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LEVELLING OUT...?

‘Conventional wisdom’ is a term often given to ideas or beliefs that are widely held and accepted, but may not, in fact, be true. At the start of 2009, the conventional wisdom was that the long period of relative market softness was over, and that the market was hardening and would harden further in 2009. The major market lever was macroeconomic: the aftershocks of the global economic crisis being felt in every field of activity. Rating levels were held to be unsustainably low in the face of 100%+ combined ratios, the result of a steady stream of natural catastrophe and risk losses (many involving Combined Cycle gas turbine failures), and the collapse in investment returns had removed the main means by which insurers have traditionally subsidised underwriting losses.

The main reason that the 2009 hard market failed to materialise was insurance market forces. Surplus capacity and reduced customer demand, in an improving economic environment and an unusually quiet year for insured losses, largely prevented underwriters from increasing rates to the level that many thought appropriate.

Conventional market wisdom today is very different from 12 months ago. Most commentators believe that the rest of 2010 will be characterised by softening market conditions and rate reductions (for clean risks, at least), even in sectors which have contributed more than their fair share of losses in recent years, such as the power sector. But can we have any confidence that they are right this year, when their predictions turned out to be so wrong in 2009?

The business environment continues to be as challenging for power generation companies as it is for the insurers that offer risk transfer. Continuous modification and innovation in generation technologies to increase efficiency and performance, with increased use of prototypical machinery and the accelerated development of ‘clean’ energy will continue to make this a complex and exciting arena for both parties.

Recent events in the Gulf of Mexico have highlighted that the future of expanded offshore drilling, at least off the United States coasts, is highly uncertain. This event will unquestionably affect forthcoming Energy renewals that have upstream exposures. The case for alternative, ‘clean’ energy resources is making itself. Underwriters can rely on some degree of predictability from the operational experience and data of generation machinery. Natural catastrophes are less predictable and the increased activity in the first half of 2010, from earthquakes in Chile, Mexico, Haiti and elsewhere to Windstorm Xynthia in Europe and the Eyjafjallajökull eruption, remind us of nature’s power.

So far, none of these events – either individually or in combination – have proved market-changing as far as the power generation sector is concerned. Accordingly, it is reasonable to assume that the current conventional wisdom on market conditions in 2010 is probably going to be accurate; 2010 will continue to see a softening market. However, as 2009 showed us, market predictions are not infallible, and it is by definition impossible to predict the unpredictable. Over the years there have been several market-changing events – 9/11, Piper Alpha, Hurricanes Andrew and Katrina – which were unpredicted, and largely unpredictable, and which re-drew the market landscape almost overnight.

Although the market picture for 2010 seems fairly clear at the time of writing, it is entirely possible that in 12 months’ time we will again be reviewing how market conditions failed to follow the path that conventional wisdom expected.

In our review we have performed a broad and deep examination of power generation (excluding Oil and Gas) as it relates to buyers and sellers of insurance and related parties. No such analysis can claim to be truly comprehensive but we believe that our report gives the reader a useful overview of this sophisticated and essential sector. A glance at the contents page will confirm the breadth of scope of this document.

With profound thanks to all those who contributed, we hope that our report proves a stimulating read and useful in highlighting risk management and insurance issues which may be of relevance to your businesses.

Graham Knight
Managing Director
Utilities Industry Practice Group
Global Markets International
THE MARKETS AND BUSINESS INTERRUPTION
Insurance rates in the power sector are generally softening. Insurers’ 2009 results, new entrants, and increased capacity have driven competition for market share, driving rates down. However, further natural catastrophe activity, perhaps in the form of a more active windstorm season, could bring the softening to a sharp halt.

So far, 2010 has already experienced several significant events that, in themselves, are not market-changing: included here would be the higher than usual frequency of non-severe earthquakes, the severe earthquakes in South and Central America and India, Western European windstorm Xynthia – and the high frequency of gas turbine losses. They are, nevertheless, sufficient to generate heightened attention to rate adequacy, construction standards and climate change in their respective fields.

The market is finely balanced and underwriters will need to be vigilant. Many consider 2009 to have been an abnormally benign loss year, unlikely to be repeated – that said, some key markets in the sector still made a technical loss on their power book last year.

Whilst 2009 saw a welcome return to underwriting profitability for many insurers specialising in the power sector, it also provided much relief to the underwriters themselves, after at least three consecutive years of poor loss ratios, some in excess of 150%. Nevertheless, sentiment in the marketplace is not as buoyant as might be expected, with rating levels remaining low and claims still being made.

The low natural catastrophe activity during 2009 was certainly a key factor in contributing to the encouraging results. The first half of 2010 has already seen an increased number of natural catastrophe loss events, such as the earthquakes in Chile, Mexico and India. In addition, the effect of the recession in dampening power generation company revenues in certain regions helped to ease the underwriters’ curse of large Business Interruption claims arising from relatively modest property damage losses.

The key to the market mood probably lies in the fact that although loss levels were significantly lower in 2009 than in prior years, power insurers continued to be presented with attritional volumes of machinery breakdown losses, particularly involving gas turbine technology, plus a number of less predictable loss events. This may have caused some underwriters to incur an underwriting loss on their power book in 2009, notwithstanding the healthier position of much of the rest of the market.

There is also frustration among some underwriters that the current surfeit of capacity in the market has militated against an increase in rates to levels they consider to be justified. There is little doubt that underwriters would increase their rates if circumstances allowed.
POSITIVE RESULTS ➔ NEW CAPACITY ➔ INEVITABILITY OF SOFTENING...

The cycle of the insurance market continues with new and increased capacity entering the market. This fresh capital is searching out a more stable environment after the extreme volatility experienced in other financial markets.

The new market entrants, particularly those start-ups under the Lloyd's franchise, bring new capacity to deploy at the key areas of an insurance programme – targeting the lucrative but riskier primary or first loss strata as well as the excess, layered (non-proportional) levels. When this new blood is combined with the increase in underwriting capacity from some of the more established markets, current theoretical worldwide capacity is pushing towards record levels, breaching the USD 4 billion mark.

GLOBAL PROPERTY MARKET CAPACITY

![Chart showing global property market capacity from 2003 to 2010.](chart)

Source: Willis database

To assume that all of this worldwide capacity could be used on any one programme in a cost-effective way would, however, represent a triumph of hope over reality. Certainly, programme limits up to USD 1 billion are not uncommon, and further coverage is often sought above this level, stretching to limits exceeding USD 2 billion – substantially above most perceived risk Probable Maximum Loss (PML) thresholds. The key driver of capacity deployment at this level is more often one of commercial availability – where underwriters offer capacity provided that an adequate return on investment is anticipated.

Power generation as a sector is rarely excluded from the business plans of these new capacity providers. This has inevitably sharpened focus on market share as an element of strategy, the pursuit of which is another force driving costs down. Furthermore, improvement in investment income has added to the mix of factors which contribute to a softening market – most pronounced at these higher levels. Nevertheless, this capacity will be restricted, particularly where engineering information is thin or out of date and especially in territories with significant natural catastrophe exposure.

TERRITORIAL FOCUS

In Asia, reinsurers continue to arrive in the region drawn by growth opportunities and a desire to be physically closer to the business. Singapore now represents approximately 19% of global reinsurance capacity.

Lloyd's syndicates now appreciate that, if they are to justify their presence in the region, they need to write business at rating levels that are considered – by international underwriters – to be highly competitive. Furthermore, as local entities build a critical mass, they are pushing to achieve autonomous underwriting authority.

With growing electricity demand in the Middle East (likely to triple in the UAE by 2020) and some additional 35,000MW required in Saudi Arabia over the next 10 years in order to meet projected demand, requiring capital expenditure of more than USD 50 billion, it is unsurprising that USD 1 billion of energy and engineering capacity is now available from within the region.

In South America, the liberalisation of the Brazilian market for facultative property reinsurance placements continues. The compulsory offer of a ‘right of first refusal’ to local reinsurers has recently been reduced to 40%, enabling a larger reinsurance offer to non-local reinsurers. Regional markets are trying to adjust rates after the earthquake in Chile, and this may well shift the focus of where to access the most competitive capacity to outside the region.

Domestic capacity for energy business remains strong throughout Europe where, similar to other regions, many local or regional insurers have been shielded from the historically poor global loss results in the power sector. In countries such as Spain, Italy and the UK, plenty of competitive domestic capacity remains available, even for those operators that have produced a series of significant risk loss events eroding many years of premium.

Understanding the reasons why these countries have produced such weak underwriting results is a subjective exercise but, in any event, certain underwriters have decided to avoid deploying capacity in nominated EU countries. This has little effect on the domestic market conditions.
but it does mean that this capacity has to be ‘serviced’ elsewhere around the globe. This inevitably creates oversubscription and therefore increased softening in other regions that are considered more favourable to the underwriting of the power business.

ONE SWALLOW DOES NOT MAKE A SUMMER...

Some commentators in the sector observe that underwriters seem to have rather short memories, as new or increased capacity has started to rush back into a sector that has produced one profitable year in four, coinciding with Lloyd’s record-breaking 2009.

Some underwriters believe that, as the global economy recovers, there is likely to be a return to the more established level of risk losses (in the main, machinery breakdown), with increasing Business Interruption exposures. If 2010 develops into an active windstorm season, coupled with the recent earthquakes around the globe, then circumstances will be primed for a spike in rates.

