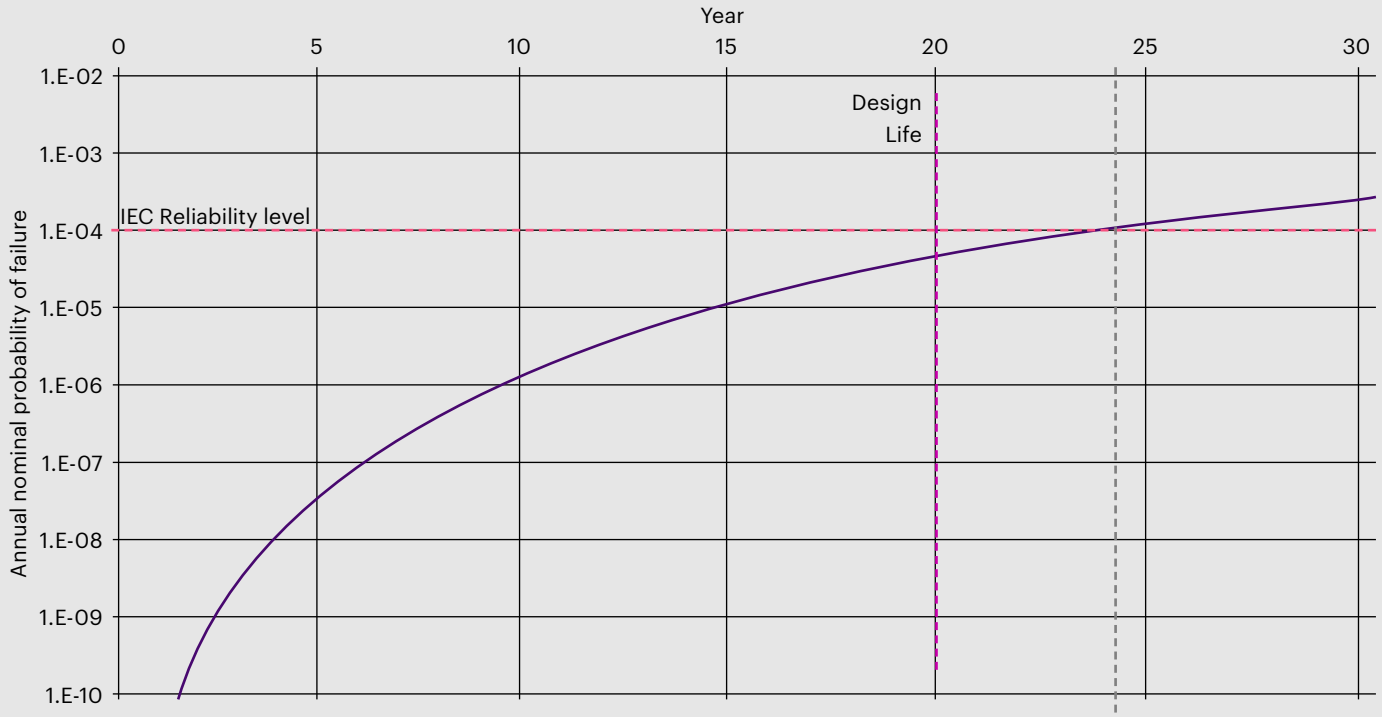
Potential to extend Operational life

The reliability target for operation of the wind turbine is nominal annual probability of fatigue failure of one in ten thousand (10^{-4}) according to IEC 61400-1 standard, based on which the turbines are certified, and partial safety factors are applied to both class loads and material strengths in the design of turbine components. This often introduces an element of conservatism in designing the structural components and rotor nacelle assemblies (RNAs).

> **It is expected that a lesser degree of conservatism is considered in the design of the offshore foundation in compared to older onshore foundations.**

[2] John Coultate, Mike Hornemann, December 2017, "Why wind -Turbine gearboxes fail to hit the 20 – year mark", WindPower Engineering & Development https://www.windpowerengineering.com/wind-turbine-gearboxes-fail-hit-20-year-mark/

Figure 2: **Failure rate curve of a typical wind turbine**



Source: Wind Energy Ireland, " Wind Energy Ireland Guide to Wind Turbine Lifetime Extension", October 2021 https://windenergyireland.com/all-documents?s_files_title=Wind%20Energy%20Ireland%20Guide%20to%20Wind%20Turbine%20Lifetime%20Extension

Typically, uncertainties in wind conditions can be relatively large, particularly owing to seasonal variations, storms and changing terrain conditions over the life of a turbine. Furthermore, the instability of power grids in locations such as Ireland can introduce variability in power production and reduce the load factor of the operating fleet.

The combined effects of conservatism in the original design of turbines, uncertainty in site-specific weather conditions, and variability in the power grid can facilitate wind turbines to operate beyond their certified design life. In other words, the design life of the turbine may not be fully consumed within 20 years of operation.

The design life of a turbine can be reassessed using the actual operational data obtained from the turbine supervisory control and data acquisition (SCADA) system. Correspondingly, fatigue analysis can be performed using 10 min average SCADA data to determine the remaining useful life (RUL) of the turbine.

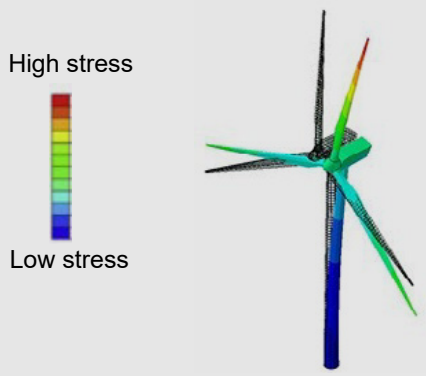
Notably, methods used to conduct life assessments of wind turbine design have been well documented. However, only limited codes and standards are available for assessing the life extension potential of operational wind farms. The two primary documented guidelines are the DNVGL-SE-0263 "Certification of lifetime extension of wind turbines" and the UL4143 "Standard for Safety Wind Turbine Generator–Lifetime Extension (LTE)."

DNV GL-SE-0263 considers the following four primary methods for extending the life of wind turbines: in-service inspections, together with simplified, detailed, and probabilistic analytical assessments. Notably, the choice of the assessment method often depends on the availability of original design information. A simplified approach is normally selected when wind farm design documentation and calculations are unavailable, which is often the case for old wind farms, for which copies of as-built documentation are not digitally stored or are missing owing to repeated changes in ownership.

As displayed in Figure 3 overleaf, the simplified approach uses a generic aero-elastic model of a wind turbine to estimate the RUL, using IEC 61400 generic class loads. However, detailed methods require access to the original design documentation to perform the corresponding assessment. Unlike simplified and detailed methods that use load calculations to assess the structural integrity of a turbine, the probabilistic method uses stochastic models that determine the failure probabilities of different components[3].

[3] Chandran, Aneesh & Dettmer, Ronald & Gilmour, Nicholas & Harper, Daniel. (2021). Wind farm life extension: A review of economic, social, technical and safety factors. https://www.researchgate.net/publication/355164408_Wind_farm_life_extension_A_review_of_economic_social_technical_and_safety_factors/link/6161bfc9ae47db4e57b3a440/download

Figure 3: **Wind turbine Aero-Elastic model**



Source: WindForS, Windenergie Forschungscluster

After the foregoing assessment, certification is issued to projects for an extended operation period. However, the validity of this certificate is limited to the extended lifetime during which the turbines may require regular inspection, and the corresponding report is sent to the certification body.

The IEC 61400-28 "Wind Energy generation system – through life management and life extension of wind power assets" is currently being developed by the International Electrotechnical Commission. IEC 61400-28 is expected to introduce more relaxed reliability requirements for operation beyond the design life.

Regulatory requirements

Apart from the general safety regulation and machinery directive for extending wind turbine operations beyond their design life, no specific regulations exist in Spain or the UK. This is because the concept of life extension is relatively new, and this subject is yet to mature and develop in these countries.

The UK is expected to introduce its legislation in the future, owing to an increasing number of turbines approaching the end of their design life. However, this is not the case for Denmark and Germany, wherein the average age of the turbine fleets is older than in the UK and Spain. In Germany, DNVGL-SE-0263 is followed for operational life extension and is regulated by the German Institute for Construction Technology (DIBt). The standard entails analytical and practical assessments of all components at the end of the design life.

The regulation for the extension of life in Denmark is mandated under Executive Order 73, which includes requirements for inspecting both blades and structural components at the end of the design life, which are repeated annually.

Interface considerations

Other factors that require consideration before making decisions regarding the operation of wind turbines beyond their certified design life include the park control system and SCADA infrastructure.

Notably, wind turbines are connected machines, requiring reliable communication with local and remote external servers for safe operation. Moreover, the turbine controller and SCADA infrastructure require constant updating or upgrading to avoid the risk of cyber-attacks. Older turbines and wind farms are often not designed to withstand cyber-attacks, and they may not comply with the IEC/ISO 62443 standard for the security and safety of industrial automation. For that reason, upgrading SCADA systems on older wind farms is paramount in minimizing cyber risk exposure and vulnerability to new attacks.

Notably, the balance of plant electrical systems, such as main transformers for transmission network connected projects, array cables, HV substation and protection, are considered critical parts of any wind farm, being crucial in ensuring that power can be exported to the grid. The power industry has extensive experience in extending the life of electrical assets and power transformers in thermal and other conventional power plants which can be applicable to the windfarms. Asset aging plans therefore need to be developed, which consider a series of integrity tests and inspections to ascertain the operational life while ensuring compliance with new grid regulations imposed on power generators.

The covenants and conditions set out in the lease of land agreements, together with planning documents from local authorities, are other important aspects to be considered. Typically, access or emergency roads to the plant may not remain viable during the extended operational period, resulting in operational difficulties in the upcoming years. Additionally, development on neighbouring lands may require plants to comply with unforeseen safety, operational and environmental requirements.

Risk considerations

Whilst the revenue through the subsidy scheme is expected to be curtailed or terminated during the extended operation, it may not necessarily result in lower Business Interruption values because the lead time for replacing the main components (such as rotor and blade bearings) can be longer, owing to obsolescence, lack of spares or smaller supply chains.

The turbine-type certificate no longer remains valid for operations beyond turbines' design life. The requirements from regulatory bodies, lender or insurers may include conditions for the turbines to be type certified. The certification of extended operation based on a recognized industry guideline (for example, IEC 61400-28) is crucial in assuring the reliable operation of the turbine until the type certificate expires.

Likewise, the third-party requirements may involve an obligation for thorough and frequent inspection of the key structural components. This may not be in line with the ambitions of the owner to reduce the OPEX and the cost of maintenance during the extended operational period and the final years before decommissioning.

Conclusion: strengthening standardization and regulation

The current Net Zero targets in many European countries and increases in spot market prices are having a positive effect on the economic viability of the extension of windfarm lifetimes. On a global scale, it is expected that around 180 GW of installed wind energy will reach the end of design life within the next decades[4]. While a strong regularity regime for extending the operational life does not exist, the industry is expected to strengthen the standardization and regulation for the operation of aging assets, in line with the formal release of IEC 61400-24.

Babak Nejad is Risk Control Consultant – Renewables, WTW.
babak.eftekharnejad@wtwco.com

[4] https://iopscience.iop.org/article/10.1088/1742-6596/1222/1/012033

BESS: key risk factors

As the energy crisis continues and the world transitions to a carbon-neutral future, Battery Energy Storage Systems (BESS) will play an increasingly important role. BESS can optimise wind & solar generation, whilst enhancing the grid's capacity to deal with surges in energy demand. BESS are able to store excess energy in periods of low demand and can be discharged into the grid during periods of high demand. Operators are able to receive a higher price per Megawatt hour for their stored energy; this provides financial incentives for meeting surging energisation needs. Combined with the continued fall in Lithium-ion prices over the last decade, this has made BESS an increasingly attractive sector.

So what's the catch? Lithium-ion batteries are seen to be combustible and hazardous. There have been a number of high-profile BESS insurance claims in recent years, so insurers require projects to demonstrate first class risk mitigation and planning.

Thermal runaway & site layout

When insurers are reviewing a BESS project, their primary concern is thermal runaway. Thermal runaway is an uncontrolled exothermic reaction that raises cell temperature and can propagate between cells, occurring when a cell achieves elevated temperatures. Thermal runaway can occur due to mechanical and electrical breakdown, thermal failure, internal/external short circuiting, or electrochemical abuse, leading to a fire.

During the design and planning phase, the project's layout of the battery containers is of crucial importance; insurers would like as much space as possible between battery containers, with a minimum of 4.5 metre spacing. If a project site is constrained by the available space between containers, suitable fire walls between them can help to prevent propagation.

If a project's thermal runaway exposure is not effectively managed, insurers could impose thermal runaway or fire sub limits, higher premium ratings and increased deductibles.

Probable Maximum Loss

Probable Maximum Loss (PML) is an insurer's risk analysis of a project's 'worst case' loss scenario. For BESS projects, the PML is likely to be a thermal runaway event that causes the total loss of one or more battery containers. The PML could be calculated as follows:

- **Loss Scenario 1:** a project has 4 containers with a value of £1,000,000 each. There is less than 1.5 metre spacing between containers, and no fire walls installed. Insurers could foresee in their risk analysis that with inadequate spacing, fire would spread to all 4 containers and would result in a total loss of all 4 containers, valued at £4,000,000.
- **Loss Scenario 2:** a project has 4 containers with a value of £1,000,000 each, spaced 4.5 metres apart. Underwriters could take the view that only one container will be lost if there is a thermal runaway event, as the spacing adequately addresses the chances of fire propagation between containers. The PML is therefore limited to the 1 container valued at £1,000,000.

The lower the PML that insurers think a project has, the more favourable the of terms of coverage available. Early engagement on the project layout is highly recommended, so that developers can be advised on the best separation measures for their site design.

Industry standard: UL9540a

Insurers will always ask for proof that the manufacturers batteries have undergone successful UL9540a testing - the UL9540a is a test method for evaluating thermal runaway fire propagation in BESS. The batteries are tested on how capable their fire suppression technologies are at preventing thermal runaway from spreading. The UL9540a is not a type certification that are typical of wind turbines; however, successful testing demonstrates that the batteries meet the current industry safety standards.

Battery Management System (BMS)

Insurers will review the Battery Management System's ability to identify, control, and eliminate potential risk scenarios. Battery Management Systems should have:

- Recording, monitoring, and analysing of the battery's recharging/discharging rate, to prevent over-charge/discharge - this helps identify abnormal battery conditions and maintain optimum battery health
- Fire detection systems which are industry standard certified, such as NFPA855 or equivalent
- Effective suppression systems that can isolate cells when critical imbalances have been identified, cutting the flow of electrons or ions from the affected cells
- Remote offsite monitoring, allowing for 24/7 surveillance of the site
- Cyber security

Container design

Gases being given off by battery cells are an early indicator that a thermal runaway event is occurring, so early detection of gases is critical before a build-up can become volatile. In conjunction with the BMS, the containers should have some of the following characteristics:

- Sensitive monitoring and sensor systems which can detect gases such as methane and hydrogen
- Ventilation systems which are able to remove flammable gas to prevent a build-up which could result in explosion
- Temperature and moisture management systems which can maintain the optimum conditions for the batteries

Fire response

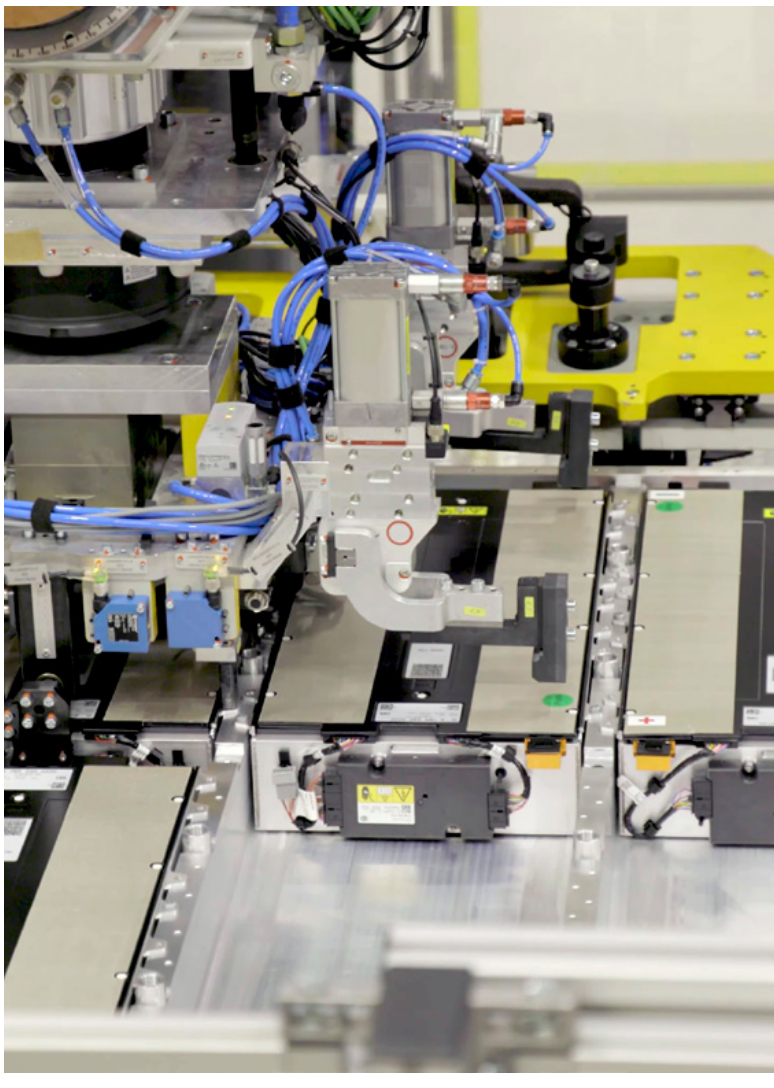
Emergency response planning should be undertaken in collaboration with local fire services. Insurers will ask for a detailed fire response plan and confirmation that the local fire department is trained to deal with electro-chemical fires, as well as having planned a means of response.

Fire crews may look to contain a thermal runaway event rather than extinguishing it. If a thermal runaway event has occurred, the batteries could be heating up at 100s of degrees a minute. Fire fighters will look to cool the areas around the battery in containment measures, aiming to reduce the radiant heat. The containment measure will allow the battery to burn itself out but not spread to adjacent containers. It can take several days for the batteries to cool and be fully extinguished, so it's important that the site has sufficient access to water sources.

Conclusion

The continued development of BESS will be at the centre stage of a clean and secure energy future. Providing effective risk solutions will go hand in hand with the future development of this sector. Although there are risks and hazards involved, early engagement and thorough planning can mitigate the risks and help maximise the BESS potential.

Chris Ketley is a Renewable Energy Account Executive & Broker, Natural Resources, WTW London.
chris.ketley@wtwco.com



OEMs: technology, risk and insurance

Introduction

Over the past few years there has been increasing scrutiny in the market for the performance of the Original Equipment Manufacturers (OEMs) in the wind industry. The technology has scaled up vastly over the past few years; but now that wind turbines are bigger than ever, does bigger actually mean better? In fact, the wind industry has faced several challenges due to design and workmanship issues with OEMs. With the need for global upscaling in clean energy availability post-COP27, are these issues really in the past, or are they likely to remain going forward?

In this article we will explore what the major challenges have been with OEMs over the past few years, what has been the done to rectify the issues and to what extent they can be successfully alleviated.

Lightning Protection Systems (LPS)

There has been concern in the renewable energy industry over the adequacy of the design of the lightning protection system for the Vestas V110, V126, V136 and V164, and it is understood that this is reflected in the insurance industry. These models utilise Vestas' LPS2, which features a single down conductor placed into the blade to divert lightning attachment. There is a view in the market that the current design lacks adequate equipotential bonding along the blade length, with several large-scale lightning damage claims across the fleet. The insurance market took a hard stance in insisting that the LPS2 was not effective - as such, any lightning damage would not be "sudden and unforeseen" and has therefore excluded coverage for lightning damage for any turbines utilising LPS2 where Vestas has not completed a review and a retrofit.

While Vestas has not formally accepted any LPS2 inefficiency, they have listened to both the renewable energy and insurance industry and worked on a solution to retrofit a second down conductor in the blades which the market accepts, which it hopes will address the issue. Vestas has been in discussion with DNV-GL to update the type certification and also to seek full verification for the retrofit. Vestas has also brought out an updated Optimised Lightning Protection System (OLPS) on their new fleet which insurers are finding acceptable. There remains a challenge that in the event of a damage to a retro-blade requiring replacement, all three blades on the turbine will need to be replaced. This is due to the need to balance the blades; it is likely that the replacement blade will utilise OLPS rather than the retrofitted LPS 2 due to Vestas taking them out of production.

Locking pins

The hub locking pins are a critical link in the safety chain when performing turbine erection and maintenance tasks; when engaged, the three pins provide a positive lock and are designed to prevent the rotor from turning. It is essential that before the rotor is put back into operation, or allowed to turn, the operator ensures that all three pins have been fully disengaged. Allowing the rotor to turn or operating the rotor turning gear when a pin is engaged can cause catastrophic damage to the rotor, drive train, nacelle and potentially other components. Several instances within the industry have been recorded recently, where turbines have suffered significant damage resulting from rotors pins being partially engaged during turning gear operations.

The response from the insurance market was to look to exclude coverage for contractor negligence within owner-controlled insurance policies. The way they would do this would be by excluding coverage for breaches of Good Industry Practice, as defined within EPC and/or TSA contracts.

In order to avoid further issues, Vestas has simplified their design. The new platform, EnVentus, has only two rotor locking pins, whereas the older platform has three (V150 and V136). The status/position of the EnVentus rotor lock pins are much easier to visually detect than on V150 & V136; transparent inspection "windows" have been introduced in the front cover of the nacelle, through which the position of the rotor lock can be seen. These mitigants have been viewed as positives by leaders in the insurance market, with many believing the locking pin issues to be an issue of the past.

Edgewise Vibration (EV)

EV is edgewise or chord wise movement of the blade where it's designed to move and flex in a shell wise direction. EV affects all blades and is an operational force that should be accounted for during design, but Vestas controls their blades by pitch control instead of adding more weight in the blade. When the turbines are switched off, it means that there is no power which in turn means that there is no pitch control; this has resulted in blades bending, flexing and oscillating. The damage caused by EV is aggressive shell separation and is referred to as a buckle, whereby vibrations resonate in the trailing edge and then delaminates in a transverse direction until it contacts the spar cap, and then splits and runs longitudinally.

EV is a known issue for wind turbine blades but is particularly prevalent in Vestas blades, as they use about half as much fibreglass as other blades; this means they are lighter but also much more fragile. Vestas' resistance to EV is therefore much lower than on an equivalent blade from another manufacturer. The repair process is expensive and very time consuming; the blade has to be brought down to ground level, sealed in a hermetically controlled environment and then the layers need to be stripped down until the damage is removed, before building them back up again.

The response by Vestas has been to introduce dampers into the tower, which includes a pendulum structure which acts to reduce the vibrations when the turbine is idle, which has been seen by the industry to be effective in reducing exposure to edgewise vibrations.

Leading Edge Erosion (LEE)

It has become evident over the past few years that the leading edge of blades erodes at a much higher rate than the trailing edge. A combination of UV light, debris in the air, raindrops and rotor speed causes the blades get eroded over time, resulting in a reduced performance. OEMs have often dismissed LEE as wear and tear, which in not usually covered by insurers and will ultimately fall on project owner's balance sheet. As such, it is vital that project owners agree a blade integrity management programme with the OEM whereby they carry out a regular inspection of the blade edges and document the status. It is important to manage the erosion from an early stage and not let it grow, as it can affect performance and output significantly. It is estimated that LEE has caused an estimated 5,000 days of cumulative downtime globally, resulting in excess of EUR60 million of direct repair costs and lost revenue.

To combat LEE, OEMs have come up with several mitigating measures:

- **Using 3M tape**: this is applied to the leading edge of the blade to provide additional protection; it has a limited life of three years and needs to be reapplied at this point.
- **An additional coating** applied to the blades on top of any erosion; this has a life of 5 to 10 years and needs to be topped up.
- **The PowerEdge**: introduced by Siemens Gamesa, this involves attaching an additional piece of polymer on the leading edge to prevent erosion and is being rolled out fleet-wide on newly manufactured turbines. These additional protection measures are largely viewed as effective by the insurance market, as long as they are coupled with a blade integrity management program to monitor the status of the blades.

Gearbox challenges

There have been many challenges with gearboxes utilised by the tier 1 OEMs, and this has been one of the biggest cost drivers for OEMs, project owners and insurers over the past few years. The issues ultimately stem from challenges with pitch bearings and drivetrain failures.

Quite often there is wear between the raceway and the internal part of the bearings, normally as a result of a poor design of the bearing seal, which should seal the bearings against ingress of water and egress of grease. The wear can also be caused by the poor quality of grease used to lubricate the bearings as well as a lack of adequate lubrication. This is a failure of the automatic turbine controls; these bearings are normally automatically greased, so it important to effectively schedule the greasing of the bearings.

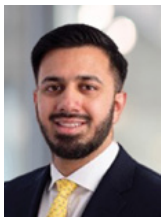
In addition to this, cracks often appear in the raceway. Most pitch bearings have four points of contact which distribute the load, if the ball bearing is not adequately hardened it gets truncated and the ball goes past its guideline and fractures the raceway. There are three main methods of mitigating this:

- Visual monitoring/inspections, to ensure that the cracks don't appear.
- An automated monitoring system, that includes a failsafe locking system on top of the bolt as the cracking appears; the lock activates and sends a signal to the O&M contractor to advise of the potential fault.
- Changing the bearings themselves; there are manufacturers who now offer a two-point bearing, which reduces the points of contact and therefore minimises the possibility of failure. However, this can be expensive and is not yet fully certified.

Drive train failures mostly concern gearboxes and large main bearings. It is not always possible to replace or repair the gearbox in-situ and so expensive major component exchange is required, resulting in large PD/BI claims. The main reason for the failure is normally a result of either manufacturing or material, i.e. inadequate surface hardness or poor-quality steel. The most effective way to reduce exposure to drivetrain failures is to effectively inspect their status via control/monitoring systems. As it is not always possible to repair the gearbox in-situ, it is also important to maintain an adequate stock of spares to reduce downtime and minimise loss of production.

Conclusion: the importance of contract wordings

With the prevalent OEM issues, together with the insurance market's position of not providing cover for known issues that are not sudden and unforeseen, the importance of engagement of brokers in the earliest possible stage in the project lifecycle to assist with the drafting of EPC/TSA and O&M agreements is paramount. While warranty issues will often be picked up during the defect notification period, it is important to have an all-encompassing O&M agreement to provide protection during the operational life of the project, by ensuring that there is sufficient availability guarantee, spare parts, crane availability and labour to resolve any contractor issues at the earliest possible stage. Ultimately the contracts need to ensure that the contractors deliver the project within a timely and financially viable manner, and to the expected quality. They need to exclude defects in design, engineering and contractor performance as well as any consequential damage. They also need to include a clear definition of what a force majeure risk is. For too long, TSA/EPC contracts have included broad force majeure definitions which has allowed OEMs to pass on costs onto project owner's balance sheet.



Dillon Patel is a Renewable Energy Account Executive & Broker, Natural Resources, WTW London.
dillon.patel@wtwco.com

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Insuring revenue swings for Onshore Wind and Solar

Introduction: current challenges

The beginning of the Ukraine conflict in February 2022 did not immediately cut Europe's gas supply from Russia (that didn't start to happen until June), but it did lay a further burden on an insurance market that was already facing a number of challenges in the post-pandemic recovery period. While consumers currently face the highest energy prices of this generation, many power generation assets that are not tied into fixed price Power Purchase Agreements (PPAs) are experiencing significant increases in their projected revenues that need to be carefully considered by both owners and insurers alike.

The conflict in Ukraine has been one of a myriad of other factors that were already in play. Low demand during the pandemic resulted in a drop in investment in generation facilities, causing a post-pandemic mini boom, driving significant increases in demand. This came at a time when an energy mix that is increasingly reliant on wind energy was seeing lower than expected wind – for example, the average wind speed in the UK last year was the second lowest recorded over the last 50 years.

European summer heatwaves have played their part too, along with depleted gas supplies. As of December 2021, gas storage levels in Europe were below the minimum volume recorded at that time of year in the any of the prior five years.

Unfortunately, no amount of painful energy bills will immediately bring about new sources of power generation to meet the massive imbalance currently faced between supply and demand.

Inflation

While perhaps not quite as significant in terms of growth or unpredictability, similar challenges are being faced in the asset valuation space.

The same post-pandemic growth in demand has put enormous pressure on the supply chains used for both the construction and repair of wind and solar facilities. Other factors have been at play too, including the six-day blockage of the Suez canal by the Ever Given (with an estimated hourly cost to the global economy of US$400 million) and the winter storm in Texas.

The result has been unprecedented inflation, and while there are encouraging signs that the situation should level and may even improve in 2023, we are still sailing in unpredictable waters in a Renewable Energy insurance market that has not faced such economic conditions before.

How is this impacting insurers?

An immediate impact on insurers has been a real time escalation in the average value of any given claim. On the revenue side, insurers have been in the uncomfortable situation of loss of revenue (Delay in Start-Up/ Business Interruption) sums insured being rapidly eroded by monthly claims which are eating into the declared values much more quickly than was envisaged when considering 'annual' sums insured.

The cause for this is relatively simple to understand: while revenues can fluctuate from month to month (particularly for those assets exposed to 'merchant' pricing, or the spot market), insured values are typically declared on an annual basis. The result has been that in some cases monthly revenue has risen well above that declared at the start of a coverage period, leaving longer indemnity periods with exhausted limits.

In terms of property damage events, this effect has been mirrored through the impacts of inflation and supply chain challenges on the cost of repair and reinstatement following physical damage.

It is not unusual for operators to rely on valuations supplied by contractors (for example, the CAPEX cost of a construction project) and adjust annually thereon. While such costs reflect the market situation at the time of the construction contract signing, the last few years have demonstrated that the marketplace, particularly the cost of raw materials and shipping, is increasingly volatile and unpredictable.

In some cases, the result of this has been both Property and DSU/BI claims being significantly more costly than anticipated. This has resulted is some robust dialogue between insurers and buyers as they seek to address the disparity between declared values (on which premium is charged) and the actual loss. Above all, this highlights the need to ensure that this risk is addressed adequately by both parties.

What are insurers doing?

One such way in which insurers are seeking to manage their exposure to this 'known unknown' is through the imposition of conditions that restrict the maximum amount an Insured party can claim for both Property and DSU/BI losses.

Such restrictions are linked back to the values declared at inception. Where previously buyers had been able to take comfort in knowing that the declared values represented the maximum they could claim, insurers are increasingly seeking to create 'inner limits' tied, for example, to daily or monthly generation values (declared in advance) or, in the case of Onshore Wind, a breakdown of values linked to each turbine.

For example, the LMA 5608 clause, introduced on 21 December 2022, links any Business Interruption claim back to the initially declared annual revenue forecast (plus an escalation amount, i.e. 10%) and caps the maximum amount that can be claimed to ensure insurers are protected from any sudden, unadvised escalations in exposure.

This clause, and other similar clauses, need to be handled carefully to ensure that sufficient coverage is always in place. As we all know, the sun does not shine for the same amount of time every month of the year and neither does the wind blow with the same force from season to season.

Some of these clauses were originally created for the oil, gas and petrochemical businesses, where revenue is considerably more 'linear', and adaptations are necessary to ensure that they are shaped around the generation profiles of a specific site or portfolio.

In a similar manner, insurers are at times seeking to limit property damage claims back to a breakdown in asset value provided at inception, preventing, for example, a single turbine replacement claim from rising above the proportion of the total sum insured that the turbine constituted.

In both cases, this places the burden on the insured party to ensure that the values they declare are as accurate as possible, and that any sudden changes (for example, due to market price increases or elapsing PPA contracts) are advised in advance (or as soon as possible) and that the impact these changes have on limits and premiums are discussed by all parties.