Current market indications are that current pricing remains unsustainably low and that in the medium/longer term loss ratios of 60% have to be achieved or capacity may start to withdraw. This in turn would alter the dynamics between supply and demand, and make price rises more likely.

However, for the time being, it seems safe to assume that the power sector can be categorised as perhaps not soft yet – as deductible discipline remains, and increased rates are being achieved for loss-hit buyers – but certainly softening. There is every indication that this phase will continue during 2010, barring any significant natural catastrophe activity.

ENGINEERING REMAINS KEY

In the area of power generation the quality of underwriting information is vital to securing the best risk transfer programme. This is perhaps more the case than in any other heavy industry sector.

Despite softening conditions, providing underwriters with quality and current engineering analysis and risk management reports (particularly where it can be demonstrated that the plant operator has focused on risk mitigation) – together with comprehensive underwriting submissions – remains essential to achieving the best outcome from this specialised market.

Insurers pay close attention to risk profiles and engineering data. The presentation of such data in a consistent and accepted format will enable preferred access to all of the global power underwriting specialists. With such access comes more of their desired capacity, thereby providing greater choice and insurer selection.

The design and layering of required insured limits can be modelled on this engineering data, producing meaningful simulations of the most likely potential catastrophic risk events that could impact a power company’s assets and setting limits (or layers) accordingly. Consequently, this allows for the design of an optimal insurance programme using capacity most cost-effectively.

THE QUALITY OF UNDERWRITING INFORMATION IS VITAL TO SECURING THE BEST RISK TRANSFER PROGRAMME

An engineering approach to risk management and exposures will equally assist new project developers, especially where project financiers are involved and where the starting point for discussion of insurance requirement is often an insistence on full asset value insured coverage. An engineering review, producing PML simulations for catastrophic machinery failure, fire and/or explosion with the resultant impact to loss of revenues, will provide a sound basis for discussion of required policy limits with both lenders and underwriters.

It is now increasingly common for some of the more innovative global broking houses that specialise in risk transfer and risk engineering in the power sector to optimise use of this knowledge and available capacity by structuring ‘composite’ layered programmes. Such compositions blend traditional specialist and the newer, non-specialist, commodity capacity. A layered approach means fewer insurers in the key area of the programme, the First Loss limit, which is normally aligned with the PML limit for non-catastrophe events, typically in the region of USD 200 million.
This has the outcome of creating an auction effect, giving buyers the freedom to select which limited number of insurers they wish to partner with out of the many quotations received in this area of the programme. It is here that the majority of risk losses will fall and hence where the majority of premium will be allocated.

**ASSET VALUATIONS**

Costs for new power plants and generation of electricity continue to rise and this also remains a key area of underwriting focus. Whilst engineering information is critical for underwriting review, this will not always be able to provide an accurate evaluation of the current replacement cost of assets. Correct asset valuation remains vital for underwriters when assessing risk exposure, PML limits and in calculating premium based on applied rates to asset values. Where insureds are unable to provide recent asset appraisal, underwriters will often either impose Average to the policy or adjust the premium they charge to reflect what they believe to be the correct level for the exposure – or both.

**BUSINESS INTERRUPTION**

Business Interruption is one area where power underwriters are focusing particular attention when assessing potential risk. One manifestation of this is that the technical underwriters are making greater efforts to fully understand the risks they are being asked to underwrite and their maximum monetary exposure in the event of a loss.

This is not always a straightforward task, since Business Interruption in the power sector is a particularly complex field of insurance. Different types of generator have different risk exposures: a portfolio generator may face potentially large additional costs of generation to replace the capacity of a damaged unit from elsewhere in its portfolio, while an Independent Power Producer (IPP) may only require cover for its fixed costs; a merchant producer will have a different, and more volatile, risk profile to one that sells under a power purchase or tolling agreement; some generators may have contractual obligations that they wish to insure, such as ‘take or pay’ fuel purchase commitments or penalties for non-performance; others may have significant contingent Business Interruption risks; and so on.

The measure of an underwriter’s task in assessing the risks he or she is underwriting can be illustrated by the example of a portfolio generator with a monopoly or dominant position in its territory. In the event of damage to one of its merit order units, it will want to replace the lost capacity from its generating fleet. The replacement capacity will usually be more costly to run than the damaged unit (otherwise it would already have been running instead of the damaged one) and, for the purpose of this example, let us imagine that the reason for the difference is that the two plants run on different fuels. The generator therefore requires its Business Interruption insurance to provide indemnity for the increase in the costs it incurs for fuel as a result of a loss.

**SO FAR, SO SIMPLE. BUT IN THE EVENT OF A LOSS, HOW MUCH MIGHT THESE ADDITIONAL COSTS BE?**

This will depend not only on the duration of the outage, but also on:

- The market cost of the replacement fuel at the time of the outage, relative to what it would have cost to buy fuel for the damaged unit;
- Whether the generator is locked into a ‘take or pay’ fuel purchase contract in respect of the damaged unit, and is unable to store or use the contracted fuel elsewhere or sell it to a third party;
- The level of demand at the time of the outage (itself dependent on such factors as the weather and the economy), which will determine how much of the generator’s portfolio is already running and how much is therefore spare;
- General plant availability – how much of the generator’s portfolio is unavailable due to planned maintenance and/or other forced outages.

Few of these factors can be known at inception, since they are mostly conditional on the circumstances that apply at the time of the loss. Yet underwriters are increasingly seeking certainty over this kind of information, so that they can measure their exposure and cap it if necessary by limiting their line size or imposing caps or sublimits to the cover (or by doing both). If the insured generator submits estimated Business Interruption values per unit or plant based on expected circumstances, underwriters may try to limit their coverage for each unit or plant to these declared values – even though they may prove to be lower than the actual loss sustained due to factors beyond the Insured's control, such as increased fuel prices or unseasonal weather.

Similar issues apply to merchant IPPs (i.e. those that do not have a standard PPA but do their business in the electricity marketplace), whose Gross Profit estimates will be based on predicted market prices.
If actual market prices at the time of a loss are higher than the level predicted at the start of the insurance period, the traditional principle of Business Interruption insurance – to do for the business what the business would have done for itself had no loss occurred – dictates that the policy indemnity should be based on the actual market price (adjusted for the extent to which the absence of the damaged unit itself affects the market price). However, if underwriters have introduced sublimits based on the estimated values declared at renewal, this may deny the Insured a full indemnity.

The desire for certainty may be understandable from the viewpoint of underwriters who want to be sure of the extent of their financial exposure (and also want the indemnity provided to reflect the premium paid), but it places the Insured in a difficult position. Not only does the Insured have to produce a large amount of data (typically, the estimated Gross Profit or additional cost of generation for each generating unit on a month-by-month basis to identify seasonal or other variations) – but may then find that the policy limits are insufficient to provide a full indemnity.

**SO WHAT CAN GENERATORS DO TO ENSURE THAT THEIR COVER BEST REFLECTS THEIR NEEDS?**

As in the case of engineering information, they should provide as much Business Interruption underwriting information as they can, in the format requested by insurers. If certain details have not been requested by underwriters in previous years, it does not follow that there is no need to provide them when asked to do so today. Underwriters are more likely to commit their capacity to business that they can assess and measure than to exposures that are unclear to them. Some have declined to write or renew business, even where the general risk quality is acknowledged to be good, because they have not been given the information they feel necessary to properly underwrite the Business Interruption risk. The time and effort involved in producing the more detailed information requested by underwriters should be rewarded by underwriters’ greater willingness to offer terms.

As to policy limits, the indemnity under an insurance policy is always limited to the policy limit or sum insured, and this can affect any company that operates in a business environment in which revenues or costs can be volatile. Such volatility can sometimes be catered for by allowing a margin in the sum insured and making the insurance retrospectively adjustable based on actual revenue (or some other measure), but adjustable policies are not to the liking of all Insureds.

Where revenue or costs can be volatile, it is important that any *per diem* or *per mensem* sublimits are based on the estimated exposure for the periods of the year when the monetary exposure is at its highest (usually mid-winter and/or mid-summer), rather than just averaging the annual exposure throughout the year. The amounts of any sublimits are usually negotiable, and Insured and broker should work together to identify the key areas of exposure and the limits which the Insured feels necessary, before negotiations with underwriters take place. It is often beneficial for the Insured to be involved directly in such discussions.
CLAIMS OVERVIEW

In our Special Reports section we analyse the Era of the Power ‘Mega Claim’: using extensive loss data from the Willis Energy Loss Data Base (WELD) we demonstrate that losses of over USD 100 million, our threshold for a ‘mega claim’, were a frequent occurrence in the power sector, occurring on average once every seven months.

The topic of the Mega Claim seems to have struck a chord with insurers and insureds and during the last year we have been asked to further expand on the subject at two Power Insurance conferences. The theme has also been widely reported in the press. The ‘mega losses’ have continued – with a catastrophic failure at a Russian Hydro electric plant probably the most notable in 2009.

So far 2010 is proving no exception to the rule with Kleen Energy, a 620MW Combined Cycle plant under construction in Connecticut providing the first Mega Claim of the year.

It will be fascinating to see if the trend continues: if 2010 follows the pattern of the last decade we can expect to see at least one more USD 100+ million loss before the end of the year. We will continue to monitor losses in the sector and report on this and any other interesting trends.