One impact of this market approach is that the revenue values being covered at any given time are limited by those declared at inception. As such, risk managers need to ensure that they regularly review the maximum monthly caps imposed by these clauses and compare them against current revenues and availability, in order to be able to address any potential under-insurance as soon as possible. The same applies to construction project covers, where a delay in start-up revenue value may be based on current pricing forecasts that are twelve, twenty-four or even thirty-six months ahead.

We are also seeing an increased focus on reviewing the terms of PPA contracts, particularly where they allow operators to opt out, delay entry or even exit early to benefit from the merchant pricing market. Regardless of the circumstances, at current energy pricing levels this is likely to result in significant under-insurance.

"insurers are increasingly seeking to create 'inner limits' tied, for example, to daily or monthly generation values (declared in advance) or, in the case of Onshore Wind, a breakdown of values linked to each turbine."

Conclusion: un-fogging the future

As we begin 2023 there are at least some encouraging signs, as we begin to see a slowdown in inflation and an increasing investment in Renewable Energy capacity – we are particularly pleased to see the potential re-ignition of the Onshore Wind industry in the UK.

Nevertheless, this period of energy cost uncertainty is expected to stay for at least 2023 – new generation capacity takes significant time to come online, and as we head into a northern hemisphere winter period of heightened demand, we may still have not seen the worst of this uncertainty.

Oliver Warren is Renewable Energy Account Director, Natural Resources, WTW London.
oliver.warren@wtwco.com

Political Violence: an intelligent approach to covering Renewable Energy assets

Introduction: is your project exposed?
Insurance buyers in the renewal energy sector are often presented with the difficult question of whether to purchase Political Violence Insurance (PVI) and to what level. This is not a simple question to answer; there are many variables to consider, including:

- the location of the asset in geopolitical terms
- the value it provides to the local community
- its strategic importance in national infrastructure
- the insurance market's risk appetite (and that of the project stakeholders)
- the available budget

Would a renewable energy project perhaps be less exposed than an oil and gas asset, given that it is part of the drive to a sustainable future? This is a question that several solar and wind projects in Ukraine can answer. Are some territories considered lower risk exposures to Political Violence than other emerging economies? Does it matter if the project is located onshore or offshore?

For many projects in the industry, the purchase of Political Violence insurance for their property and revenue risk is not an exact science. If should be expected that a general site security risk assessment would be conducted, considering the high-level threat assessment to the country in which the project is located. This should provide general recommendations around fencing and security, but how is this linked to the perils to which the project assets might be exposed, such as Strikes, Riots and Civil Commotion, Sabotage & Terrorism or even War.

Many project developers and/or owners may decide to cover their assets for a set of defined perils, aligned to common practice in the region, frequently purchasing cover to the full value of the generating asset. But is this an intelligent approach to covering assets against Political Violence?

How much cover should be purchased?
All developers and owners of assets around the world will have performed a high level of commercial and technical due diligence in their risk assessments, detailing the threat of their asset(s) being unduly exposed to various geopolitical perils to achieve Financial Investment Decision (FID). There will be a number of ways of managing these risks, including transfer to the insurance markets.

Frequently the risk transfer solution option is clumsy and inefficient, trading full exposure of assets and revenue with the commercial insurance markets. This frequently leaves insurance buyers overpaying for cover which may not be necessary or instead underpaying and leaving the assets and the buyer's balance sheet unduly exposed. Either way, the risk adjusted return of the investment in the project will not be optimised. Insurance purchasing should be driven by insights and data mapped to the specific risk, not by a "one size fits all" approach.

Experience suggests that for many renewable energy projects that are supported by the debt financing community that there is perhaps a risk averseness to Political Risk perils. As such, projects are broadly expected to over-insure to a level which really does not make economic sense. A very good example of this is South Africa, where many projects by convention arrange local Political Violence insurance to a combined physical damage and loss of revenue limit of ZAR1.5 billion. This applies to both the construction and operation phases of the generating asset(s), which is likely to be 20 years plus in most debt financing arrangements.

Why this level? Well, this is the level which has been offered by the local Political Violence pooling system, also known as SASRIA (South African Special Risk Insurance Association). This is a public enterprise, non-life insurance company that provides coverage for physical damage caused by special risks such as politically motivated malicious acts, riots, strikes, terrorism and public disorders in South Africa[1]. SASRIA is the example of the mandatory insurer in South Africa by which insureds are required to purchase PVI insurance or get dispensation to go to the open market.

Earlier this year, following the July 2021 riots in South Africa, SASRIA was unable to renew their Excess of Loss reinsurance facility, which expired on 31 March 2022, at economic terms - only the primary limit was available as from 1 April 2022. Cover for more than the primary SASRIA limit for these perils could only be bought in the open Political Violence Insurance (PVI) market. For both existing and prospective renewable energy projects in South Africa, this would lead to a significant increase in the cost of the excess cover to meet any pre-agreed contractual obligations. And were this increase to be applied over the lifetime of the project, it would amount to a meaningful increase in the project costs that were awarded under a strict value for money auction system.

This issue is not limited to South Africa. Across the world, many projects are already operating at very tight margins; any unnecessary or unplanned costs have the ability to disrupt long term financial models, the overall return on investment and project viability.

Is there a solution?

As complex as this issue may seem, there is a solution. Effective risk management is of strategic importance to the success of a project; in conjunction with the transfer of risk, risk intermediaries can provide a range of risk advisory solutions, which includes in-house security risk consultancy. This involves providing intelligence, analysis and technical risk engineering understanding to deliver:

- Security threat assessments
- Desktop security risk & vulnerability assessments
- Assessments of estimated maximum loss based on credible malicious attack scenarios

Once these insights are known and assessed, the insurance procurement process can be optimised, and insurance capacity secured from the market to the optimum loss level for the relevant perils, in an insightful and data-driven manner.

Products available in the insurance market offer coverage in case of the following perils:

- Terrorism and Sabotage
- Malicious Damage
- Riots, Strikes and Civil Commotion
- Civil War, Rebellion, Revolution, Coup d'état, Insurrection and Mutiny
- War

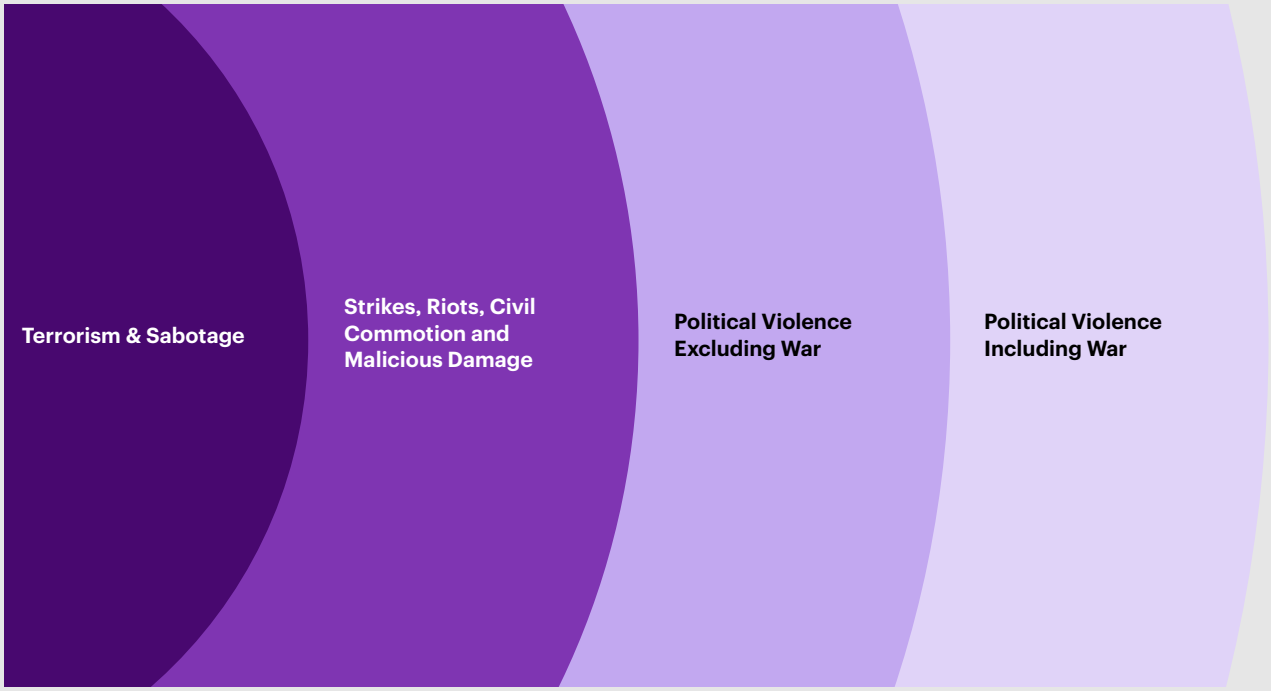
This includes fundamental coverages such as:

- Direct Physical Damage to the insured location
- Consequential Business Interruption as a result of Direct Physical Damage
- Additional damage caused during suppressive acts by authorities
- Contingent Business Interruption – Suppliers/ Customers, Denial of Access

Figure 1 overleaf shows how the coverage steps up.

[1] https://www.sasria.co.za/about-us/who-we-are/

Figure 1: **Insurance coverage available from the Political Violence market, 2022**



Source: WTW

Conclusion: reducing your overall cost of Political Violence risk

The purchasing of PVI cover has been an uncertain science, but there are means to apply insights and data to ensure that a renewable energy project has the insights in hand to ensure that cover is purchased to the best possible level.

Myles Milner is a Renewable Energy Account Director & Broker, Natural Resources, WTW London.
myles.milner@wtwco.com

Part Three: the renewable energy insurance markets in 2023

The Renewable Energy Insurance Markets in 2023: key drivers and challenges

Introduction: a 12-month recap

In previous editions of this Review we have reported on current market dynamics and successfully predicated the overall direction of travel. In this article the aim is to capture some of the key drivers and challenges anticipated within the burgeoning Renewable Energy market, both in London and on an international level.

We have previously reported that the Renewable Energy insurance market was - and continues to be - a complex, fragmented, dynamic, evolving global market still accommodated within many different product lines, making it opaque and difficult to directly analyse. It's certainly complex, traversing the fortunes and prevailing appetites in several product lines:

- Renewable Energy Speciality markets, for project lifecycle and portfolio risks
- Power and broader Downstream markets, for operational and portfolio risks
- Construction, Marine and Liability markets
- The Upstream market, more frequently for offshore wind and hydrogen technologies

As these markets expand to accommodate the low carbon opportunity, they have captured many new graduates who now have 2-3 years market experience; however, they only know the harder market conditions which still prevail today.

Where were we in late 2021/early 2022?

In our January 2022 Review, we reported that as the pandemic became more controlled, insurers Combined Ratios were indicating a return to more sustainable levels. The technical adjustment of 2018-2021 was producing the desired impact, and there was a clear sense that the head of steam which had driven the last three years of pricing acceleration was stating to run out.

Considerable pain had been endured by insurance buyers, and with the hardening of attitudes towards ESG and the reduction in thermal opportunities, there was unlikely to be any shortage of capacity interested in supporting clean and green technologies. With the market fuelled by a feelgood factor due to this rapidly growing and now profitable sector, it was likely to experience a period of buoyant capacity (although still with limited technical engineering leads) which in turn would lead to signs of tentative competition beginning to show for some programmes.

It was felt that in some circumstances, the peak in rates was in sight - if buyers approached the market with their brokers in the right way, at the right time and with the right information:

- If they respected and navigated the technical disciplines which had been formed over the previous three years, it was now possible to anticipate some level of rate reduction.

- However, other buyers, that approached the technical engineering markets without a long-term relationship - on a more limited, transient, transactional basis - may not have received the same level of consideration by the market.
- This left some unfortunate buyers with unattractive occupancies and geographies, poor loss ratios, stand-alone projects, or late submissions likely to receive comparatively negative, selective responses from a market enjoying the opportunity and benefits of the journey to harder trading conditions.

The marketplace realities of 2022

To a large degree, this trifurcation of the market became a reality. Attractive portfolios and projects achieved up to 20% rate discounts from the prior years, as insurers sought to continue to pivot their portfolios towards technical quality and forward opportunities, not just revenue for growth.

The more transient risks achieved a steady market response, with flat to middle single rate increases. Those clients with more challenging assets were required to demonstrate solid remediation of their accounts; the brokers worked hard to achieve high single or low double-digit rate increases. However, these buyers were likely still necessary to lose some elements of cover which had been or were considered potentially loss producing; furthermore, the underwriting community maintained tight controls on capacity, ensuring that the strong underwriting disciplines of the last few years were maintained. Underwriters remained fearful that, in the event of an obvious loss which had not been managed, there would be an investigation; with the market's technical adjustment fresh in their minds, all market decisions continued to require justification.

H1 2022

In hindsight, the first half of 2022 was relatively positive for market conditions from a buyer perspective. Yes, there were the known issues with the solar industry in Texas, historical wildfires, and some OEM technology issues; furthermore, the twin shocks of the beginning of the conflict in Ukraine in February and Hurricane Ian in September sent shockwaves through the London market. However, their impact was not yet being felt, and expectations of deteriorating global economic conditions and rampant inflation were pushed forward to the next half of the year. Renewable Energy underwriters were left looking in horror at their colleagues in the Aviation market, where US$25-30 billion of losses were estimated, and reflected (with relief) that there was a very limited exposure to their individual programmes, as a result of the late development of the renewable energy industry in this country.

Outside of sanctions on Russian-related business, the Renewable Energy market continued its positive march towards 2030. Many existing and new entrants took the opportunity to define and expand their appetite and capacity and build their teams. This had been challenging, due to the limited availability of personnel and the well-reported market resource "super cycle". The focus was on delivering on their 2023 business plans drawn up in late 2022, stretching out to projections to 2030 and beyond.

H2 2022

The second half of 2022 has been more challenging. As well as sanctions on Russia and global hyper-inflation, the market had to contend with Hurricane Ian ripping through Florida in late September (after an absence of Nat Cat events during much of the US windstorm season). Soon afterwards, the market drums signalled that new Nat Cat capacity constrictions would come into effect in 2023.

So in general terms, there has been a lot for the market to contend with. The Renewable Energy market has sought to stay technical, selective and stay in the black, by maintaining sustainable terms and conditions (at least for the near future) and a steady hand on the rudder to resist increasing competition for the best and most profitable programmes.

Can the Renewable Energy insurance market make money?

This is the most common question asked in the market. Prior to 2019, it would be true that a combination of abundant capacity, competitive underwriting pressures and issues with technology occupancy, design, experience and location all contributed to the market not performing at a sustainable level.

Good loss ratios recorded for 2022

However, within that general Property market, where Combined Ratios exceeded what was required to break even, there have been some insurers that have produced excellent loss ratios, including those focused on Renewable Energy. This is ultimately down to good underwriting - and perhaps a dash of luck. Baked into the challenge is that the renewable energy industry is labelled as having many attritional losses, frequently due to its rapid growth trajectory and the challenges of keeping up with the pace of new technology (aligned to the technology readiness index) and maintaining experienced partners and workforces.

As any loss adjuster involved in the industry will attest, claims have been less frequent in 2022. Some are being avoided due to more experienced personnel, and some because of the increased deductible levels that were the result of the technical adjustment in the hard market which have been maintained.

Today's challenges

The greater challenge is that when there is a loss today, the severity is amplified by the size, scale and complexity of the technology.

The associated downtime is likely to be longer, due to issues with supply chain logistics and stretched manufacturers seeking to deliver full order books for a well-predicted sector growth. As such, it is no longer an option to underwrite based on generating revenue volume to hedge sufficient funds to meet general loss attrition. Each risk must be considered and underwritten on its own merits, with a view that any single loss could create a severity spike in the underwriter's portfolio.

> **Baked into the challenge is that the renewable energy industry is labelled as having many attritional losses, frequently due to its rapid growth trajectory and the challenges of keeping up with the pace of new technology.**

Nat Cat risks

This consideration is especially acute when considering assets which are exposed to Nat Cat risks where EMLs (Estimated Maximum Losses) have frequently been achieved, being highly impactful to the overall profitability of insurer portfolios. In the last two years there have been a raft of Texas solar projects which have ended up being total constructive losses, some even exceeding the insured programme limits. There is a deep appreciation of these factors within the market, increasing the demand for detailed, early modelling and experienced Renewable Energy underwriters seeking to maintain a strong underwriting disciplines, who are prepared to walk away when necessary.

Collectively, it's estimated that the London Renewable Energy market now writes more than US$1 billion premium annually of core renewable energy power generation business, supported by a booming market with over 100 dedicated underwriters - even more if European insurers are included.

Positive insurer results

Despite many losses still being experienced, overall, it's believed that the market is achieving a satisfactory return, with insurers reporting Combined Ratios between 80-100%, compared to the hard market's 120%-150%. Lloyd's of London returned a Combined Ratio of 91.4% in first half of 2022, demonstrating a positive turn in the market.[1] While 2022 saw seismic political and economic events, it also marked a year in which Lloyd's Gross Written Premium (GWP) increased to £24 billion, up 17% from £20.5 billion in 2021[2] - the best underwriting result for the Lloyd's market since 2015. The market expects to grow; all eyes will be on whether Lloyd's syndicates manage to return an underwriting profit despite the impact of the Ukraine conflict and hurricane Ian in 2022.

However, within this more positive scenario there will be winners and losers, depending on the risks written, terms, losses, and various elements of luck. Following a review of our Renewable Energy Loss Database (RELD) we see that in aggregate our programmes are net positive, returning healthy profits to participating insurers.

Winners and losers

2022's positive underwriting performance should affect Renewable Energy underwriters' competitiveness, appetite, and ability to grow in 2023. As noted, there will always be winners and losers. Munich Re has issued guidance for a EUR4 billion (US$4.26 billion) consolidated profit in 2023 under newly adjusted

[1] https://www.lloyds.com/about-lloyds/media-centre/press-releases/lloyds-reports-strong-underwriting-result-in-2022-half-year-results#:~:text=Combined%20ratio%20of%2091.4%25%20(HY%202021%3A%2092.2%25),-Underlying%20combined%20ratio

[2] https://www.lloyds.com/about-lloyds/media-centre/press-releases/lloyds-reports-strong-underwriting-result-in-2022-half-year-results#:~:text=Combined%20ratio%20of%2091.4%25%20(HY%202021%3A%2092.2%25),-cusn Underlying%20combined%20ratio

IFRS17 reporting standards, while their P&C reinsurance Combined Ratio is expected to improve significantly to 86%. Munich Re recently confirmed that it remained on course to deliver a profit of EUR3.3 billion for 2022; those insurers making money with strong ESG protocols would appear to be the ones more ready to take advantage of a strong market opportunity[3].

Attracting offshore wind capacity

In our 2022 Review we reported that the offshore wind sector was perhaps experiencing its greatest revolution in the past decade. The global oil & gas industry, being carbon intensive, has been challenged with cleaning up their act, to meet Net Zero targets by 2050. The Upstream insurance market is a massive sector; in 2022, we sense that they have finally accepted the bitter pill that their clients' business strategies were changing and life for Upstream underwriters and brokers would therefore also be changing. It was telling that last year's Energy Insurance London Conference, a well-attended market event held in Bishopsgate in October, focused heavily on sustainability together with floating offshore and renewable technologies, as the Upstream market tries to master the new language of 2022 and beyond[4].

The insurance market transition

Oil and gas will certainly be with us for a while; however, it's important to manage an orderly energy transition. Difficult boardroom decisions are being made, and insurer capacity continues to be withdrawn from carbon-intensive industries. The market shockwave of 2022 was Munich Re's Syndicate 457 ceasing to write traditional Upstream oil & gas business, effective January 1 2023, citing ESG, and the Syndicate is now focusing on clean technologies[5]. However, the Upstream market is foremost a capacity market; it's now embracing the next technology or deal to continue fuelling the machine as less carbon-based and more clean electrons are injected into the energy system. The Upstream market is still finding its home, feeling a natural affinity with wet technologies in harsh offshore environments. There is certainly good alignment with the oil & gas majors, who are supporting offshore wind and hydrogen development globally.

The greatest support is likely to be from other capacity already involved with or considering entering this market sector, often with a deeper experience of this renewable technology sector, which happens to also be in Upstream insurers' offshore domain. Will these insurers just be drawing another seat to the Renewable Energy market table, or will they find a way to offer different coverages, perhaps without Design Exclusion clauses, more aligned to the traditional cover provided to their client's carbon-intensive businesses? It remains to be seen if they will be as comfortable in higher Nat Cat-exposed locations which have traditionally not had a significant oil & gas footprint.

Following the client

The insurance market rightly has a history of following its clients. The Norwegian Protection and Indemnity Mutuals know this full well and are now frequently supporting their clients' interests as they expand into Offshore Wind in their well-understood offshore environments, while the Upstream insurers may be keen to support their transitional clients with capacity in a way in which both are familiar.

[3] https://www.theinsurer.com/breaking-news/munich-re-targets-e4bn-profit-for-2023/?utm_source=listrak&utm_medium=email&utm_term=Munich+Re+targets+%e2%82%ac4bn+profit+for+2023&utm_campaign=ins-generic-news-alerts
[4] https://energyinsurancelondon.com/2022-agenda/
[5] https://www.theinsurer.com/news/munich-re-cites-esg-as-syndicate-exits-oil-and-gas-from-1-1/

Other offshore wind backers

The growth in the offshore wind industry will not be limited to companies in these sectors; there will also be a heavy involvement from a range of more traditional power & utility, independent power producer and private equity enterprises. These developers and asset owner/operators have a different DNA to oil & gas majors and are likely to require a different level of response from the markets. They tend to feature lower self-insured retentions, greater debt financing and risk aversity, and offer more experience and methodology in terms of moving from the power, IPP and green utility sectors.

High levels of risk and reward

The North Sea, North America and Asia promise many opportunities and will continue to attract much attention. Offshore wind technology continues to rapidly evolve; for example, the 16GW Offshore WTG recently emerging from a factory in Fujian province in November 2022, with Chinese giants China Three Gorges (CTG) and Goldwind claiming a new benchmark with China now "leading not following" in the global wind industry[6].

CPS losses

Losses from Cable Protection Systems (CPS) also continue to be a challenge for the industry; for example, Orsted recently reduced the cost to reinstate the integrity of inter-array cables affected by cable protection issues to DKK1.3 billion (around EUR175 million) and not the DKK3 billion initially anticipated[7]. Insurers have general concerns about development zone aggregations (for example, Taiwan, the North American East Coast and ScotWind expect 27.6GW of development over the next decade[8]). The deployment of projects in Asia and North America, where projects are exposed to typhoons/hurricanes, will continue to define price and availability of cover, which will be considered in the context of the global constriction in Nat Cat capacity. This may be more influential than technology choices, as we move forward into 2023/24.

A global exercise

Acquiring capacity for offshore wind projects continues to be a truly global exercise, particularly if the projects are exposed to Nat Cat risks; the fact that these risks command attractive premiums will help drive a healthy interest in providing capacity. A greater reliance on the purchase of capacity on an agreed value basis is expected, relative to the technically assessed Estimated Maximum Loss (EML). This is not an exact science, remaining indicative; unusual and worst-case scenarios can occur, demonstrated recently by the cargo ship Julieta when it crashed into the foundations at Vattenfall's Hollandse Kust Zuid offshore windfarm[9].

Limited Offshore Wind leadership

While we are seeing greater interest in Offshore Wind business in the Upstream sector, particularly for energy sector-partnered clients, there remains a scarcity of large leading capacity for such projects.

We believe there are at least 20 key London/European insurers who are all increasingly active, with an interesting dynamic still to be fully realised by three or four MGAs in this space. However, there remains no outright market leader in the way that some of the Danish markets were positioned during the previous decade. We have also seen OIL rebrand as Everen to support its mutual clients, emphasising its commitment to the continuously evolving renewable energy sector[10].

[6] https://www.rechargenews.com/wind/goldwind-and-ctg-claim-worlds-largest-wind-turbine-crown-as-16mw-giant-rolls-out-in-china/2-1-1360638
[7] https://www.offshore-energy.biz/orsted-expects-much-lower-hit-from-cable-protection-system-issues-than-anticipated/
[8] https://www.crownestatescotland.com/news/three-shetland-scotwind-projects-announced
[9] https://swzmaritime.nl/news/2022/02/03/julietta-d-damages-wind-turbine-foundation-master-and-chief-officer-under-suspicion/
[10] https://ffnews.com/newsarticle/everen-limited-formerly-oil-insurance-limited-reveals-its-brand-identity/#:~:text=August%2022%202022-,Everen%20Limited%20(formerly%20Oil%20Insurance%20Limited)%20Reveals%20its%20Brand%20Identity,the%20continuously%20evolving%20energy%20sector.

Looking into 2023

Inflation

At the time of writing (in December 2022, with January 1 renewal negotiations intensifying) the impacts of a tumultuous 2022, including the Ukraine conflict and Hurricane Ian, are still being considered. What is clear is that Renewable Energy insurers needed to see their portfolios grow at least in line with inflation to achieve parity, given the prospect of inflated claims. Claims inflation is set to be a major factor influencing the profitability of the insurance industry in 2023 and beyond. And as a result, all buyers will be challenged to have appropriate reinstatement values declared for rate application by insurers.

Often there are fewer total losses in the market and more partial losses; without an inflationary increase in asset values, insurers will consider that they are not receiving a commensurate contribution to the funding pool to meet inflated partial loss settlements. As such, insurance buyers and their brokers approaching insurers with historical or level reinstatement values are likely to chastised by underwriters, who in consequence are likely to apply an enhanced rate to the static original values to compensate for the increased costs anticipated from partial losses as a result of claims inflation. This will be separate to any technical occupancy or experience market rate adjustment; on that basis, its realistic for an insurer with a US$100 million revenue portfolio to project organic growth to perhaps US$110 million.

Independent revaluations take time to arrange and have a cost attached to them. It's likely that the market will settle on a comfortable middle-of-the-road position, where it can be acknowledged that inflationary impacts have been addressed. This is certainly different for some technologies and occupancies where reinstatement values have been consistently falling for years, and where asset insurance premium modelling has been aligned to this accepted trajectory, making the realities of 2023 difficult to swallow.

Most property covers will support an escalation provision, providing automatic adjustment of the premium without revised declaration of values to perhaps 10% of the original declared values. We anticipate that these provisions will come under increased pressure and additional charges can expected if buyers seek to rely on them too heavily without demonstrating appropriateness of the declared values.

2023 rating increases

Nat Cat

The greatest influencing factor for 2023 for the Renewable Energy market will be the availability and pricing of Nat Cat cover. Reinsurers have been signalling throughout the second half of 2022 that there will be a constriction in capacity and a strong need for direct insurers to retain a greater degree capacity on their portfolios. The pre-January 1 treaty renewals are indicating strong double-digit increases for this market, particularly North American Nat Cat Property business, where early indications have been conservatively alarming – increases of 20-50% on this product line. This is going to be acutely felt by many projects, especially in North America and Asia, although Europe has also shown itself not to be immune to the ravages of unexpected heatwaves and flooding in 2021 and 2022.

2022 – a terrible year of Nat Cat events

The Swiss Re Institute estimated in that floods and storms in the first half of 2022 would drive global insured catastrophe losses of US$38 billion, 22% above average of past ten years (US$29 billion). Floods in Australia set a record for insured losses of US$3.5 billion, the costliest natural catastrophe for the insurance industry during this period. The general outlook was already looking very bleak before the arrival of hurricane Ian in September. Ian was the largest single loss-causing event of 2022; the latest numbers suggest the all-in loss may breach the US$50 billion threshold and could point to an industry loss of closer to US$60 billion - at the top end of the estimate range[11].

The effect was to increase Nat Cat estimates for 2022 to US$115 billion, coming in well above the 10-year average of US$81 billion. However, the key focus remains on risk management for secondary perils such as Flood and Hailstorms, which caused over US$50 billion of insured losses, yet again confirming their significant contribution to the global total. 2022 is the second consecutive year in which estimated insured losses total more than US$100 billion, continuing the trend of a 5–7% average annual increase over the past decade. The (re)insurance industry covered roughly 45% of the economic losses this year, indicating a large protection gap across the world.[12]

[11] https://www.swissre.com/press-release/Floods-and-storms-drive-global-insured-catastrophe-losses-of-USD-38-billion-in-first-half-of-2022-Swiss-Re-Institute-estimates/4d31d695-e49f-4168-85bc-2a5944313b05#:~:text=Floods%20and%20storms%20drive%20global%20insured%20catastrophe%20losses,in%20the%20first%20half%20of%202022%20More%20items

[12] https://www.swissre.com/press-release/Hurricane-Ian-drives-natural-catastrophe-year-to-date-insured-losses-to-USD-115-billion-Swiss-Re-Institute-estimates/2ab3a681-6817-4862-8411-94f4b8385cee

Design and risk?

There are many projects which have been built in locations which are not considered benign from a Nat Cat standpoint; many of these projects are completed, energised, and delivering long-term operations aligned to fixed risk financing, deductible, and cost models. A constriction in global capacity and price increase is likely to be single greatest challenge to insurance premium modelling in 2023. The January 1 treaty renewals will provide an indication of how serious this is likely to be; currently the Renewable Energy insurance market, its brokers and clients should be very concerned, although the impact will probably not be fully appreciated until the April 1 renewal season.

We do have a concern that Special Purpose Vehicle (SPV) projects with traditional debt financing structures will need to accept greater levels of self-insured retention for all aspects of Nat Cat business, and specifically Windstorm, Severe Convective Storm, and Lightning. Retaining this risk may not be commercially viable to all SPVs in the operational phase, or contractually possible to pass through to balance sheet-constrained contractors during the erection phase.

General rate increases

The psyche of the market does not move that quickly. It has made substantial gains towards creating a profitable and sustainable marketplace, but the two greatest challenges remain inflation and the availability of economically priced Nat Cat capacity. We therefore believe that the Renewable Energy market will continue its current trajectory of maintaining its technical assessment, management, and pricing of risks, assessing and responding to trifurcated client types according to their underwriting model and strategy for the year.

So far, many insurers' balance sheets have proved resilient; despite the volatile geopolitical climate, insurers are still anticipating positive underwriting conditions in 2023. As the world lurches from one geopolitical crisis to the next, the resilience of insurance balance sheets, demonstrated in some 2022 third quarter results, is testament to the major strides that the London market has made to remediate their portfolios in prior years. However, the slow-burn nature of the general market loss emanating from Ukraine is anticipated to impact the profitability of the market for years to come, with the lines of business affected handing a disproportionate loss to London insurers in general compared to other re(insurance) hubs.

However in contrast to 2022, additional consideration will be given in 2023 to the way in which insurance buyers and brokers approach inflationary factors, together with the level of exposure and/or evidenced mitigation of Nat Cat risks. Premium increases for 2023 will therefore be a result of a combination of inflationary factors, occupancy losses and technical rate adjustments and higher reinsurance spend; this is likely to result in a double digit increases in overall premium.

Conclusion: a market trifurcation

General rate increases will be tempered by an appetite for client/asset type, with a trifurcation in rate aligned to Renewable Energy insurers' strategy and appetite:

- Buyers' programmes that fall within insurers' high appetite level can anticipate low-mid single digit increases.
- Those transient clients not looking for longevity in relationships may achieve similar, with some of the new markets fighting for a share in an over-capitalised marketplace but are more likely to receive middle to high single digit rate increases with more circumspect markets.
- Those with challenging occupancies, poor claims experience and a poor strategy to approaching the market will continue to be the worst hit, with high single into double digit increases, excluding final Nat Cat considerations, which promise to be jaw-dropping.

As we move into 2023, for insurance buyers it may appear that the sun will stop shining for a while. However, those who come prepared with the biggest umbrellas at the ready will undoubtably weather the storm best.