CURRENT EVENTS

2010 has so far been dominated by earthquakes with major incidents in Haiti, Chile and Mexico.

The Earthquake in Chile is reported to have caused substantial disruption to power supplies and significant damage to Transmission and Distribution lines while some reports suggest damage to power plants as well.

The recent earthquake on the California/Mexico border produced many similar problems to Chile with even comparatively new plants designed to withstand this peril reportedly knocked out at least in the short term.

More recently it’s the Oil and Gas world which has been making the headlines with the loss of the Transocean rig continuing to make the news months after it sank.

In the same arena, another rig has sunk off the coast of Venezuela which will lead to a large hull claim and possibly claims for pollution and redrill.

CLAIM TRENDS

It is curious that each year seems to bring a ‘fashionable’ type of claim. A few years ago there was a ‘bunching’ of transformer problems associated with contaminated oil – see our engineering analysis of this matter in the Special Reports section; more recently, Gas Turbine blade failures have dominated – and this year seems to have been the year of the generator failure. We have seen a whole series of generator failure claims this year although no single discernible cause of loss seems to link them. This has led underwriters to ask questions about maintenance activity. Time will tell but most likely it is simply a ‘blip’ in the claims experience during the last 12 months.
A PRICE-FOCUSED COMPETITIVE MARKET

Insurance buyers still have the upper hand in a liability insurance market that remains competitive. The liability account remains profitable with few losses of any size (at least outside the United States). The sector has produced some events which we highlight later but as yet there is no tangible impact on market sentiment.

As we go to print the Deepwater Horizon loss in the Gulf of Mexico is still unfolding. The size of the liability loss is as yet unclear but is likely to be very significant. The immediate impact will be on the offshore energy markets where rates have risen in response. Any effect on the wider market will be indirect. These are a number of energy markets who also write power and utility exposures. We may see consequences over time on rating if their overall loss ratio is impacted significantly. Insurers continue to target increased revenue in a market environment where there is no shortage of good quality capacity. At the same time insurance buyers are focused on driving down costs to mitigate the effects of the global recession. The result is a price-focused competitive market. A complete picture has to recognise that there are some players in the market who are resisting reductions in rating. However, the overall capacity position has not dealt them a strong hand. The more specialist providers tend to rely on strong relationships with their key clients and the ability to write specialist extensions for the power market such as failure to supply cover.

The relatively benign claims environment has produced combined ratios below 100% for many markets, reducing reliance on investment income. This has enabled them to sustain their growth targets. However the financial environment does remain uncertain. The spectre of recession is still present. Interest rates in most economies are likely to remain low for some time to come. Insurers will need to maintain underwriting profitability without the level of investment returns seen in past soft markets. The exceptional natural catastrophe losses in the first quarter of 2010 may eventually produce a change in sentiment across all market sectors: however, at least in the liability market, there is no evidence that conditions will change during the second half of 2010. Whether insurers can maintain profitability in the longer term whilst targeting revenue growth, particularly if losses from other sectors affect their capital position, is questionable. However at the moment we are in a short-term world.

There are geographical variations in the market. Competition for liability business is intense in local markets, particularly in Asia. The insurance microclimate in this part of the world is seeing a steady increase in available capacity as London-based insurers expand their networks to capture more locally generated business. These differences in degrees of competitive behaviour can be exploited in designing marketing strategies. For example, local markets may be able to write a primary at competitive rates but will often lack the total capacity required. This primary price can then be used to drive down the price of excess capacity in the international market.

FUTURE RESERVE ADJUSTMENTS WITHOUT THE HIGH INVESTMENT RETURNS OF THE PAST TO CUSHION RESULTS COULD PUT THE MARKET BACK IN THE RED
In the longer term, particularly in the liability market, there are fundamental factors which must at some point lead to a return to firmer market conditions. The long-tail nature of Liability exposure raises the question of whether insurers’ reserves will prove to be adequate once individual years have run off. Future reserve adjustments without the high investment returns of the past to cushion results could put the market back in the red.

There is little evidence that the underlying liability claim trends are changing. Most societies are becoming more litigious. Claims awareness is increasing across the developing world where claims inflation continues to run significantly ahead of general inflation. Over time this will drive up the level of attritional claims.

**2010 OUTLOOK SUMMARY**

- At worst for the Utility/Power sector we see flat renewals with a fading away of upward rating pressure.
- A small number of specialist energy insurers are attempting to put a floor under the market but risk business flowing away in the absence of strong client relationships.
- There is potential for further softening of conditions towards the end of the year as markets strive to reach their revenue targets.
- We expect to see continuation of aggressive competition in some local markets. The Far East, for example, is still producing significant premium reductions for risks which fit within local market retentions or authority. This is often driven by the local operations of global insurers. In Latin America and Asia there is strong competition for power generation business which is perceived as having relatively low exposure.
- Central underwriting control will, by and large, be maintained for the heavier utility and power exposures although we expect to see local markets targeting the lower end and drawing business away from the global underwriting centres.

**WE MAY SEE CONSEQUENCES OVER TIME ON RATING IF THEIR OVERALL LOSS RATIO IS IMPACTED SIGNIFICANTLY**

**COVERAGE ISSUES**

As we have highlighted above the insurance market is price-competitive. However, power generation and distribution have some exposures that insurers will focus on in the underwriting process and where cover may be limited.

**BUSH FIRE**

Transmission and Distribution exposures in areas where this is a risk will receive very specific scrutiny. Insurers will focus in detail on the line maintenance and operational procedures during the bush fire season including vegetation maintenance programmes. Overall market capacity for these exposures is reduced as compared to other sectors leading to somewhat less competition.

**ELECTROMAGNETIC FIELDS**

Market capacity for EMF exposure is limited. Where it is available it will normally be on claims made basis with an aggregate limit. There have been no significant successful personal injury claims in any jurisdiction. No authoritative scientific study has been able to produce clear evidence of any link between EMF and injury in relation to power transmission. The principal concern of insurers providing cover is the exposure to attritional legal defence costs.

**FAILURE TO SUPPLY OR VARIATIONS IN SUPPLY**

Basic liability forms may only provide cover for direct injury and property damage caused by variations in supply: fires or equipment damage as a result of power surge, for example. In some cases insurers may seek to further restrict cover to exclude all claims arising from failure in or variations in supply. The specialist insurers in the power market will offer wider cover but normally only in respect of claims resulting from damage to the generation plant of a distribution system leading to third party damage. This is an area that requires detailed review before approaching the market. How critical such cover is depends to a significant extent on the legal and regulatory environment of the territory concerned. There may be effective limitations of the suppliers’ liability.

An issue that needs particular focus is commercial supply contracts to single major users. For example, a failure in supply to an aluminium plant may have very significant consequences. A review of the contracts in relation to the available insurance cover is an essential element in the liability programme design process.
MARKET CAPACITY
The chart illustrates the steady increase in Liability capacity over the past years. The rate of growth has reduced during 2009 and the first quarter of 2010.

The chart indicates total theoretical capacity. Maximum Capacity available in practice for the heavier utility exposures is in the region of USD 1 billion.

INDEMNITY LIMIT BENCHMARKING
The Willis benchmarking database has been tracking indemnity limits purchased by the Power/Utility sector. There is a wide variation. Thermal Power generation plants in Latin America, for example, may typically buy USD 25 million or less. The largest limits purchased in Europe reach USD 1 billion for major operations with Gas Transmission and electricity distribution exposures. Hydroelectric power generators also tend to buy limits at the upper end.

As investment is directed towards the development of generation capacity in developing countries the most significant driver of increased indemnity limits is lenders’ requirements. They will frequently take a cautious approach and insist on Western European levels of cover. It is sometimes possible to negotiate this issue, however the relatively low cost of excess liability insurance compared to other costs may mean that this is not a worthwhile course of action.

MAJOR CLAIMS
There have been some significant loss events in the Utility sector, including:
- **Hydroelectric plant failure**
  On the August 17, 2009 one of the world’s largest hydroelectric plants, on the Yenisei River in Russia, suffered a catastrophic turbine failure. A 900 ton turbine was ejected from its housing by water pressure. The turbine room was flooded. More than 70 people in the plant died.
- **Sempra Energy**
  Southern Californian wildfire destroyed over 1100 homes in October 2009.
- **Kleen Energy**
  A gas explosion at the Kleen Energy plant in February 2010 during testing and commissioning cost five lives and many injuries. As yet no definitive cause has been established for the event. The impact on the liability market is not yet clear but could be significant.
ENGINEERING
FUTURE CHALLENGES

There are many changes facing the power generation sector in the coming years, each bringing its own element of risk. For example, there is the development of viable carbon-capture and storage (CCS) technologies – the reader is directed to our in-depth review of CCS in the Special Reports section – that can be either installed as part of new facilities or used to retro-fit existing operations. The emergence of renewable technologies has resulted in companies’ adjusting their asset structure to incorporate this type of production into their portfolios. Some companies are taking a larger stake than others. Finally there is the resurgence of nuclear power.

All these changes are being driven by the dual forces of an ever-increasing demand for power combined with a growing governmental (and demand side) requirement to reduce the impact on the environment when working to achieve the increased supply.