Steven Munday ACII is Global Renewable Energy Leader – Natural Resources Global Line of Business, WTW.
steven.munday@wtwco.com

The cyber insurance market: green shoots at last!

Good news! After the last 18 months of increasing rates, requirements and restrictions, the Cyber insurance market is settling, there are signs of flexibility and even – dare we say it - softening stances.

Over the last 18 months there have been numerous reports outlining the factors contributing to the difficult conditions experienced by insurance buyers (or companies looking to transfer risk), so that information will not be re-cycled here. However, it should be noted that that for First Party losses, both Ransomware and Business Disruption events are continuing to cause problems for industry; our WTW cyber claims analysis report for 2022 estimates that over 50% of an average first party claim is funded through insurance and that ransomware continued to increase between 2020 and 2021.

This article will instead look to rationalise why now may be a great time to press forward with transferring Cyber risk (if not already done) and why there could be light at the end of the tunnel for renewables industry buyers coming up to their first renewal following the recent market peak.

Starting with the basics, insurers have been pushing for 'adequacy' during the period of hardening conditions. This concept of adequacy was, in general, consistent across the insurance market and concerned both Cyber controls (or maturity) as well as premium rate adequacy; in other words, how exposed a given risk was and whether insurers were receiving enough premium to warrant the capacity provided.

Increases in the information required helped buyers further understand individual risks; any subsequent requirements laid at the buyers' door to improve or explain mitigations have helped insurers pull some organisations' control maturity to acceptable levels.

This improved the average control levels of insurer risk portfolios, protecting the market and ultimately reducing the potential for premium rate fluctuations based on insurers' current knowledge of Cyber vulnerabilities. This information need was industry-agnostic and impacted businesses from all geographies. No one escaped, but the result was increased market stability.

The improvement in portfolio maturity has now enabled insurers to start to review and look at holding (and in some cases) reducing premium rates for the top tier of well managed risks. This is especially noteworthy in that the premium adequacy is at a level that is encouraging new capacity providers to enter the Cyber space.

With increased competition from new providers and the pressure of challenging budgets, insurers are increasingly aware that they need to fight to win the best risks and demonstrate flexibility. This is especially the case where buyers may fall a little short in some of the less key areas (noting that Multi-Factor Authentication use, Privilege Access Management, training and management of backups are still central to discussions, no matter what the industry[1]).

What does this mean for the buyer? Competition. And competition not only drives pricing but also innovation, so now is a great time for buyers to work with their broker and to partner with forward thinking insurers to transfer risk and support their growth plans.

Matt Ellis is Head of Cyber & TMT Retail, WTW.
matt.ellis@wtwco.com

[1] for the renewable industry a company's specific risk assessment is predominantly focused on control and management of assets, operational technology vulnerabilities, planning for cyber events and how a financial loss will manifest. Approaching insurers with clarity around quantification (preferably scenario based) is significantly advantageous and provides the buyer and its board with clarity around coverage tracked to the buyer's individual business.

Part Four: postcards from around the world

Postcard from North America: transformers and market conditions

Transformers: has the risk of failure been truly optimized?

Introduction

Transformer supply chain issues have been a growing business interruption risk for some time, with the required waiting times previously experienced before the pandemic to order and receive a new transformer continuing to lengthen.

This is a global problem that solar and wind farm projects simply can't escape from. The risk is even greater for solar and wind turbine projects that are designed with only one generator step-up transformer (GSU) connecting an entire projects generation to the grid, which is common. While the redundancy provided by multiple turbines or solar strings minimizes the impact on generation output and business interruption from the loss of a few turbines or solar panel strings, the same can't be said for GSUs.

A GSU is usually located in the project's substation, connecting the project to the grid, and increasing the project's output voltage to match the local grid. While transformers are generally reliable, failures do occur; while a minor issue might be repairable on site, a worse case event would be a total loss of the unit, such as that caused by an internal fault, leading to an explosion followed by fire. Should such a catastrophic failure occur, a long wait can be expected in the absence of a spare unit available on standby.

Most current loss duration estimates that we have seen from insurers suggest that any replacement units would take 18 to 24 months from their purchase order to enter operational service. Even these estimates may be optimistic; a recent article at publicpower.org, from a survey of the American Public Power Association (APPA), reported that some of their members were quoted 3–5-year delivery times by some domestic manufacturers[1], while another survey reported a 38 month wait[2]. The potential for loss of revenue, contracted failures to supply penalties and the overall business interruption risk is naturally of concern to project owners and insurers alike.

However, this risk can be managed, and decisions made early in the design phase of the project are critical to optimize the risk of a transformer failure. Factors that will help ensure that a wind or solar project will prove to be reliable generation source include specifications suitable for the entire system it is connected to, the number of GSUs to consider, the operating and maintenance practices during the life of the project and a pre-plan for a failure.

So, what measures should developers and operators consider that would mitigate this risk and improve their underwriting submissions – at a favorable cost?

[1] https://www.publicpower.org/blog/we-must-keep-expressing-urgency-about-transformer-crisis
[2] https://www.tdworld.com/utility-business/article/21243198/transformative-times-update-on-the-us-transformer-supply-chain

Design phase

At the project design phase, a risk analysis should be conducted to determine the optimal number of GSUs. This analysis could result in a single GSU, a single GSU with an identical installed spare, multiple installed GSUs (each of which are sized for a similar portion of output) or a spare GSU stored off site, as part of the project cost. Consideration should be given for a shared or pooled spare among multiple projects, while perhaps outside entities may also be a cost-effective solution.

Spare GSUs should be located at a protected site where they are not subject to the same level of risks affecting the project site itself – moreover, they should be subject to some basic periodic inspection, preservation, and properly grounded.

To address in-transit risks for new or replacement transformers, companies should choose experienced heavy transport vendors, and specify that shock-impact recorders should be installed on transformers to ensure they are not subjected to damaging forces.

The design phase is also an opportunity to ensure that the proper specifications are included in the GSU purchase order, as reliability is affected by the choices made during this phase. Special considerations for wind or solar project GSUs should consider power quality issues (such as harmonics), especially when inverters are used. One important specification to consider is whether a K-rated transformer is needed to withstand the heating effects from the calculated harmonics caused by the system electronics, as the overheating of transformers leads to early failure. Improper design work relating to these issues has been reported by one transformer manufacturer to be the cause of some significant failures at several solar and wind projects[3].

Since many solar and wind projects operate remotely with minimal onsite staffing, the inclusion of an incipient fault gas monitor (IFM) to be installed on the GSU should be considered. Periodic manual sampling and lab analysis of the transformer oil for dissolved gases is a standard maintenance activity with proven benefits. An IFM installed on the transformer will detect various dissolved gases in the transformer oil throughout the day; such gases are indicative and predictive of potential failure modes. Further analysis can then lead to early corrective action, avoiding a catastrophic failure. A key benefit of an IFM is that it can identify a rapidly evolving problem that needs a timely resolution before the typically annual lab test. Key operating parameters should be monitored and trended by the local site staff, while output data to the remote monitoring location should also be monitored, along with other site operating metrics.

Operational phase

Once in operation, a GSU Loss Contingency Plan should be developed. A transformer replacement contingency plan is intended to help to shorten the recovery time following the loss of a transformer. Should a total failure occur, while recovery efforts are underway many of the steps needed for obtaining a replacement can be expedited. This plan would resemble the project details for the procurement and installation of the original unit. A large GSU for a 250MW solar farm can weigh 150 tons, requiring special transports by multiple modes (rail, ship, and truck), road permits for multiple jurisdictions and an experienced transport partner. It's worth noting that such a plan requires an annual refresh.

Recent vandalism events warrant a new transformer risk consideration

Physical attacks to transformers in utility substations have recently been in the news. It was reported that on December 3, 2022, two separate substations in North Carolina were found to have been vandalized, including transformers damaged by gunfire, leaving about 40,000 customers without power[4]. Initial cost estimates of the damages were in the millions for the repair or replacement of damaged equipment. This is not the first-time intentional damage to transformers has occurred; on April 16, 2013, a sniper attack at a Pacific Gas and Electric substation damaged 17 transformers. The event cost US$15 million, and those responsible have yet to be identified[5]. And there have been other attacks elsewhere in the US as well.

With over 55,000 substations in the United States, most of which are in areas that are not fully secured for such attacks, it is time to consider protecting substation equipment, as it is especially difficult to replace transformers[6]. One risk mitigation option for transformers includes a ballistic protection option during manufacture, designed to provide some level of protection from bullet damage. Another risk mitigation option is the installation of bullet-resistant physical barriers, which might also double as fire barriers commonly installed to protect transformers adjacent to one another from normal fire risk during construction of the substation. Another option would be as a retrofit application; at least one manufacturer offers ballistic-resistant panels that attach directly to existing transformers.

[3] https://www.windpowerengineering.com/abb-paper-the-problems-connecting-renewable-energy-sources-and-solutions/
[4] https://www.cnn.com/2022/12/05/us/power-outage-moore-county-investigation-monday/index.html
[5] https://money.cnn.com/2015/10/16/technology/sniper-power-grid/index.html
[6] https://spectrum.ieee.org/attack-on-nine-substations-could-take-down-us-grid

Resources

Finally, the manufacturer's operating and maintenance requirements should be followed, along with their best practices. Reference should be made to guidance such as IEEE C57.93-2019 and IEEE C57.152-2013, and similar publications. With the correct design specifications, proper operating and maintenance practices will help optimize the reliability of the GSU for the life of the project.

Insurance market conditions

Introduction: a look back at 2022

The 2022 calendar year saw a deceleration of rate increases in the North American insurance market through 2022, culminating with Property rates hovering at around slightly positive. The Property rates found relief through new entrants to the market, as well as a continued ESG push to grow a Renewable Energy portfolio. Capacity remained tight, with insurers having a renewed focus on individual risk qualities to determine overall support. Casualty underwriters continued to give attention to third party wildfire exposures in Texas and California, which did much to limit capacity. Rates remained steady, with GL and Umbrella rates remaining in the 0% to plus 5% range and Auto rates ranging between plus 5%-10%.

2023 outlook: Property

A tightening Reinsurance market, driven by losses and increased interest rates in turn driven by the Federal Reserve, are expected to impact the 2023 Property markets. These two events are converging, as many lead and supporting insurers are negotiating key corporate catastrophe reinsurance protection. This tightening in reinsurance capacity and pricing is expected to be passed on to direct insurers via a reduction in natural disaster reinsurance program limits and a double-digit rate increases for Nat Cat perils. Other perils such as Fire and Mechanical Breakdown should see modest increases, in line with insurer loss cost trends of 4%-6%. Insurers will need a strong review of Nat Cat cover given the expected capacity and pricing crunch.

A tightening Reinsurance market, driven by losses and increased interest rates in turn driven by the Federal Reserve, are expected to impact the 2023 Property markets.

We do expect slightly better terms for the Renewables portfolio than the general Property market, due to continued ESG initiatives and early indications growth. Insurers that rely heavily on reinsurance will be tasked with making tough decisions to fend of insurers that are well positioned to grow in 2021. The first quarter of 2023 will be a good indicator of market trends, as insurers decide on whether to defend their existing portfolio.

2023 outlook: Casualty

With the Inflation Reduction Act (IRA) signed into law in August, there's a renewed "goldrush" towards the development of the Renewable Energy industry. Battery Energy Storage Systems are still considered a developing technology that insurers learn about with every loss. In 2023 we expect further underwriter tightening of third-party Wildfire capacity, as insurers have concerns surrounding thermal runaway during a red flag warning event.

New contractors continue to flood the market and experienced contractors will differentiate renewable energy companies with better Casualty pricing and terms. Additionally, a strong engineering contribution will provide the underwriting support to offer higher Umbrella capacity. Overall Casualty rates will remain modest, with insurers focusing on increasing premium in line with loss cost trends. Top Casualty buyers will continue to dominate the market, with fewer competitors entering the Casualty markets than their Property counterparts.

Jamie Markos is US Technical Director - Renewable Energy, Energy Storage and Power Practice, WTW.
james.markos@wtwco.com

Alex Forand is North American Power and Utility Leader, WTW Chicago.
alex.forand@wtwco.com

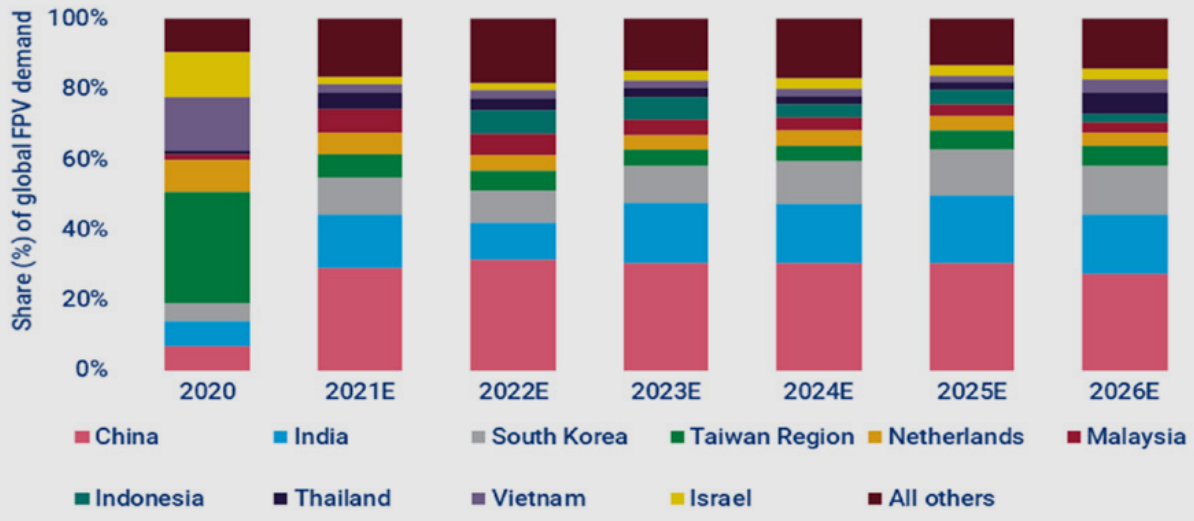
Postcard from Singapore: floating solar and a disciplined insurance market

Floating Solar development overview

Floating Solar has quietly gained significant traction over the last couple of years as developers seek to capitalize on the more attractive tariffs allocated by governments and to overcome some challenges where traditional ground mounted solar projects are limited by land shortages or more challenging planning consents. Moving forward, Floating Solar is destined to play an important role in the energy transition by driving new growth in the renewable energy sector in countries that continue to accelerate their efforts to achieve renewable energy targets.

As evidenced by Figure 1 below, China is expected to dominate global floating solar installations over the next few years, followed by India and South Korea.

Figure 1: **Global floating solar demand: top 10 markets, 2020 – 2026E**



Source: https://www.woodmac.com/news/opinion/why-floating-solar-has-an-important-role-to-play-in-the-energy-transition/

Detailed engineering design is fundamental

As might be expected, mixing electrical installations with a wet environment makes Floating Solar far more complex than the well-known traditional ground-mounted photovoltaic projects. A number of extensive technical studies must be conducted during the early Front End Engineering Design (FEED) stage, especially when the project increases in size and is installed in more challenging site conditions such as the open seas. It is now not unusual to have discussions with developers about GW Floating Solar projects; where there is significant degree of developer incentivization, there is a natural alignment to scaling up opportunities.

Risk considerations

Outlined below are some of the risk considerations:

- The anchoring and mooring lines must be designed to ensure they can withstand the external forces, and that the uniform loading/stress is distributed across the entire system.
- The modelling of the wave or water current movement must be conducted to ensure the design of the cabling system, anchoring and mooring lines has adequate tension to cater for the water level variations.
- Bathymetry and Geotechnical surveys should be conducted to obtain accurate environment data, which plays an important part in the overall project design.
- Strong structural design of the floating platform is required to ensure it is suitable for the site conditions and to last throughout the expected life cycle of the plant.
- There should be sufficient separation between the 'solar islands' to prevent collision.
- Corrosion protection measures should be implemented from the salinity conditions on site.
- A thorough cable burial assessment study should be conducted if the cables are to be buried.
- The workforce should be experienced and there should be a process as to how they access the facilities by the floating walkways.
- The quality and term of any manufacturer warranties will be key. These are traditionally much shorter than those experienced by ground mounted installations, which can impact financing.

In essence, there are no 'standard' Floating Solar Projects per se, as for each project site geological conditions are unique and so each project is required to be engineered differently. Closed water reservoirs have traditionally provided greater comfort to underwriters; we are seeing an increase in opportunities in tidal reservoirs, nearshore and open water, which increases complexity and can reduce insurers' appetite for the risk.

Industry loss

The Yamakura Floating Solar Project suffered a fire loss following Typhoon Faxai in 2019 which caused some panels to flip over due to the strong winds and were stacked on top of the unaffected panel, creating a hotspot for fire[1]. *"The final, root causes identified by the METI investigation, which was concluded in April 2020, were the island size and shape, the stress concentration load, and the safety factors used during construction[2]"*.

The insurance landscape for Floating Solar

Key underwriting considerations for Floating Solar include:

- A review of the overall project design in relation to site conditions
- The track records of the Engineering Procurement Contractor (EPC) & Original Equipment Manufacturer (OEM)
- The installation method statement
- Natural Catastrophes exposures on site
- Project certification by an international reputable certification company - a plus point for insurers

Floating Solar remains a relatively new sector for insurers; while we have seen an increase in appetite from the wider global insurance market, the number of insurers prepared to quote remains limited. A key challenge remains the size of the opportunities, the level of self-insured retention and insurer understanding of the risks, coupled with limited warranties. It has always been the insurance markets position to support development, albeit not to shoulder the research and development risk. It is likely that for the near future, insurers will be supporting this class as an accommodation to a broader relationship, where a key client is seeking support to move into this new and exciting area.

> **Mixing electrical installations with a wet environment makes Floating Solar far more complex than the well-known traditional ground-mounted photovoltaic projects.**

[1] https://www.pv-magazine.com/2019/09/09/japans-largest-floating-pv-plant-catches-fire-after-typhoon-faxai-impact/
[2] https://www.pv-magazine.com/2021/02/22/japans-largest-floating-pv-plant-reconstructed-after-typhoon-impact/

General insurance market outlook

Asian renewable energy outlook promising

The outlook for the Renewable Energy sector in Asia remains promising, with ambitious targets announced within the region. For instance, the countries that make up the Southeast Asian region have committed to a target of renewable energy accounting for 23% of the total primary energy supply by 2025[3].

However, there are a number of challenges to overcome to achieve these targets, such as:

- Access to international financing, should the Power Purchase Agreements not meet international standards
- A lengthy permitting process, delaying the execution of the projects
- The lack of a carefully planned renewable energy policy framework to accelerate growth
- Political instability
- Localization requirements

Nevertheless, it is expected that significant capital will continue to be invested into the sector as interest within the region intensifies.

Insurance outlook

Renewable Energy remains a core target growth area and capacities are generally stable, with new entrants into the sector. However, insurers tend to struggle to keep pace with the newer technologies as the industry continues to evolve, and extensive technical information are required to evaluate the insurability of this sector.

Insurers are still adopting a disciplined underwriting approach to ensure that they are achieving adequate pricing and deductible levels commensurate with the risk profile. While the impact of COVID-19 is gradually easing, supply chain disruptions and inflation are still key concerns, which will extend into 2023.

Nat Cat capacity has continued to tighten, due to unprecedented global Nat Cat losses putting pressure on the insurers' portfolio, which is why insurers are extremely cautious in deploying their capacity in high-risk locations. Indeed, natural catastrophes caused an estimated US$115 billion of insured losses in 2022, coming in well above the 10-year average of US$81 billion[4].

Parametric solutions

Clients globally are facing increasing risks due to climate change and parametric solutions could play an increasing important role going forward in complementing the traditional insurance products. Just to put into context, we are expecting a Nat Cat capacity crunch in the Asia Offshore Wind insurance market in the very near future and foresee that this will be exacerbated when each country accelerates its Offshore Wind development plan. Another example is that renewable energy developers are facing revenue volatility due to adverse or abnormal weather patterns (e.g. lack of wind/sun irradiance/water). A Parametric solution is therefore a powerful tool that could plug the 'gap' whenever possible, and - more importantly - satisfying lenders' requirements.

Conclusion: the outlook for 2023

We are expecting renewal rates to continue to increase, but on a lower scale for risks with a good loss history. Deductibles are expected to remain stable, but newer technologies would warrant a higher level and cover would be restricted. For risk with heavy Nat Cat exposures, we expect insurers to either limit their line size or impose policy sub-limits.

To achieve optimal results, early engagement with your insurance advisor to kick start the process is critical and to ensure that good quality information is provided to alleviate any risk uncertainties.

Sam Liu is Director, Renewable Energy, Natural Resources, WTW Asia.
sam.liu@wtwco.com

[3] https://www.ey.com/en_id/energy-resources/how-clean-energy-can-fuel-southeast-asia-s-economic-growth
[4] https://www.swissre.com/press-release/Hurricane-Ian-drives-natural-catastrophe-year-to-date-insured-losses-to-USD-115-billion-Swiss-Re-Institute-estimates/2ab3a681-6817-4862-8411-94f4b8385cee

Postcard from India: further investment in the renewable sector

Introduction: sector overview

In the wake of global warming and climate change trends, the world is shifting towards sustainable and clean energy sources. In 2010, the Indian Government, as part of their National Solar Mission, targeted 20 GW of solar power by 2022, which was later increased to 100 GW in 2015. With 2.5 GW of utility solar power generation in 2014, India exceeded this target by nearly 25 times to 60 GW as of December 2022[1]. The overall target, set to be achieved by 2022, was 175 GW of renewable energy installations (solar, wind, biomass and small hydro); however, owing to these unprecedented times of COVID-19, supply chain disruptions and change in policies the remaining 50 GW will take some additional time.

With a global interest in the renewable energy sector, India witnessed an overall investment of US$1.6 billion Foreign Direct Investment (FDI) in the non-conventional energy sector during 2021-22, up by 101% from the previous year. At this pace, India would receive a minimum of US$30 billion FDI by 2030.

At COP26, India reiterated its clean energy transition, and set itself updated goals in this race, aiming to achieve:

- 50% of total installed capacity from renewable energy by 2030
- reducing total projected carbon emissions by one billion tonnes from 2023 to 2030
- becoming a Net Zero emission nation by 2070

2022 also set a foundation for India's National Hydrogen mission, that targets a production of 5 MT of Green Hydrogen by 2030.

The next wave of energy trends in India

India has set an ambitious target of achieving 500 GW of non- fossil fuel-based electricity capacity by 2030. As of October 2022, with the cumulative installation at 165 GW[2](including large hydro) solar continues to dominate, with 14.7% of the total installed power capacity and 36% of the renewable capacity.

[1] https://en.wikipedia.org/wiki/Electricity_sector_in_India
[2] https://cea.nic.in/?lang=en

Evidently, the PV industry remains attractive, owning to numerous factors including robust demand, increasing investments, government policy support and competitive advantage. However, 2022 witnessed this industry being hit by a few laggards, leading to a flash of uncertainty amongst the stakeholders. While setting new records in the past in attaining lowest tariffs, over-subscription of tenders and immense growth rates, the developers have showed resistance in bidding new projects for stand-alone solar. Moreover, the projects in the pipeline are being delayed in going operational, primarily owning to commodity price volatility, increases in Basic Custom Duty (BCD), Approved List of Models and Manufacturers (ALMM) and changes in policies.

Shift in technologies

In the race to meet 2030 targets and ramp up installations from the current rate, India is shifting its focus towards other technologies. For example, Round the Clock (RTC), Battery Energy Storage Systems and Wind Solar hybrid projects are becoming prevalent, as they cater for uninterrupted supply, meeting peak power deficits and for a more reliable and sustainable investment option.

In addition to these emerging trends that will set the trajectory for the industry in the coming years, Floating Solar Photovoltaic (PV) is an entrant that will soon become mainstream. Moreover, a potential estimate by the Energy and Resources Institute (TERI) indicated that with 18,000 sq.km area of reservoirs, 280 GW of capacity could be installed across India through floating PV. With a current installed capacity of 200 MW and an upcoming pipeline of 650 MW by 2023[3], this is gaining immense traction amongst both developers and authorities.

Staying abreast of the technological advancements, including the risk management of non-conventional energy sources (primarily Floating PV) still needs to be worked on in India. Unlike modules on land, projects on water pose several unique risks that includes adequate design, water contamination and high-quality floats, backed by warranties, proper safeguard standards and more - please refer to our separate comments on Floating Solar elsewhere in this article.

The Indian insurance market landscape

Evidently, the future is bright for renewable sources, including solar, wind, hybrid and now Green hydrogen; logically, an increase in risk exposure should follow from a number of variable factors. A major trend for the renewable energy sector in India has been a huge influx of capital investment; however, for this trend to continue and cashflows to increase, the risk profile of the power plant must be satisfactorily managed during the entire life cycle of the project.

Historically, India has been regarded as a soft market for premium underwriting, with relatively lower deductibles compared to the International market. However, with the introduction of the fixed tariff regime since January 2019, Renewable Energy premiums for operational risks have increased threefold, providing an opportunity for international reinsurers to explore the market and in turn offer attractive premium savings and competitive deductibles. However, insurance still remains de-tariffed though the Project phase, offering huge discounts with the lowest possible premiums.

With this increased premium pay-out, recently some large IPPs have shifted their focus and considered the possibility of a new reinsurance programme for their Solar portfolio. The Wind portfolio continues to be a non-preferred line of business, due to unfavourable loss ratios, OEM financial health and the overall complexity in the nature of the operation. Taking a look at the non-traditional products, primarily Weather Derivate cover and Module Performance Warranty, the market relies on reinsurers, with fronting by local partners. With the lender imposing a requirement for future proofing the projects, these covers are seeing increased enquiries over time.

> **Unlike modules on land, projects on water pose several unique risks that includes adequate design, water contamination and high-quality floats.**

[3] https://www.saurenergy.com/solar-energy-blog/the-top-5-upcoming-floating-solar-power-projects-in-india

Insuring Floating Solar (PV)

From an insurance standpoint, the local market is hesitant to underwrite Floating Solar risks due to low-risk appetite, the unavailability of historical loss data and a limited technical understanding. Even the global Reinsurance players are subject to capacity constraints and are sowing a degree of reluctance, making this a challenging aspect for the insurance placement of large projects in terms of both the erection and operational phases. In the case of modules, the performance warranty extended by Original Equipment Manufacturer (OEM) can be backed by insurance through the availability of long term (25-30 years) insurance cover. However, the OEMs of floating units have no such product to back their balance sheet for the 8-10 years of warranty that is extended.

This rundown on the present scenario leaves the insurance market with an avenue of opportunity to develop, explore, innovate and be receptive to providing long term solutions for addressing such risks, given the dynamic nature of renewables sector. Amid the momentous growth, to fill the void we may need a change in the insurance landscape whereby:

- insurers offer a broader array of new products
- local insurers increase their appetite
- the reinsurance market provides more support

As ever, staying ahead of the game and being responsive is the only path to a well-managed, sustainable future.

Conclusion: paving the way for the journey ahead

Given its increasing momentum and growth, the Indian market is predicted to remain soft and competitive; however, underwriting trends may vary in different sub-segments, depending on the technology adopted. In overall terms, the sector has attained a significant following amongst insurers and reinsurers, which contributes to its further development by incentivising innovation and being receptive to providing long-term solutions for the Renewables industry – especially given its dynamic nature. The mission remains to align with the mission of working together towards a greener world.

Ankush Gupta is Practice Leader Renewable Energy at WTW India.
ankush.gupta@wtwco.com

Ishita Gogia is Client Manager Renewable Energy at WTW India.
ishita.gogia@wtwco.com

Postcard from Australia: how record floods are changing Australia's renewable energy industry

Introduction: the La Niña effect

In Australia's most populous state, New South Wales (NSW), 2022 will go down as the costliest year on record for Nat Cat claims. A prolonged La Niña weather system has inundated widespread areas of the state, as well as Queensland and other parts of Australia to a lesser extent.

The flood claims bill has reached over A$5.5 billion in NSW alone, according to figures released by the Insurance Council of Australia in November 2022[1]. It is not surprising, with several areas of NSW being impacted several times over the year, that some risks have been deemed uninsurable. For those still able to attract cover for their Nat Cat exposures, premiums have soared as capacity has steadily left the Australian market.

Effect on the Australian renewable energy industry

Three consecutive La Niña events have wreaked havoc in the renewable energy industry, catching many operators and developers out in terms of their risk mitigation, management and transfer. It has led to not only a major rethink, not only in terms of their approach to risk but also changes in working practices throughout the construction of new renewable projects. Many such considerations have led to increased costs for developers, after decades of practices geared around the prevailing drought conditions.

Flood risk is not unique to Australia; many of the changes in construction and development practices we are now seeing will have significant implications for renewable energy projects around the world.

Other Nat Cat perils reduce insurer appetite

While flooding is directly responsible for a major shift in insurer attitude in Australia, other Nat Cat perils across the country such as wind and hail damage, have added to the claims bill and resulted in a reduced insurer appetite for renewable risks. Australian projects are also competing for global capacity that continues to be selectively applied. There is no hard and fast ratio, but capacity is highly dependent on the size and complexity of the project.

[1] https://www.abc.net.au/news/2022-11-22/pm-albanese-visits-flood-stricken-towns-as-nsw-crisis-continues/101680934

The need to anticipate adverse weather

Several renewable energy projects throughout Australia, but most notably in NSW and Queensland, were caught out by the severity of flooding throughout 2022 with widespread damage to open trenches and unsealed roads, with some evidently failing to account for the cost of dewatering. Project developers and operators are clearly on notice that anticipating adverse weather and planning an appropriate risk management strategy is now paramount.

Given the reduction in insurer capacity and appetite, having principal oversight of risk management at any renewable energy project site is key to a successful long-term relationship with the insurance market. This is vital for projects seeking the most favourable renewal terms; insurer portfolios are running at a loss, resulting in increases in premiums, much higher deductibles and more restricted coverage. Essentially, any practice the insurance market deems to be unsafe or likely to cause physical damage (especially following an adverse weather event) is increasingly resulting in its being excluded - or at least, severely restricted coverage.

Here are some major examples:

- **Restricting a single length of open trench to a certain safe distance before it is backfilled.** If long stretches of trenches are left open for an extended period, and there is an adverse weather event, insurers may cynically view this as not fortuitous/or unforeseen. Rather, they are now saying this is a risk that can be anticipated and therefore should have been mitigated by being backfilled the same day.
- **Restricting the length of unsealed roads.** This can be defined as 'Unsealed Roadworks being partially or completed roadworks at any stage of construction that have not received a minimum of one application of a weatherproof course'. The riskiest period for roads in a renewable energy project, which are often in remote regional areas of Australia, is prior to being sealed. Insurers increasingly take a dim view of potentially large claims or costs from delays arising from washed away roads, when a project does not seal them in a timely manner.
- **Dewatering.** Insurers encourage strong mitigations to be in place against rain events that can be forecasted. With an ongoing La Nina weather pattern, insurers expect a sophisticated level of risk mitigation against any resulting damage or delay. Buyers cannot hide behind the adage 'that's what insurance is for'. Project owners and operators can mitigate this risk by purchasing spare pumps to remove excess water from foundations, trenches, etc.

Conclusion: fully embrace risk management into project methodologies

All these restrictions have come into force for renewable energy projects over the last 12 months and, to be fair, have come as a bit of a shock to many; however, all insurers offering capacity for these risks have taken a hit throughout 2022. Having said that, the response by the industry is more of an evolution of work practices than wholesale changes and should not be onerous for most projects.

Risk intermediaries work with insurers and projects to make sure that these restrictions are adapted and incorporated into the project methodology, ensuring that there is minimal impact to the schedule. Projects that fully embrace risk management into their project methodology get the best results with premium rates and coverages, while minimising potential issues/ conflicts in the event of a claim.