With all these changes it’s vital that companies focus their attention and resources on these ‘big ticket’ issues. In so acting, they can ensure that they are properly positioned to take advantage of both commercial and regulatory changes – and that the changes do not introduce new, unacceptable risks into their organisations. However, it’s also important to ensure that companies do not forget or loosen their grip on many of the day-to-day issues that could equally impact their profitability. This would include: maintenance of key equipment; ensuring that the appropriate level of personnel, with the correct training and knowledge, are available to help manage operational risks, and that procedures are maintained and enhanced.

One such area which we hope will be of interest has been reviewed in our Special Report on Transformer-related claims.

THE EMERGENCE OF RENEWABLE TECHNOLOGIES HAS RESULTED IN COMPANIES’ ADJUSTING THEIR ASSET STRUCTURE TO INCORPORATE THIS TYPE OF PRODUCTION INTO THEIR PORTFOLIOS
MARKET CONDITIONS

The construction power market largely remained static during 2009 and into early 2010. Despite expectations that we would see some hardening during the later parts of last year and in early 2010 this has not materialised. While deductible levels have remained strong for testing and commissioning with the widest covers of defective design, material and workmanship (LEG3/06) a number of key markets have been prepared to take on their competitors in their outlook, especially where a strong existing relationship exists.

Gas Turbine Technology continues to be developed apace and we are already seeing ‘H’ and ‘J’ technology being introduced and tested in pilot plants which will once again bring new challenges to the market, particularly in the Defect Cover given and the deductible.

Original Equipment Manufacturers (OEMs) of the gas turbine technology, however, continue to keep the insurance markets abreast of their technological developments and potential issues. This helps alleviate some of the concerns that underwriters may previously have had.

Large losses in the geothermal power construction sector are relatively uncommon with the majority of major technology losses coming once the plants have been operational. This continues to give confidence to the construction market and, together with the additional capacity entering this sector and the huge future growth potential, we do not expect to see any major changes in the remainder of 2010.

Delay in Start Up (DSU) or Advance Loss of Profits (ALOP) covers continue to present challenges. However, as long as adequate information is available on revenue streams and debt financing, and OEMs continue to provide quality and realistic warranties and guarantees with their equipment, cover still remains readily available. Again, deductibles in the form of time exclusion periods have remained strong and will continue to remain fairly static at between 60 - 120 days on major projects utilising heavy duty gas turbines and between 30 - 60 days on smaller projects.

While 2009 brought many challenges to project financing, one of the major drivers in this sector will be the global need for ‘clean energy’ and the massive increases in demand expected over the next 20 years. This will put severe demand on the available resources and materials needed and global market economics will dictate where the supply will secure best efficiencies and volumes.
KEY MARKET DRIVERS
Underwriters’ appetite for this class of business is expected to continue to grow over the coming years and this is mainly due to the anticipated significant growth in the construction of new power plants of all kinds around the globe.

Estimates indicate that in the UK alone GBP 90.3 billion will be spent on new power projects up to 2015 with a further GBP 108.7 billion being spent up to 2025. On a global basis, these numbers increase to a staggering USD 12,500 billion (USD 12.5 trillion) being spent on global power projects up to 2030.

This amount of spending will be across all energy sectors but a substantial tranche will be directed towards renewable energy and the associated reductions in carbon emissions. To this end we can anticipate a further increase of projects in the following areas:
- Wind Energy, onshore and offshore
- Solar Energy
- Biomass
- Waste to Energy
- Ethanol production
- Smart Grids and Smart Metering
- Carbon Capture

Coupled to this, a nuclear revival is taking place around the world. Currently, there are 439 nuclear reactors operating in 30 countries providing around 15% of the world power needs. 35 new nuclear power plants are currently under construction globally with a further 90 in planning and this is expected to increase to 200+ by 2030.

Underwriters will use their capacity wisely but may need to make some key decisions on the sectors they wish to target and will have to make arrangements to ensure adequate treaty protections to write business where they may historically been unable to do so. Examples of this are Offshore Wind, and long project periods for nuclear or hydroelectric projects .

In turn the demands on OEMs to deliver the goods and the EPCs to be able to deliver projects to budget and on time will also have a huge impact on the markets’ appetite and the extent of cover available.

THE PRIZES AVAILABLE TO UNDERWRITERS WHO MEET THE CHALLENGES OF THE INDUSTRY WILL BE BOTH REWARDING AND SIGNIFICANT

Increasingly we see expectations of wider and broader cover. Requests are often made for some of the more esoteric covers such as efficacy, exploration costs, loss of wind or lack of sun and so forth; this will continue to offer challenges to the lead insurers who have historically regarded many of these issues as being risk of business issues.

Lenders and financiers also have their own requirements and their expectations to mitigate loss through a risk transfer mechanism will continue to challenge the market for the foreseeable future.

Clearly, though, with the amount of investment in the power and utility sector, the prizes available to underwriters who meet the challenges of the industry will be both rewarding and significant.

MARKET CAPACITY
Existing market capacity in the sector has grown to around USD 2.6 billion on a Probable Maximum Loss (PML) basis and – although new entrants were seen during 2008 and 2009 and further capacity has become available in 2010 – only one insurer withdrew from the London market in 2009.

Despite this growth in capacity the number of lead markets with the required experience and technical leadership qualities for major risks has remained fairly constant. However, security remains a major issue with Sponsors’ and Lenders’ expectations requiring minimum A– security as a prerequisite for major power projects, especially where DSU or ALOP is being sought.

Another major factor in global markets is the move by many underwriters to open local and regional offices and hubs around the world to provide local response. Underwriting centres in Dubai, Singapore and strategic Latin American countries mean that placement of risks is now a global probability – in addition, the majority of small- to mid-markets are (virtually) all written locally.
OUTLOOK AND LONG TERM OVERVIEW

With Global energy demand set to grow by up to 50% by 2030, the general outlook and long term potential for construction insurance in the Power and Utilities sector is significant.

The high demand for new and cleaner technologies combined with the need to replace ageing and inefficient plant (from 2010 onwards more than 90GW p.a. of all generating equipment will be over 40 years old) will lead to a global resurgence in new projects. This could create issues for some manufacturers and contractors who will need to grow their manufacturing outputs and labour forces and will continue to place demands on basic construction commodities such as steel, concrete and contractors’ plant. This is particularly so for specialist plant such as tower cranes, Tunnel Boring Machines (TBMs) and offshore installation vessels.

Improving technology and increasing power output will remain a key factor. However, as long as OEMs continue to keep the insurance markets updated and aware of advances and the enhancements being incorporated into older designs these problems should be resolvable – as long as all parties (Manufacturers, Owners and Lenders) maintain a realistic approach.

Risk management and quality assurance is of prime importance to underwriters. The provision of the necessary and concise technical information early in a project cycle to enable insurers and their engineers to evaluate the risk remains a key factor to underwriters.

Natural hazards such as Windstorm, Earthquake and Tsunami continue to be a consideration, especially as more power will be required in some remote parts globally due to the emerging countries’ need for power, water and energy.

One of the most significant topics going forward will be increased growth from developing economies and the Chinese involvement in new projects. We anticipate Chinese technology being utilised and Chinese EPCs competing for global projects, not just in Asia but in markets such as the Middle East, South America and Europe.

Market conditions in 2010 will remain stable with rates also remaining competitive. Beyond that we see few factors that will influence any increases although some of the Civil Engineering and Energy sector losses might force this trend to change.

Deductible levels should also remain stable although, for proven technology, with experienced contractors plus limited natural peril exposure, major competition for this business could result in continued softening.

Relationships between Suppliers/Contractors, and Insurers continue to remain an important factor, but contractors and principals will look beyond their normal markets for wider product range and competitive premium levels.
POLITICAL RISK
MARKET UPDATE

2009 proved to be an *annus horribilis* for the political risk market. Insurers faced an unprecedented number of claims resulting from the rise of resource nationalism and growing unrest as a result of the financial crisis. Total claims amounted to approximately USD 2 billion against premium written of roughly USD 1.5 billion, effectively wiping out more than one year’s premium.

It was feared that, despite being billed in many quarters as ‘a once in a hundred year event’, some insurers would take flight and exit the market or, worse, become insolvent. However, far from being the ‘perfect storm’ as some observers predicted, most insurers have managed to weather the situation and ride it out. In fact the market has ‘fronted-up’ and responded to the needs of their clients, with the result that somewhere in the region of USD 1 billion has already been paid out and further claim settlements are expected.

It was also thought that there might be a severe reduction in capacity going into 2010. Whilst reinsurance rates have increased overall by approximately 10% and some reinsurers’ limits have been reduced, January 1 treaty renewals were generally very encouraging. Furthermore, 2009 heralded the arrival of new markets, such as MarketForm and CV Starr – as well as reinsurers such as Ariel Re and Renaissance Re – who have provided additional capacity. This year, Ironshore have also started to write this class, supporting the existing offerings of its Lloyd’s Syndicate, Pembroke. The net result is that market capacity has, in fact, increased by approximately 8-12%.

Rates, which are typically 1% to 3% of the value insured, did harden and were increasingly in the upper reaches of this range during the course of 2009. This was largely fuelled by the liquidity crisis and heightened risk awareness amongst lenders and investors alike, but was also a function of tight capacity in high demand territories such as Brazil, Russia, India and China (BRIC).

POLITICAL RISKS FACING THE POWER/UTILITY INDUSTRY

As natural resources become scarcer and global demand for energy continues to increase, substantial capital investment will be required in the coming decades. However, investors and project lenders in emerging markets face the increasing risk of governmental expropriations. Indeed, the rise of resource nationalism, as witnessed recently in the Bolivarian republics and Russia, has meant that these risks are ever more prevalent and need to be mitigated.