John Rae is Renewable Energy Leader, Construction and Natural Resources, WTW Australia.
john.rae@wtwco.com

Kishan Dasan is Director of Strategic Growth - Construction and Natural Resources, WTW Australia.
kishan.dasan2@wtwco.com

Postcard from Latin America: latest market developments

Introduction

What can we expect of Latin American (LatAm) insurance market behaviour for the Renewables sector in 2023? On the positive side, aligned with their head office guidelines, LatAm insurers see the renewal of their Renewables portfolio as the business they really need to write to achieve their own Net Zero targets. However, the last three years have not been easy for Renewables insurers, as mainly Machinery Breakdown losses (including some design defect issues) have affected the portfolios.

So how are insurers balancing their energy transition targets against their concerns regarding loss activity? The current answer is that they are very carefully reviewing the terms and conditions being offered. Although in terms of rating we will continue to see erratic results, single digit increases, "as expiry" rates or even some minor reductions have been negociated (as shown in Figure 1 below). We are also seeing consistent trend in respect of requests for underwriting information.

Figure 1: **Expected rating levels for Renewable Energy business in Latin America, Q1 2023**

Country	Expected rating All Risk Renewables (average combining all renewable risks)									Expected rating Construction Renewables (average combining all renewable risks)								
vs.2022 subject to NKORL	+ 20%	+15% to +20%	+15% to +10%	+10% to +5%	+5% - 0%	0% to -5%	-5% to -10%	-10% to -15%	-15% to -20%	+ 20%	+15% to +20%	+15% to +10%	+10% to +5%	+5% - 0%	0% to -5%	-5% to -10%	-10% to -15%	-15% to -20%
Argentina						x								x				
Brazil				x									x					
Central America				x										x				
Caribbean				x								x						
Chile				x									x					
Colombia				x								x						
Mexico				x									x					

Source: WTW for guidance only

Request for increased underwriting information as inflation bites

We are also seeing requests for increased underwriting information. When the risk is retained by local insurance companies or local treaties, there is generally more flexibility but once there is a need to access reinsurance capacity, the challenge is different. As ever, insurers are requiring more information about manufacturers warranties and PPA details, but now there is a "new" concern, not exclusive to the Renewables industry - inflation.

Inflation is affecting all companies' costs and therefore cannot be ignored in the underwriting process. Insurers are very concerned about the values at risk, not only on the BI side, which has been on the agenda for several years (especially after COVID-19 and the supply chain disruptions that required a better analysis of the Indemnity Period) but now also on the Property side, as inflation is linked to property values as never before. Some countries with high inflation rates have been impacted for many years; however, rising prices are no longer limited to a single country. Insurers are therefore now imposing subjectivities relating not only to the updated internal updated valuations that many companies already do but also those provided by external valuation companies.

Additional comments

The following additional comments can be made for separate classes of business:

- **Hydro:** this industry unfortunately doesn't often fall into the category of "attractive renewable business"; furthermore, small hydro plants have a bigger challenge because they face minimum premium requirements from the international market.
- **Windfarms and solar:** the Latam market is well-developed for these industries and there is enough capacity to generate "competition" between local insurance companies and regional markets.
- **Battery storage and Green hydrogen:** for these industries, the experience in Latam is quite limited so underwriters mostly refer to their head office, making the whole placement process longer.

So buyers such as SCM companies, those investing in new technology or even leaders in the renewable sector should definitely be encouraged to prepare well for the renewal process, with a complete submission in advance so all the avenues can be explored, and your risk intermediary is providing the best possible terms for your programme.

The Construction market

What happens with Construction risks? Especially when considering the Testing and Commissioning phase (or if the projects are delivered in stages) there is no doubt that a combined Construction + First Year of Operation programme is the optimal solution for a risk management/ risk transfer strategy. But what happens in terms of costs? There are those insurers that are more eager to write the Construction and avoid MB losses, while others prefer to not deal with the usual extensions which are a common feature of Construction programmes; in the Latam region, we are seeing medium size company programmes usually being placed separately. So once again, buyers are encouraged to ensure that they work sufficiently in advance to be able to analyse and identify which is the preferred combination, given their specific financial indicators.

Conclusion: presentation is key

In conclusion, the Renewable Energy market in LatAm continues to develop at a good pace, reflecting the upswing in renewable industry investment in the region. We definitely don't foresee 2023 being a year in which the markets won't be interested in these risks; however, how they are presented - especially if a loss has been suffered - will be key to getting the most value for each individual risk transfer strategy.

Sol Batallé is Latin America Regional Industry Leader, Natural Resources, WTW.
sol.batalle@wtwco.com

> **Some countries with high inflation rates have been impacted for many years; however, rising prices are no longer limited to a single country.**

Postcard from China: the rise of Chinese wind power

Introduction: a critical boost

On 23rd November 2022, the manufacturing process for a new generation of offshore wind turbine, the GWH252-16MW, developed by Goldwind and the Three Gorges Group, began in Fujian. With all components made in China, the 16MW turbine has a rotor diameter of 252 metres with a hub height of 146 metres, and under rated operating conditions, a single unit can generate 34.2 kWh per revolution. Put simply, it is now the largest single turbine in the world.

Today, Goldwind ranks second only to Denmark's Vestas among global wind turbine manufacturers, with its business covering 38 countries and regions across the world. According to the Global Wind Energy Council's annual supply-side data, Goldwind is the second-largest global turbine supplier with 11.8% of new installations in 2021, bettered only by Vestas with 17.7%[1].

A major claim materialises

On June 30 2022, the typhoon "Siam Ba" slammed into the Guangdong area in South China. An Offshore wind installation vessel, "Fujing 001", was damaged in the typhoon, and sank after 50 nautical miles of uncontrolled drifting. Of the 30 crew members left behind, 4 were rescued while 26 were either killed or went missing. "Fujing 001" was a 39-year-old ship and had undergone many refits. In March 2021, the unit was transformed into a floating crane ship and in 2022, it was towed to Yangjiang, Guangdong to begin its first operation after its transformation. From the insurance market feedback, the uncontrolled ship also crashed into some offshore wind turbine pile foundations during its drifting.

The main cause of the loss was that the "Fujing 001" anchor chain was broken. Apart from the problem of the anchor chain itself, the accident might have been caused by the fact that the anchor chain strength was insufficient to withstand the forces exerted by the typhoon.

Developments in the Chinese renewable energy industry[2]

In the first three quarters of 2022, the newly installed capacity for renewable energy in China will be 903.6GW, accounting for 78.8% of the newly installed power generation capacity nationwide. Among them, 159.0GW of hydropower, 1.92GW of wind power, 5.26GW of photovoltaic power, and 2.62GW of biomass power, respectively accounting for 13.9%, 16.8%, 45.8%, and 2.3% of the newly installed capacity in China. By the end of September 2022, the installed capacity of renewable energy power generation in China had reached 1,146TW,

[1] https://www.chinadaily.com.cn/a/202210/21/WS6351f36ea310fd2b29e7dbba.html
[2] All data for this section is to be found in the following article: http://www.chinapower.com.cn/sj/zxfb/20221115/174847.html

of which hydropower is 406TW (including 4.3GW of pumped storage), wind power is 348TW, photovoltaic power is 358TW and biomass power 40.6 GW.

Energy storage and hydrogen

Up to the end of September 2022, the newly installed Energy Storage capacity in China was 963.7MW. 2022 was also the year that the top three battery companies in China started to expand their business into the European market, with their new factory plans in Hungary, Portugal and Germany.

In March, the China National Development and Reform Commission and the National Energy Administration co-released a mid and long-term development plan for China's hydrogen energy industry, which stated that the industry is an integral part of China's energy system. It also stated that it will promote the low-carbon transition of areas such as transportation, industry and other energy-intensive sectors.

The plan indicated that by 2025 China will master core technologies and manufacturing techniques; it also indicated that the number of hydrogen fuel cell vehicles will reach about 50,000. Meanwhile, a number of hydrogen refuelling stations will be built, and the amount of hydrogen produced from renewable energy will reach 100,000 to 200,000 tons per year – reducing carbon emissions by 1 to 2 million tons per year.

Chinese insurance market developments

During 2022, the Chinese insurance market adopted a very cautious approach to offshore power projects. Given the extremely high pending cases from Yangjiang, rates and deductibles are expected to go up in the coming years, especially as deductibles currently remain at levels which are much lower than the international benchmark. However, for onshore wind farms, the market is still soft.

In 2022, Chinese insurers started to restrict the capacity available to centralized PV plants and shift their focus more towards the panel of distributed PV plants. They seem to have decided to set a firm policy limit for centralized PV plants, even though these projects are typically not located in the coastal area.

In 2022, PICC was in the final process of restructuring, but their underwriting guidelines have not been loosened since the end of 2021 and their speed and engagement is somewhat negative. CPIC continues to support overseas projects with Chinese interests, but the terms & conditions offered are deteriorating from a buyer's perspective. Other Chinese markets prefer to participate as followers.

So, for renewable energy projects with Chinese interests, it now seems that only PICC and CPIC can provide leading quotes, with the result that the market is getting much harder.

Motto LV is head of New Energy, Power and New Energy, Construction, Power and Infrastructure, WTW China.
motto.lv@wtwco.com

Postcard from Japan: the evolving Energy Policy and the hardening local market

Increasing systematic pressures

The updated Strategic Energy Plan (6th) formulated by the Government of Japan sets out an increasingly ambitious target of energy transition for 2030.

The basic guideline of the strategy is based on the "S+3E" principles[1] (Safety, Energy Security, Economic Efficiency & Environmental Protection) in which the Japanese government recognises the emphasis of creating a supply-demand structure which is multi-layered, diversified, and flexible.

The highlight is the inflated projection targets of renewable sources for energy in domestic Japan in 2030, set at 36-38% of the total energy production compared to the 22-24% previously forecasted. The production will continue to be driven by solar and hydro; however, an increased proportion of wind and biomass is also largely in scope. Currently, the usage of renewable energy sources is just over 20%, which demonstrates the rapid growth in this field required to meet the strategic objectives.

Furthermore, the Tokyo Stock Exchange has mandated all companies listed in its prime markets to include a TCFD style disclosure in their annual governance reports to ensure that all organisations are supporting the environmental initiatives set out by the Japanese government.

Renewable Energy insurance market conditions in Japan

The Japanese domestic insurance market is an oligopoly, and historically relationships between buyers and insurers played a vital role in the renewal negotiation process. The domestic market's cycle tends to be less volatile and is often slightly delayed compared to the international markets.

However, 2022 saw a rapid rise in claims arising from the perils of Snow, Water, Wind and Theft in the renewable sector and was driven mainly by solar project losses across Japan. Worsening Combined Ratios are triggering conversations within the market, with suggestions of intense market movement (rate increases of 100%+) which is very unusual in this market.

Leaving pricing issues aside, market appetite for certain perils is also reducing as they become less attractive; maintaining coverages both quantitatively and qualitatively will therefore require an innovative approach moving into 2023.

With the offshore wind sector due to rapidly increase in the Japanese domestic market during the next couple of years, identifying the risk control structure to maximising local capacity, supported by international markets, will be crucial to maintaining the bankability and long-term stability of large-scale projects.

Katsuyoshi Hoshino is Account Director & Strategic Planning, Japan Global Practice Group, WTW London.
katsuyoshi.hoshino@wtwco.com

[1] https://www.enecho.meti.go.jp/en/category/others/basic_plan/

Postcard from Vietnam: more losses as shortages continue to impact the industry

Renewable energy investments slow in 2022 - but set for growth from 2023 onwards

The domestic renewable energy industry in Vietnam has experienced rapid growth between 2018, where installation was negligible, to 16.GW for solar in 2020 and 4.1GW for wind in 2021; this is largely due to highly incentivized governmental Feed-in-Tariff (FiT) schemes. However, since November 2021 there have been almost no new projects; now everyone is waiting for the government to release their new Power Development Plan (PDP8) and their power purchase pricing framework.

To date, 8.17GW of wind projects have executed PPA (Power Purchase Agreements) with EVN (Offtaker) but interestingly, only 3.98GW achieved full commercial operation and energization before the government imposed a deadline on 31st Oct 2021 which was required to achieve the (FiT) support schemes. This left 3.479GW failing to complete the race to the finish line in time, with uncertain export arrangements in an open merchant market. At the time of being awarded PPA opportunities with EVN, we all would have expected completion to be achieved within this timeframe to take advantage of the fixed tariff arrangements. Without the government's extension of the FiT deadlines, over US$4 billion worth of projects have been left unexpectedly exposed to the impacts of supply chain and construction delays resulting from the global pandemic.

In the latest draft Power Development Plan of Vietnam No 8, dated 11 Nov 2022 by the Ministry of Industry and Trade, the planned capacity for solar is 19.5GW and 28.45 GW for wind installation, which is split 21.48GW in respect of onshore and nearshore windfarms and 7GW in respect of offshore wind farms.

Wind power

Since 2018, the Vietnamese domestic insurance market has relied heavily on accessing local insurers' reinsurance treaties for onshore wind power and facultative reinsurance for nearshore wind power.

As the first new construction projects transitioned to commercial operations, given the relatively good claims experience there has been a strong appetite for these projects from the market, with competitive terms offered for first year operations during 2021.

Programmes underwritten by local insurers have historically been competitive, with deductibles which are much lower than those imposed by the international markets. Market practice has been to purchase All Risks of Physical Loss or Damage cover, with very small levels of cover for Machinery Breakdown, frequently between US$500,000 and US$2,000,000, and some projects consider Business Interruption coverage.

For nearshore wind farms, only a few international reinsurers who are familiar with the Vietnamese markets are leading these programmes, with local insurers still accessing additional reinsurance treaty capacities with small net retentions.

Insurance market impact: more claims in 2022

Toward the second half of 2022 we have seen many more claims incidents than previously, mainly related to blades, turbines and damages caused by lightening; this is causing local insurers and reinsurers to be more cautious than previously. Deductibles and premium rates are generally on the rise, with significant increases for projects experiencing loss incidents, whether covered by insurance or not (i.e. OEM warranty claims). We are also seeing more restricted cover, with a reduction in some sub-limits.

We see these factors potentially limiting appetite and competition as the number of potential lead reinsurers participating in these programs reduces, which will impact renewals. From a client perspective, they will need a smart and professional approach to reinsurance markets and brokers to attract the interest of alternative lead markets.

Most projects still benefit from having a valid OEM warranty in place. When incidents occur, we experience complexities with ascertaining the root cause of the loss incident, the responsible party for the loss and liability with strong views from manufacturers, contractors, O&M providers and insurers.

Shortages continue to impact the industry

In the interim, shortages of stocks, maintenance tools and experienced staff continues to be experienced. The boom in wind power in Vietnam in a relatively short time frame, coupled with the recent blockage of supply chain in Asia and China, continues to impact the industry.

As discussed, almost 4GW (over US$4 billion) of wind farms did not finish the construction phase nor achieve partial or full commercial operations before the deadline for FiT on October 31st. The impact has been to place many of these farms in a difficult situation as whether to continue the construction phase (with the risk of not securing sufficient unsupported revenues) or not. For projects which achieve completion but only after the government deadline, official testing and commissioning to move to handover and operations cannot be completed without the regulator's permission. There remains a big question regarding insurance coverage for these projects, whether they are constructional complete (EAR cover) or operational property damage risks (OAR cover), albeit they are not yet operating. There are therefore substantial contractual complexities, which require individual consideration.

Solar market continues to be competitive

Having experienced no significant or Nat Cat losses for the last few years, the Solar insurance market continues to be competitive, accessing reinsurance treaty capacities for solar farms up to 300 MW. However, there is less competition for projects with insured values below VND1,000 billion, subject to a requirement for a minimum premium tariff for compulsory Fire and Explosion insurance of 0.12%. Nevertheless, local capacity will be limited once there is requirement for Business Interruption coverage with large values or for facilities which share sub-stations.