Power and utility projects in emerging markets are often highly politicised and are therefore particularly exposed to the risk of governmental interference. Furthermore, these infrastructure projects require both lenders and investors to commit for long maturities. This means catering for possible actions by future administrations. Opposition parties may often electioneer on a platform of providing more affordable electricity. When they come into power there is a very real risk that previously agreed tariffs may be renegotiated or that the new administration may seek a complete abrogation of the concession agreement. A prime example of the impact of a change of government on power projects was the sequence of events surrounding the Dabhol power project in the Maharashtra State in India.

THE RISE OF RESOURCE NATIONALISM

It is a truism that as commodity prices rise, national governments tend to seek to boost their revenues or share of proceeds in strategic projects – but then, when prices fall, they loosen their fiscal regimes in an effort to encourage direct foreign investment. Price volatility, however, will probably become increasingly regular, meaning that the risk of intervention by host governments, even in previously perceived ‘investor friendly’ countries, will become more commonplace and needs to adequately protected against.
Hugo Chavez’s nationalisation of the operations of international oil companies in Venezuela’s Orinoco river basin have been well publicised. This trend has spread like a virus to neighbouring states such as Bolivia and Ecuador, as these countries seek to take back ownership of prized assets through forced renegotiation of existing contracts. Justification for these actions may include perceived historical injustice or alleged environmental or contractual misdeeds by western companies. Likewise, the ‘Yukos affair’ and the ‘re-designation’ of the Sakhalin Island project limited foreign participation in Russia’s oil and gas industry. Russia sought to reconsolidate state power under the Putin regime and instigate a much wider rollback of privatisation in strategic sectors, much to the alarm of potential investors.

Rather than a direct or overt expropriation of a foreign investor’s assets, investors are increasingly likely to witness a more insidious form of government intervention, in the form of ‘creeping expropriation’. This refers to state conduct that substantially deprives a foreign investor of the use or benefit of their investments, even though formal legal title may continue to vest with the investor. Indirect expropriations do not necessarily result in overnight deprivation but may in fact take years. Such expropriations could take the form of the imposition of a punitive tax regime, or new legislation that is applied retroactively and selectively against the foreign enterprise – but which is not applied to local companies.

Expropriation has been held by arbitral tribunals as to include ‘not only open, deliberate and acknowledged takings of property, such as outright seizure but also covert or incidental interference with the use of property which has the effect of depriving the owner, in whole or in significant part, of the use of reasonably-to-be expected economic benefit of property even if not necessarily to the obvious benefit of the host state.’ A further extension of what may be considered expropriation arose during the Argentinean debt crisis, when it was argued that the elimination of the peso/dollar parity peg and other regulatory measures caused the indirect expropriation of various foreign investor assets as well as forcing foreign investors to default on their dollar-denominated loans.

GROWTH OF CARBON CREDITS AND RENEWABLES

Climate change is increasingly on the agenda of foreign governments and, stimulated by the need to reduce carbon emissions under the Kyoto Protocol, the trading of carbon credits (Certified Emission Reductions) is a rapidly growing market. Such credits are generated by undertakings such as renewable energy power projects, waste-to-energy plants and energy-efficient initiatives in developing countries. Coverage is now available to protect these projects against a host government’s acting to prevent an investor from receiving benefits associated with emission credits. In addition, cover extends to political violence events, such as war and terrorism, which might disrupt operations. Credit insurance is also available to protect against both commercial default and political risks. Carbon credit financing can be expensive without the appropriate mitigation of risks and in order to obtain better financing terms the project risk needs to be lowered.

PAST AND RECENT POLITICAL RISK EVENTS

- **India**: Expropriation of assets and abrogation of a power purchase agreement by the Maharashtra State government in relation to the Dabhol power project.

- **Guinea**: A dispute by the world’s largest bauxite producer with several mining companies (including UC Rusal and AngloGold Ashanti) following a military junta seizing power.

- **Ecuador**: A 50% tax on ‘extraordinary profits’ of international oil companies based on crude oil prices and the forced renegotiation of joint-venture agreements. Ecuador also expropriated Occidental Petroleum’s interest in an oil field.

- **Bolivia**: A decree which forced producers to relinquish control of the production of hydrocarbons to the state oil and gas company, Yacimientos Petrolíferos Fiscales Bolivianos (YPFB).

- **Venezuela**: A decree requiring operators in Venezuela’s Orinoco Belt to agree to new contracts with the state oil company, Petroleos de Venezuela SA (PDVSA), as well as the direct expropriation of assets of foreign owned investors.

- **Russia**: The threatened cancellation of projects operated by Total and Exxon Mobil using its environmental permitting process as leverage to renegotiate contracts and return gas and oil fields to state control.

- **Argentina**: The forced ‘pesofication’ of the dollar resulting in the indirect expropriation of assets.

- **Colombia**: Continued political violence events resulting in physical damage to overhead transmission and distribution lines.

TYPES OF COVERAGE AVAILABLE

Political risk insurance is available to, amongst others, contractors, investors, and lenders involved in the power and utility sectors. Aside from providing risk mitigation, it is simply good risk management practice as these risks are often difficult for companies to adequately assess when working in foreign countries with different jurisdictions and laws.
**CONFISCATION, EXPROPRIATION AND NATIONALISATION**

Confiscation, Expropriation and Nationalisation (CEN) offers protection against the acts of a foreign government that could deprive the project sponsor of its equity/ownership in the project company, and the confiscation of assets (both mobile and fixed). Coverage can also extend to include cancellation or termination of any concession (such as a PPA) or operating agreement provided to the project company, forced abandonment of the project and forced divestiture of the project assets. Cover for ‘creeping expropriation’ can also be obtained.

**EMBARGO**

Cover can be provided to protect the project company against the introduction of any law, order or decree, including the cancellation or non-renewal of any previously valid import, export or transit licence which prevents or delays the import or export of goods and/or services into or out of that host country.

**POLITICAL VIOLENCE**

Political Violence protects against losses resulting from damage or destruction of project assets due to events such as War, Civil War, Riots, Strikes, Civil Commotion, Sabotage, Terrorism, Insurrection, Rebellion, Revolution, Coup d'état or Malicious Damage. This is of particular relevance to overhead transmission and distribution lines where there is a very real risk of acts of political violence. It is also possible to cover the resultant business interruption.

**CURRENCY INCONVERTIBILITY/EXCHANGE TRANSFER EMBARGO**

Cover can be provided against the inability of the project company to convert local currency into a freely convertible currency such as US dollars or the inability to transfer hard currency funds out of the host country to remit dividends or earnings back to the project’s sponsors and/or to service its debt service obligations. Situations where the project company is unable to make a deposit due to a government action or where currency cannot be remitted following the cancellation of a permit that previously allowed the project company to hold offshore accounts can also be covered. During the financial crisis there was an increased risk of currency inconvertibility as governments sought to impose stringent foreign exchange controls.

**BREACH OF CONTRACT**

This covers the breach of specific contracts by host governments such as a joint venture/production sharing agreements or off-take contracts where the government or state-owned entities are off-takers of the resources being produced. This may take the form of Arbitration Award Default which can sometimes be extended to include Arbitration Frustration or Denial of Justice types of cover. Where sovereign guarantees are issued to cover the performance obligations of the off-taker, non-honouring of the guarantee can also be provided.
TERRORISM AND POLITICAL VIOLENCE
THAI RIOTS HIT STANDALONE TERRORISM MARKET

Mitigating physical security risks in the world’s power producing regions is a challenge that governments and companies have grappled with for decades. Ensuring the safety of power infrastructure is never straightforward, whether it is in lower-risk countries in Europe or North America, or in higher-risk operating environments, such as those in Latin America, sub-Saharan Africa or Southeast Asia.

Power and Energy play an important role in the national security of any given country as fuel to drive the economic engine. Accordingly, threats to this ‘fuel’ can result from physical damage to the power/energy infrastructure either of the supplier, or of the importer as a result of Terrorism, Political Violence, or Warfare.

Much of the power industry’s infrastructure is virtually impossible to protect. Physical security tends to focus on substations and power plants themselves, rather than power, transmission, and feeder lines. The relative ease with which power companies can re-route or re-build these lines has meant that it is the power plants/substations that require the major physical security and represent the major threat.

Insurance plays a vital role in managing these risks and the global insurance market is organised to handle them.

MUCH OF THE POWER INDUSTRY’S INFRASTRUCTURE IS VIRTUALLY IMPOSSIBLE TO PROTECT

MARKET CONDITIONS

The recent events in Thailand have had a huge impact on the standalone terrorism market. These incidents, in terms of insured losses, are estimated to be up to USD 1 billion. The events underline how important it is that insureds have the broadest wordings possible to ensure any definitions of the events are covered, regardless of how governments or insurance companies define the events. Political Violence cover is available to ensure there are no issues in terms of definition of the event. Political Violence cover includes coverage against: War, Civil War, Riots, Strikes, Civil Commotion, Sabotage, Terrorism, Insurrection, Rebellion, Revolution, Coup d’état or Malicious Damage.

Overall capacity levels have increased by approximately USD 100 million, mainly as a result of fresh inputs from, amongst others, Antares, Market Form, Argenta, and Pembroke. As a result, we now estimate that there is a total of between USD 1.2-1.5 billion of ‘competitive capacity’ available to buyers. At the time of writing it is too early to determine what impact the events in Thailand will have on rates from the standalone terrorism market.

The insurers showing the keenest appetite for Terrorism and Political Violence business are generally from Lloyd’s, although the likes of Lancashire Re are also prepared to offer competitive terms for certain business. Other non-Lloyd’s insurers such as Axis and Montpelier Re have been more reluctant to match the underwriting stances taken by these leading markets.
Despite the limited impact of the Copenhagen Summit, renewable energy represents the fastest growing source of power generation worldwide. The size of the wind market has grown from 60GW to 130GW between 2005 and 2010. The solar market currently stands at 10,000 MW. Amongst others, the drivers for growth are: international concern about climate change; political goodwill manifesting in attractive incentives to enhance return on investment; growing price competitiveness of certain technologies (in contrast with oil and gas prices), and improved emphasis on the reliability of technology. More page space than ever is now devoted to transmission infrastructure.

For the last few years the risks have been getting Bigger, Trickier and More Challenging and the experience in the insurance marketplace is mixed. Now, inevitably, more similar risks and many completely new risks are about to be tried and the risk takers and risk carriers need to share knowledge if they are to create a sustainable and reliable renewable energy mix.

Unfortunately, try as hard as we might, things do go wrong. Even with the most robust engineering and diligence losses still occur. For the insurance industry, who see risk everyday, Renewables seems to be rolling back down the learning curve. However, the industry is learning lessons to avoid derailing future projects. Sensible approaches to development strategies, contingencies and risk sharing are all becoming aligned. This raises the attractiveness of insurable risk in the wider Renewables sector and is leading to expansion in market capacity and more sophisticated underwriting skills.

Four or five years ago, the market was very consolidated, but since then there has been a lot of personnel movement. Underwriters have left some of the established carriers for other businesses to provide a new area of expertise. Now we have more than just a handful of insurance firms who are willing to participate in the Renewables sector. Since then, rates have dropped from Construction as well as Operation. In terms of solar, the rates have been quite static, mainly because solar tends to be more lenders-driven or project-financed. All this has coincided with a reinvigorated capacity from other insurance markets. The result of the growth in Renewables, as we have seen it, has produced a soft market environment and this is unlikely to change as 2010 proceeds. More and more insurance firms are writing Renewables and this has caused competition to escalate and rates to drop.

The Renewables insurance market is developing insurance products as rapidly as the Renewables energy industry is growing. One issue that has affected the Renewables industry is that a lot of the technology involved is still prototypical and largely unproven. As a result, we have seen underwriters spread their risk over several projects rather than taking a bigger line on individual energy ventures.
OFFSHORE WIND

For renewable energy practitioners, offshore wind must be a simple and robust technology to answer future energy security in our decarbonising economy. It must also lower the marginal price of power for the end users and expand the green collar workforce.

The economics of offshore wind are unravelling but there is no consensus as to strategy for driving down unit cost per MW. Bigger, heavier ‘mega’ wind turbines – or a large number of simplified installations? Either way, better economies of scale and fresh technologies will depress the currently high unit cost per MW. Low cost serviceable units will need to be in the mix.

The risk of project delays will only increase unless new vessels, such as jack-up barges, are built to withstand the rougher seas and achieve turbine installation for heavier units well beyond the normal weather window. Similarly, greater supply chain investment – such as supporting design innovation – is needed if the world’s potential for offshore wind is to be fully realised.

Some pioneers are already designing and building floating substructures to support and secure turbines in deeper waters. Such innovation carries with it substantial and unavoidable risk but the industry cannot thrive by 2020 without these risk takers and their pioneering vision.

One of the exciting proposals for the seemingly intractable issue of Transmission and Distribution is the creation of an offshore ‘super grid’ in North-Western Europe. Nearly all developers have grappled with the transmission and distribution issues that lead to considerable export and array cable insurance losses. Such losses seem to be inherent to the offshore environment. This proposed innovation may be one of the ways to buffer the collective exposure among projects and negate single point failure risks.

Risk confronts us and requires solution mechanisms such as management, mitigation and transfer. Contract, Physical, Professional Indemnity and Liability risk demand such solutions be grounded in partnerships, founded on dialogue and mutual understanding between specialists. As technical innovations are created, so the risk horizon expands.

The growth in offshore wind will generate business for many companies involved in the supply chain of Project Development, including turbine manufacturers and construction companies, as well as financial institutions and insurers. This is critical to support such projects and to manage and transfer risk from the balance sheet of developers.

Realising the huge potential of the offshore wind sector will not be all plain sailing. Stormy waters lie ahead, with consenting hurdles, escalating costs for turbines, project delays and transmission and distribution challenging even the most experienced project developers.

Accordingly, the offshore wind sector remains relatively high risk. Key exposures include those that arise from new technologies requiring innovative installation methodologies, appropriateness of vessel type and availability and the time-constrained weather window in which turbines are installed.

During the operational phase, turbines are exposed to lightning strikes, machinery breakdown, fire damage and the risk of collision with marine vessels. However, high winds are not usually an issue for turbines which are designed to withstand harsh conditions, and such damage is less common.

Increased cooperation and strategic alliances between utility companies, offshore wind operators and supply chain partners will add experience and expertise to future projects as they share lessons learned and help spread and reduce risks.
Offshore wind has emerged in the last 20 years as the riskiest subcategory of the renewable energy boom in the eyes of the insurance market.

The risk of loss during Construction and Operation remains high due to limited contractor experience, a constrained supply chain including limited suitable vessel availability, prototypical concepts and turbine designs and the intransigence of some in the industry to adopt oil and gas best practices.

Safety is a major issue. The industry has recently seen three fatalities from big names and it concerns underwriters that the risks are not fully understood. The engineering process is still being scrutinised with varying degrees of independent design checks and assessments. Other parties’ technical advisors don’t really count as independent and we believe it is a cost issue.

Vessel suitability and classification need careful assessment, especially stability criteria, wind loading and certainly how these factors differ between transportation and lifting.

One of the challenges for insurance is the use of marine architects whose potential is currently undervalued despite some of the world’s finest working in the Square Mile. The role of the Marine Warranty Surveyor (MWS) is too limited and needs to be ingrained deeper into a project. It has to be understood that a wider dialogue between all parties, project owners, brokers and insurers is necessary. Just because it has never happened before does not mean that the status quo should be maintained. On both sides of the fence, for Project Owners and Underwriters, the MWS should be seen as a risk management investment, not a cost.

The insurance industry will not protect those projects which are considered to have cut corners. The holistic approach outlined above could curb the growing trend of recent losses – especially around the basics such as anchor handling, cable spooling, working with Remote Operated Vehicles and so on.
ACCIDENT AND HEALTH
YOUR KEY ASSET

EVER INCREASING EMPHASIS ON DUTY OF CARE TO EMPLOYEES

Power and Utility projects in emerging markets rely on local human resources and face many challenges in an increasingly dynamic world. The varied activities conducted by these organisations lead to a diverse multi-cultural workforce, spread across the globe.

Workforces are the key asset to the operation of Power and Utility organisations and provisions must therefore be made by employers for income protection and dependants’ support, should their staff be injured or become ill as a result of performing their occupational duties. The overview below explains some of the risks faced by an organisation that employs national and international workforces. Categories of staff could include expatriates on annual contracts, consultants hired on a project basis, permanent employees, temporary employees, and others.

PERSONAL RISKS

Death or disability to employees arising from accidents or due to illness are the overriding risks, wherever the person is employed. Organisations traditionally wish to:

- Continue paying the salary to the individual as long as the employee is temporarily prevented from carrying out his/her occupational duties (Temporary Disability);
- Protect the income of the employee in case the person is permanently prevented from carrying out his/her occupational duties ( Permanent Total Disability);
- Compensate the individual in the event of partial disablement (Permanent Partial Disability);
- Compensate surviving dependants.

In recent years, there has been a noticeable increase in terrorist attacks, threatening areas and groups which were not previously seen as targets.

Power and Utility companies may have staff in many parts of the world where there is war and unrest, as well as large accumulations of staff in headquarter locations in major cities. Cover for Injury and Illness resulting from such malicious acts has therefore become an absolute need and, depending on where the organisation operates, protection against the following perils should be considered:

- War
- Terrorism including the use of Nuclear, Chemical and Biological devices
- Rebellion, Revolution and Riots
- Sabotage and Explosion of War Weapons
- Murder or Assault.

TRAVEL RISKS

Employees working overseas are faced with potential problems that they might not experience in their own country. These risks include:

- Finding medical treatment in unfamiliar surroundings or areas where limited or no services are available (Medical Expenses);
- Arranging for travel and accommodation of family or friends (Supplementary Travel Expenses);
- Requiring assistance for employees and residing family members to be evacuated or repatriated as a result of medical emergencies (Medical Emergency Assistance);
- Legal liability resulting from bodily injury, sickness and disease or accidental loss or damage to the property of any person (Personal Liability);
- Pursuing a claim for damages and/or compensation against a third party who has caused them injury, death or illness (Legal Expenses);
- Loss or theft of personal possessions, cash and travellers cheques either in transit or whilst abroad (Personal Property/Money);
- Cancellation, curtailment, disruption, delay of the planned trip.
Corporate responsibility for the safety and protection of employees continues to increase globally. Accidents and illnesses that occur in the workplace and the corresponding medical expenses and potential need for repatriation are being given increasing priority.