Impact of the pandemic leaves an uncertain future

In conclusion, the level of Renewable Energy deployment in Vietnam has risen rapidly from almost zero in 2018, in response to strong governmental tariff support. While many started the race to complete projects by the governmental FiT deadline, the global pandemic has impacted the industry heavily, with over US$4 billion worth of project owners left wondering what their future will be without the benefit of a support package. As the government is committed to continuing support the industry, with its 2022 Power Master Plan opening the way for nearly 50GW of supported development, will those impacted by the pandemic be left between a commercial rock and hard place? And what does this signal for other developers, investors and financiers in 2023 and beyond? These issues keenly demonstrate the interdependence between government policy, industry support and the private sector.

Conclusion: opportunities arise from new projects

In conclusion, there has been a rush of new wind projects approved by EVN as state grid operator to take advantage of preferential financial support provided by the government. However, many did not achieve Energisation in time, leaving them open to merchant market pricing dynamics. Local markets may have been initially over optimistic, but the market is maturing and insurer appetite for this opportunity is changing; this in turn is creating stronger opportunities for experienced advisors and brokers with an international reach to add value.

Ngoc Long Dinh is Branch Director at WTW Vietnam.
long.dinh@wtwco.com

Postcard from Europe: the effect of inflation and new renewable industry initiatives

Ireland: a critical junction in Ireland's renewable journey

Introduction: sector overview

The Irish government has set a target of a 75% reduction in emissions by 2030 by facilitating the deployment of renewable energy as part of its updated climate action plan 2023 (CAP23) The updated plan published on the December 22 2022. The plan includes an ambition to dial up to 9GW of onshore wind, 8GW of solar and at least 7GW of offshore wind by 2030 (with 2GW earmarked for green hydrogen projection)[1]. The plan sets out the numbers but also recognises it is now time to deliver them. Grid, planning, geopolitical, material inflation & supply chain challenges have all escalated since the original plan was issued in 2021, meaning this really is a critical junction in Ireland's renewable journey.

Onshore wind

A report issued by Wind Energy Ireland in November 2022 showed that wind energy provided 48% of Irelands electricity in November 2022, making it the number one source of electricity in Ireland for the month of November and bring the figure to 34% of Ireland's electricity in 2022 coming from wind[2]. Despite this landmark recent experience, conditions in the onshore wind sector have been frustrating, with ongoing planning challenges for developers. Ireland has a strong track record in delivering onshore wind projects; however, this has slowed in recent years as delays in the planning system have slowed new wind arm connection rates.

Offshore wind

Collaboration on developing offshore wind energy in Ireland was recently described as "the peace project of our time" by Irelands Minister for Climate Eamon Ryan. Ireland currently holds the presidency of the North Seas Energy Corporation (NSEC) and has also joined the Global Offshore Wind Alliance (GOWA) which evolved out of COP27. Despite Ireland's ambition to deliver 7GW of offshore wind by 2030, there has been an increasing level of frustration from the development community, considering the lack of progress in key issues such as licensing, planning consent and port infrastructure. The finalizing of terms and conditions of the first offshore support scheme (O-RESS1) auction was a welcome overdue development and pre-qualification launched in December 2022[3]. The qualification stage and auction process are expected in the first half of 2023 and results will be published by June 2023.

[1] https://www.gov.ie/en/publication/7bd8c-climate-action-plan-2023/
[2] https://edwarddaly.com/2022/12/08/48-of-irelands-electricity-provided-by-wind-in-november/#:~:text=48%25%20of%20Ireland%E2%80%99s%20electricity%20provided%20by%20wind%20in,biggest%20source%20of%20electricity%20in%20Ireland%20last%20month
[3] https://www.pinsentmasons.com/out-law/news/irish-government-finalises-terms-and-conditions-for-offshore-wind-auctions

Solar

Solar energy is intent on providing 20% of the renewable energy market in order to help achieve the 70% target set by the Irish Government. In October 2022 the Irish Government announced revisions to planning regulations to allow homeowners install solar panels on their rooftops without planning permission. Ireland's rooftop market is expected to deploy circa 380MW of solar capacity in the coming years[4]. The recent CAP 23 plan includes a support mechanism of at least 500MW of local community based renewable energy projects and increase levels of micro-generation and small-scale generation.

In addition, the recent Renewable Electricity Support Scheme (RESS) 2 auction was seen as a success for solar energy, and ultimately has the potential to be transformative for the sector[5], with over 1500MW granted a RESS offer. The Solar Energy insurance market is growing, with several insurers active in the sector. However, insurers do continue to maintain a conservative approach, particularly around roof top projects. Developers such as Statkraft & Amarenco have strong project pipelines in solar in Ireland, despite the challenges presented with the increasing costs of panels and supply chain difficulties.

Battery Storage Systems

Battery storage has an important role to play if the Irish Government is to achieve its target to generate 70% of its electricity from renewable sources by 2030 - it's estimated that Ireland will need at least 1,700 MW of battery storage to support this target. As of May 2022, there are currently 13 projects operating with a combined capacity of 500MW, and this is expected to grow by 800 MW by the end of 2023. In addition, there are over 50 battery storage projects in development[6].

The insurance landscape for battery storage projects in Ireland follows the global trend, with the key concern continuing to be battery fires and thermal runway. The sharp rise in demand for battery storage, and the constant evolving of technologies, leads to a lot of unknowns which can also create challenges for the insurance market. From a client's perspective, our key recommendations are early involvement with your risk intermediary from the design stage, to ensure that appropriate risk control measures, such as adequate spacing between containers, are implemented to ensure that the battery storage project continues to be an attractive insurable risk.

Conclusion: a welcome addition to the Irish insurance market

ESG commitments from insurers have seen some new entrants to the global insurance market; this has filtered through to the Irish market, with the news that a major insurer, who have been a dominant player in the Irish insurance market for many years, will follow their UK counterparts and bring a renewable energy offering to the Irish market in 2023. This is a positive development which will hopefully result in additional capacity in the local market in addition to the established London Renewables market capacity.

Brian O'Dwyer is Head of CRB for Cork, Limerick & Galway, WTW Ireland.
brian.odwyer@wtwco.com

Donal Murray is Account Director, WTW Ireland.
donal.murray@wtwco.com

Spain: insurance market reacts to inflation and electricity prices

In the current geopolitical context we are living in almost all industrial sectors have suffered from the fall out, the renewable energy market being no exception. In the case of Spain, the renewable energy market and the current financial situation have deeply impacted the insurance market, significantly affecting all 2022 renewals, which have been determined by two specific factors:

- **Inflation**: the 10% average inflation rate that the country is facing has directly affected all insured assets, increasing their declared sums insured accordingly.

[4] https://www.pv-magazine.com/2022/10/10/ireland-introduces-planning-exemptions-for-rooftop-solar/
[5] https://www.irishsolarenergy.org/_files/ugd/dcb342_fe0ac366c49e41ddb96118b008e1b6ab.pdf
[6] https://www.energystorageireland.com/wp-content/uploads/2022/06/BESS-Benefits-Brochure.pdf

- **Skyrocketing electricity prices**: The enormous volatility in electricity price and the high values reached have put insurers into "under-insurance" mode, whereby virtually all Business Interruption values declared to them are much lower than the actual ones to which they are exposed.

Both factors have made the insurance market react, introducing several modifications to all renewal terms in order to protect themselves from the consequences of today's geopolitical situation.

Among other measures they have adopted, one has been to drastically reduce the automatic percentages they usually offer; now they are much smaller, Furthermore, they have introduced an average clause in all policies where it has not already been imposed.

Despite the above, investment in the sector will continue to increase and we will continue to see a concentration of assets in M&A operations. The capacity offered for renewable assets will also continue to increase; indeed, we believe that a reduction in rating levels may be achieved in areas without Nat Cat exposures during 2023, especially for Wind and PV risks.

As a result, the major players with the highest risk retention capacity and strongest risk management departments will benefit more than others from the current market climate.

Fernando Unturbe Lahera is a Renewable Energy Account Executive, Natural Resources WTW Madrid.
fernando.unturbe@wtwco.com

France: adapting to low carbon fuels and electrification

France has historically had a low carbon energy mix due to its large nuclear grid and decided back in 2019, through its Energy and Climate Act, to go for Net Zero emissions for 2050. France's plan is to reduce its share of nuclear in the mix by 2035 and close its last coal plants as soon as practicable. Some nuclear reactors need to be revamped or renewed in a short to mid-term. In the meantime, the aim is to maintain a safe electricity system with as low a carbon footprint as possible, while reducing the part played by nuclear, which naturally will require investments in renewable energy.

France used to import most of its oil and gas needs, and these are certain to evolve quickly, given the collateral consequences of the Ukraine conflict. At the same time, the French oil and gas industry and infrastructure is adapting to low carbon fuels and electrification.

France's objective is to achieve a 40% renewable contribution to its electricity mix by 2030 and more generally to increase the share of renewable energy to 33% of the total energy consumption in France by the same date. To reach this objective, the French government has committed to building 50 offshore windfarms by 2050, which will represent 40GW of capacity - equivalent to 20% of France's entire electricity consumption.

In addition to the offshore windfarms, in February 2022 France announced the construction of six additional European Pressurised Reactors (EPRs) by 2050 and will continue to promote photovoltaic installations and the development of hydrogen solutions. RTE, the operator of the French electricity grid, also announced some major electricity interconnections investments for the future, which will be able to connect the offshore wind farms to the main power consumers.

In that context, the French and European P&C insurance markets remain reluctant in integrating renewable energy technologies such as solar panels, lithium batteries, electric or hydrogen vehicles, etc. within their P&C underwriting strategies. Discussions and studies are in progress, but the European insurance market still needs to move faster to integrate renewables within their insurance offerings.

From a Construction prospective, we are going through a paradoxical situation where the insurance market will be looking to make their portfolio "greener" while at the same time adopting a conservative approach when considering new technologies such as floating turbines. In overall terms, we anticipate new markets looking at renewable energies in the near future – specifically Oil & Gas insurers– and a general increase in appetite from the existing market for Renewables business.

Arnaud de Moulins-Beaufort is Client Director, Large Corporate, WTW Paris.
arnaud.de.moulins.beaufort@grassavoye.com

Italy: excellent installation performance but insurer concerns remain

Introduction: the National Recovery and Resilience Plan

In compliance with the EU obligations, in 2021 Italy adopted the National Recovery and Resilience Plan (NRRP), that focuses on the growth of energy produced from renewable sources, on the simplification of procedures for onshore and offshore plants, on the strengthening of network infrastructures and smart grids and on the promotion of the use of Green hydrogen.

As a result of NRRP and of the geopolitical crisis, in 2022 Italy has recorded excellent performances in the growth of installations and in the strengthening of project pipelines.

With reference to onshore wind, the data indicate in Q3 of the current year 11.3 GW of installed capacity (up from Q1 which recorded 11.0 GW), with a growth of 3% of and 3.2 GW of pipeline projects in 2022-2027. For solar, the capacity installed in Q3 also increased to 23.9 GW (compared to 22.6 GW in Q1). The growth was therefore 6% while 17.0 GW of projects are recorded in the pipeline in the years to come 2022-2027.

Moreover, there has been the announcement of potential 5 GW of offshore wind that will be auctioned between 2023 and 2026, and the construction of the first offshore wind farm in the country[7].

A positive and encouraging sign also comes from the authorization front: in the country, in fact, there is an acceleration of authorization procedures to facilitate the spread of renewable energy projects. The regulation is also expected to be issued detailing further forms of support for renewables and associated technologies (such as batteries) that could give a further boost to the market by making some ancillary solutions to renewables "bankable" and scalable.

Insurance landscape: challenges remain

In line with the Italian Recovery and Resilience Plan (PNRR) and in collaboration with institutions and other economic and social forces, the Italian insurance industry is committed to playing a primary role in the development and growth of the country.

Local renewable energy insurers have ambitious premium growth targets; however, they face key challenges related to the significant rising costs of all materials due to inflation, the expected significant increases of reinsurance costs from January 1 2023 and the supply chain issues emanating from an over-reliance on China for equipment.

In addition, new renewables projects are often deployed in locations with high nat cat exposures, for example islands and south of Italy where concerns around the theft of photovoltaic plants' components are driving insurers to adopt a conservative and prudent approach. Deductibles for fragmented risks have historically been very low and are now rapidly increasing.

Evolving technologies concern fuel rating increases and attention to values

Moreover, rapidly evolving technologies present additional challenges to insurers looking to assess risk. Underwriters tend to be more comfortable with some advances in technology (for example, upscaling of wind and solar energy technologies) rather than others (for example, technologies for deriving energy from waste, biomass or geothermal sources).

As a result, Italian insurers are paying greater attention to the accuracy of the declared PD and BI sums insured, the specific breakdown of the costs for key components, and the availability and lead time of key spare parts. We are seeing rates hardening, reflecting higher risks and growing demand.

Eva Mariani Head of Natural Resources at WTW Italy.
eva.mariani@wtwco.com

[7] https://www.ey.com/it_it/news/2022-press-releases/12/italia-piu-attrattiva-per-investimenti-in-energie-rinnovabili

Editor: Robin Somerville
robin.somerville@wtwco.com

Sub-Editor: Steven Munday
steven.munday@wtwco.com

Beijing
18th Floor, West Tower, Twin Towers,
B-12 Jian Guo Men Wai Avenue
East Chang'an Street
Chaoyang District
Beijing 100022
China
Tel: +86 10 5657 2288

Buenos Aires
San Martin 344
Floor 25
Ciudad Autonoma de Buenos
Aires C1004AAH Argentina
Tel: +54 11 5218 2100

Calgary
308-4th Avenue SW
Jamieson Place
Suite 2900
Calgary, Alberta T2P 0H7
Canada
Tel: +1 403 261 1400

Chicago
233 S. Wacker Drive
Willis Tower
Suite 1800
Chicago, Illinois 60606
United States
Tel: +1 312 288 7700

Dubai
Business Central Tower
Tower A Floor 37
Dubai Media City
PO Box 500082
Dubai
United Arab Emirates
Tel: +971 4 455 1700

Dublin
Elm Park
Merrion Road
Dublin 4, D04 P231
Ireland
Tel: +353 1 661 6211

Hanoi
Corner Store Building16 Phan Chu Trinh
Street
Unit 415
Hanoi, Hoan Kiem District
Vietnam
Tel: +84 24 3824 5325

Houston
811 Louisiana Street
Suite 2200
Houston, Texas 77002
United States
Tel: +1 713 754 5400

Johannesburg
Illovo Edge
1 Harries Road, Illovo
Johannesburg 2196
South Africa
Tel: +27 11 535 5400

Lima
Avenida De La Floresta 497
San Borja 602, 603, 604
Lima
Peru
Tel: +51 1 700 0202

London
51 Lime Street
London, EC3M 7DQ
United Kingdom
Tel: +44 (0)20 3124 6000

Madrid
Paseo de la Castellana 36-38
6ª Planta
28036 Madrid
Spain
Tel: +34 914 23 34 00

Miami
1450 Brickell Avenue
Suite 1600 Floor 16
Miami, Florida 33131
United States
Tel: +1 305 854 1330

Milan
Via Pola 9
20124 Milan
Tel: +39 02 63 78 01 01

New York
200 Liberty Street
Floor 3, 6, 7
New York, New York 10281
United States
Tel: +1 212 915 8888

Oslo
Drammensveien 147 A
0277 Oslo
Norway
Tel: +47 23 29 60 00

Paris
Immeuble Quai 33
33 - 34 Quai de Dion Bouton
grande Hauteur
Floor 1
92800 Puteaux
France
Tel: +33 01 41 43 50 00

Rio de Janeiro
Edifício Palácio Austregésilo de
Athayde
Av. Presidente Wilson, 231
Room 501
Rio de Janeiro 20030-021
Brazil
Tel: +55 21 2122 6700

Santiago
Avenida Andrés Bello 2457
23rd Floor
Torre Costanera Center
7510689, Providencia, Santiago
Chile
Tel: +56 2 2386 4000

Singapore
21 Collyer Quay
Floor #09-101
Singapore, 049320
Singapore
Tel: +65 6591 8000

Sydney
Level 16
123 Pitt Street
Sydney, New South Wales 2000
Australia
Tel: +61 29 285 4000

Tokyo
Hibiya Park Front 13F
2-1-6 Uchisaiwai-cho
Chiyoda-ku, Tokyo 100-0011
Japan
Tel: +81 3 6833 4600

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