Overseas emergency medical evacuation of employees and the associated costs have become more and more important for employers and the security of individuals must also be considered.

Personal Accident policies can be provided to provide financial protection for individuals suffering temporary or permanent disabilities including the associated emergency medical costs and repatriation. In this way, corporations can protect contractual benefits payable to employees and this can be particularly important in the event of a serious incident involving a large number of employees. Accidental Death and Permanent Disablement benefits are generally provided on the basis of a multiple of annual salary, as required.

Coverage can be provided on a worldwide 24-hour basis.

Specific policies can be put in place to cater for key personnel within a corporation and ensure that full cover and protection is available, whatever the occupational duties of individuals are.

As we have seen in the Renewables section, the offshore wind industry has recently taken three lives.

**OUR CAPABILITIES**

With an ever-increasing emphasis on duty of care, companies are extremely attentive to providing the best protection available to their workforce throughout the world. Events such as the terrorist attacks in Mumbai and the civil unrest in Thailand underline this duty of care.

The Willis Accident and Health department is one of the largest broking teams in its field in the London insurance market, specialising in handling niche risks involving personal injury, sickness or death.

We have developed a unique expertise in arranging bespoke solutions for clients whose multinational workforce travel to or operate in remote and often hazardous areas.

The bespoke products generally comprise the following components:

**Personal Accident Benefits**

- Death
- Permanent Total Disablement (Accident/Illness)
- Permanent Disablement in accordance with a Compensation Scale (Accident only)
- Temporary Total Disablement (Accident/Illness)

**Emergency Medical/Evacuation/Repatriation Expenses**

- As a result of Accident/Illness
- Including Funeral Costs & Mortal Remains Repatriation
- Follow-Home Cover

**Travel Benefits**

- Loss of Money/Personal Property, Damage to Personal Property
- Cancellation & Curtailment
- Personal Liability
- Emergency Political Repatriation and Relocation
- Extension Benefits such as Hospital Confinement, Employee Replacement, Legal Costs

Benefits are generally a fixed amount or a multiple of salary and cover can include various categories of staff (Expatriates, Third Country Nationals and Local Country Nationals) each with their own benefit structure.
EMPLOYEES WORKING OVERSEAS ARE FACED WITH POTENTIAL PROBLEMS THAT THEY MIGHT NOT EXPERIENCE IN THEIR OWN COUNTRY
EMERGENCY CRISIS MANAGEMENT ADVICE AND RISK PREVENTION SERVICES

The increase in security incidents, natural disasters and other related threats, ranging from terrorism to epidemics, and the increasing number of malicious acts to personnel, has highlighted the need for organisations to be more sensitive to the security, health and risk management issues of the environments they operate in.

Companies are concerned with the protection of their assets but are now even more aware of the financial and management implications of incidents affecting personnel – and possible resulting litigation, which could have a significant negative impact on company reputations and compromise good governance procedures.

Willis, in exclusive partnership with leading Risk Consultancies/Security companies, has created ALERT-24, a Personal Accident and/or Business Travel product uniquely providing preventative risk management, financial protection and crisis management solutions to organisations and corporations against a wide variety of security risks, to help protect companies’ key assets, their personnel.

CRISIS MANAGEMENT ADVICE, ALERT-24

ALERT-24 incorporates Emergency Crisis Management Advice and Temporary Security Measures provided by leading Risk Consultancies/Security Companies to help clients with the management and security costs of a threat or security incident, in order to reduce the risk of death, injury or sickness to Insured Persons and therefore help our clients with the management and costs incurred.

ALERT-24 will react to the above threats or security incidents and will cover all reasonable and necessary fees and expenses charged for security materials, equipment, manpower and dedicated time, up to the benefit and indemnity period limit specified in the policy. It will also provide coverage for reasonable costs incurred by the Insured in respect of Insured Persons for travel to the nearest place of safety or to their resident country and/or necessary accommodation costs arising there from, up to the benefit and indemnity period limit specified in the policy.

- Malicious Attack
- Insurrection
- Riot
- Disappearance of Personnel
- Terrorist Incident
- War
- Murder
- Military or Usurped Power
- Assault
- Civil War
- Coup d’état
- Natural Disasters
- Epidemics and Pandemics
- Explosion of War Weapons
- Political Security Incident
- Medical Evacuation Liaison
- Security Emergency Evacuation
- Revolution
- Civil Commotion
- Sabotage

- Rebellion
- Bomb Find/Bomb Explosion
- Accidental Death
- Permanent Total Disablement
- Temporary Total Disablement
- Medical Expenses, Emergency Repatriation and Evacuation
- Hospitalisation Indemnity
- Funeral Expenses
- War, Terrorism and Malicious Acts
- Nuclear, Chemical and Biological War and Terrorism Exposure
- Crisis Management Advice
- Security Materials and Equipment
- Travel Costs for Security Evacuations

WORKFORCES ARE A KEY ASSET TO THE OPERATION OF POWER AND UTILITY ORGANISATIONS
RISK PREVENTION, ALERT-24
ALERT-24 provides clients with risk assessment and security training in a range of disciplines to reduce the risk to local personnel, travelling executives and expatriates that operate in or are to be deployed to a risk or threat environment. Companies have a duty of care towards employees, and ALERT-24 can advise on the mitigation of risks to personnel through security consultancy provided as part of our offering:

- Research and Analysis
- Crisis Management Planning and Training
- Training for Security Managers and Coordinators
- Evacuation Management
- Physical and Procedural Security Surveys and Audits
- Terrorist Damage
- Defensive Driver Training
- Hostile Environment Training
- Psychological First Aid and Trauma Awareness
- Access to security information on a worldwide basis

MARKET OUTLOOK
The Accident and Health insurance market has experienced a trend of lower rating on the majority of business over the past two years, although at the beginning of 2010 rates started to stabilise with the possibility of increased premium costs in the future. Terrorism presents a constant threat of injury and loss of life: incidents are still continuing worldwide. However, to date terrorism has not had the negative impact on the rating rationale of insurers that some predicted.

Personal Accident products continue to develop, particularly in respect of Global Personal Accident and Travel Insurance solutions. Accident and Health capacity continues to increase in the London insurance market and aggressive pricing can still be seen for medium-to-large risks of high quality, as insurers consider the sector to have a relatively constant overall loss ratio with acceptable margins.

Insurers are also concentrating on enhancing products to provide wider policy benefits and nuclear, chemical and biological coverage is becoming ever more important for a wide range of clients.
CLIMATE CHANGE IS A RISKY BUSINESS

THE PROBLEM

“The adverse effects of changing weather patterns, such as floods and droughts, and related economic costs, including compensation for lost land, could risk polarizing society and marginalizing communities. This, in turn, could weaken the institutional capacity of the State to resolve conflict through peaceful and democratic means, to ensure social cohesion, and to safeguard human rights.”

“Migration driven by factors such as climate change could deepen tensions and conflicts, particularly in regions with large numbers of internally displaced persons and refugees. Scarce resources, especially water and food, could help transform peaceful competition into violence.”

Ban Ki-Moon, 2007

Jim Lovelock’s Gaia Hypothesis suggests that the ‘Earth system’, through a variety of feedbacks, has maintained our planet’s surface temperature within the bounds that life can tolerate. However, the geological record shows that within those bounds the variations and the associated changes in sea level, rainfall and so forth have been considerable. This is particularly so from the human perspective. Our social, economic and political structures assume stasis, but stasis has never been a feature of the Earth system, quite the opposite – the planet is truly dynamic. Moreover, the geological perspective highlights that apportioning blame is futile.

Climate change is not about growing grapes in Greenland or the ‘Mediterraneanisation’ of the Kola Peninsula – it is about real risk from direct and indirect consequences of change, and in particular the risk of dispute and conflict. Minimizing that risk requires intelligent planetary management informed by the best science possible.

Climate is a highly dynamic property of the Earth system. It fluctuates constantly due to a variety of factors that all change over a range of timescales. Despite this the ‘Deep Time’ perspective on climate change has largely been ignored by the Intergovernmental Panel on Climate Change (IPCC). The IPCC has concentrated on the cool, or ‘icehouse’, Earth of the recent past that began just 1.7 million years ago instead of the ‘greenhouse’ climate that prevailed for the previous 260 million years. In fact, for about 80% of the past 500 million years, the Earth has been warmer than now. Accordingly, there is a vast amount of geological information as to how the real world operates under these warm conditions; data that can be used to evaluate the performance of predictive climate models. This failure to factor in real world observations has resulted in an overly optimistic view of future climate change.

DRIVERS OF CHANGE

The drivers of climate change operate over a wide spectrum of timescales. Over millions of years the movement of continents and the growth and disappearance of mountain belts change the geographic patterns of solar energy absorption and re-radiation, the path and strength of ocean currents and the patterns of winds. The energy given out by the Sun also changes, but over both long and short timescales. For example, the so-called ‘solar constant’ is far from fixed and solar luminosity has risen by around a third of its present value since the Earth was formed around 4,600 million years ago.
Solar output also varies over the 11-year sunspot cycle, but the change in solar flux is small – about a quarter of one percent. The shape of the Earth’s orbit, the angle of the rotational axis with respect to the orbital plane and the direction the axis points vary over cycles of different length ranging from 110,000 years for orbital shape and 21,000 years for axial direction. These so-called Milankovich cycles result in complex but predictable changes in the amount and distribution of the Sun’s energy received at the top of the atmosphere.

Once the solar radiation reaches the atmosphere and the Earth’s surface it is either absorbed or reflected. The reflectivity (albedo) is high for snow and ice and low for oceans and vegetation. Albedo of vegetation varies seasonally in mid to high latitudes and over centuries everywhere as forests develop. Snow and ice albedo can vary seasonally but cloud albedo can change over seconds and minutes. Dust in the atmosphere also plays a role in albedo, either directly, or by dust particles acting as nucleation sites for cloud water droplets.

The IPCC has tried to quantify the net effect of the different variables considered so far. Contrary to some press reports, changes in solar irradiance account for a very small amount of warming, at most 0.3 watts per square metre. This is only just higher than the effect of particulates falling on snow and ice. These effects are vastly outweighed by the cooling effect of aerosols and land use changes.

By far the greatest warming is due to increases in greenhouse gases, predominantly methane and carbon dioxide. It is very difficult to quantify greenhouse gas concentrations back in ‘Deep Time’. There are various proxies for CO2 but the values they return show great variation. That said, the combined effect of all greenhouse gases in the atmosphere today is equivalent to around 430 parts per million by volume (ppmv) CO2. This appears to be higher than anything seen for about 20 million years and certainly far higher than anything seen during the warm interglacial of around 125,000 years ago when we know that almost all the Greenland icecap melted and sea level rose by around seven meters.

In 1896 the Swedish chemist Svante Arrhenius did what today we might call a ‘back of the envelope’ calculation of the temperature effect of doubling the atmospheric concentration of CO2 from the then value of 280 ppmv. His calculation showed that around a 5°C rise would be expected – a value similar to that shown by the latest climate models, but these models factor in a range of greenhouse gases, cooling aerosols and a variety of feedbacks. Since Arrhenius did his calculations the average global temperature has risen by almost a full degree.

CLIMATE MODELS AND THEIR LIMITATIONS

Early models had very simple boundary conditions consisting of just geography (land/sea distributions), present day orbital configurations and a ‘wet carpet’ ocean lacking currents etc. and could return temperature and rainfall. As models improved clouds, prescribed (static) ice and land surface characteristics were added. The most recent Assessment Report (AR4) uses the results of what we can now call ‘Earth system models’ with dynamic coupled oceans and atmosphere, active atmospheric chemistry and dynamic vegetation included. Such models give reasonably good simulations of modern climate with all its complex feedbacks, but this is to be expected given that such models have their origins in weather forecasting and are ‘tuned’ to reproduce present day conditions.

There is a wide variety of models, and for any given set of boundary conditions and emissions scenarios each model gives different results. One reason for this is that each model has slightly different coding and sets of equations. Within each equation there are simplifications of the real world known as parameterisations to which certain numerical values are attached. Differences in equations, and even rounding errors, compound as the models calculate temperature, rainfall, pressure winds, and so forth for the numerous interacting parcels of air on 30 minute timesteps that build into decades. The values underpinning the parameterisations are themselves ‘average’ or ‘typical’ observed values and could quite validly have values either side of the average.
To evaluate the effect of varying parameter values as the equations cascade and the parameterisations interact, a public participation distributed computing exercise called ‘climateprediction.net’ was undertaken. The public were invited to run a climate model on their PCs with each download having the same boundary conditions but different values assigned to each of 23 parameterisations (for example simplifications that describe cloud physics). With doubled CO2 but real-world parameterisation values, some models gave a rise in global mean temperature of up to 8°C but some cooled to such a point that the world froze over.

Clearly the values given to the parameterisation are crucial to getting reliable model performance.

Another way of testing the models is to try to get them to reproduce ‘greenhouse’ climate conditions from the past. Here, despite over 30 years of model development, all models fail, no matter how configured, and find difficulty reproducing the warmth observed at high latitudes and in continental interiors – two key areas that today show the greatest warming.

As an example, geological data from the Siberian Vilui Basin, which today experiences a cold month mean temperature of around -40°C, suggest that between 90 and 70 million years ago the Vilui vegetation was rather like that seen in Florida today, including palms. The annual average temperature was around 13°C and winter temperatures barely fell to freezing. Out of an ensemble of 40 model runs differing in geography, greenhouse gasses and orbital configurations, the warmest winter temperature achieved was only -17°C and therefore utterly incompatible with the observed ancient vegetation.

**Figure 1.** Observed global mean temperature between 1880 and 2005 relative to the 1951-1980 mean (GISS/NASA). Note the plateau between 1945 and 1975.

**THE BOTTOM LINE**

A general characteristic of all models is that they seem anchored in the present and underestimate change that has taken place in the past. The net result is that they are inherently conservative and so are likely to underestimate possible future change.

**“ALL MODELS ARE WRONG. SOME ARE USEFUL.”**

Oliver Peterken, Willis Auditorium, 2009

The uncertainties associated with looking so far back in time are obviously much larger than when measuring present day climate. For this reason the IPCC, in its constant search for consensus, has tended to shy away from Deep Time data despite the clarity of the signal it offers. The quest for consensus breeds a conservative approach to data inclusion that, coupled with the inherent conservatism of the models, means that its projections for the future are likely to be on the benign side of reality. Risk is therefore consistently and markedly underestimated. In planning for the future it is wise to appreciate this.

**Professor Bob Spicer**

Chairman, GHG-Energy.com

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**UNLIKE SUCH PUNCTUATED NATURAL EVENTS, HUMAN INFLUENCES ON THE EARTH SYSTEM ARE ONGOING**
CARBON CAPTURE AND STORAGE
THE CARBON ‘CRUNCH’ — RISK MAPPING OF CARBON CAPTURE AND STORAGE (CCS)

Climate change grabs headline after headline and renewable energy leads the word count in the assault on global warming but, whilst Renewables clearly have a part to play in energy strategy, reliable, sustainable and economic systems rely on blended energy solutions. With economies heavily dependent on fossil fuels CCS can be one of the world’s most important carbon abatement technologies. Although the following analysis is largely focused on the European Union the underlying technology and the commercial and legislative issues raised will be played out across the planet.

A recent US article stated that,

“To meet renewable energy standards of 25% by 2025 would require 710,000 units of wind turbines at 2.5MW each, that would require 109 million acres for siting, which is 940% greater than the Department of Environment considers good siting areas for wind, and would consume raw materials 200% greater than consumed by the whole USA in 2009.”

Indeed, the US relied on coal for 48% of its electrical needs in 2009 and the UK has an extremely high dependency on imported coal, the EU is heavily sustained by fossil fuels, and developing countries continue to build coal-fired power stations.

Enter then Carbon Capture and Storage (CCS); the technology solution based on the capture and geological storage of carbon dioxide (CO2), which would otherwise be released into the atmosphere, to assist in sustaining energy production from fossil hydrocarbons. The technology solution is relatively simple and brings together proven expertise developed from oil, gas and mineral industries. To exist commercially, however, it requires a firm commitment from policy makers and legislators to a structure and system in which CCS can operate. The process as understood today presents several risks both during and post the CO2 injection phase which ultimately will lie with government – but the insurance market has a significant role to play.

STORAGE — SHORT AND LONG TERM AND DECOMMISSIONING RISKS
The environmental risks associated with CO2 storage and long-term liabilities are seen as critical to any project: developers have limited desire to absorb this risk entirely onto their balance sheets. It is likely initial projects will be formed in Special Purpose Vehicle Companies (SPVs) which have to comply with the difficult EU directive of financial security pre commencement of injection. Two key areas of environmental risk affect the entire chain and constitute new risks to the insurance market, namely:

1. The loss of CO2, leading to new pollution risks associated with the implementation of the EU Environmental Liability Directive (ELD) and potential climate change ‘Group’ actions (i.e. law suits from public and pressure groups implicating CCS CO2 losses in contribution to climate change).
2. The implications on the EU Emissions Trading Scheme (ETS) of carbon considered ‘abated’ which is subsequently lost to the environment during storage (and transport) and the commercial risk for carbon credits received requiring repayment.

In addition, commercial operators (and potentially governments) will be concerned by the long-term monitoring, remediation and decommissioning costs. These are generally considered operational and maintenance risks by insurers and therefore not covered under traditional insurance.
Generally speaking, the private sector will be more willing to accept the transfer of a particular risk if it is in turn able to transfer that risk to insurers by means of an insurance policy.

There is, perhaps, another risk that the market will need to consider involving the role of the emitters and storers under the CCS regime and the contractual arrangement in the chain. The emitters produce flue gas which needs cleaning and extraction of CO2 for storage; the emitter may well consider flue gas a product (for which he is paid through means of the ETS) and responsibility for the injected CO2 (i.e. cleaned flue gas) will lie somewhere down this chain.

There is, therefore, the probability that the CO2 as a product itself becomes contaminated or attracts contaminants during transportation. The EU Directive defines the capture as ‘overwhelmingly’ CO2 which calls for careful chemical analysis of the injected gas in order to avoid potential future damage to the storage reservoir.

Current Insurance Market

CO2 risks are not currently fully insurable as they are new risks to the environment and insurers will need to consider how they deal with such risks in relation to climate change generally. Strict liability will attach in the event of a leak although, depending on the nature of the release, the quantum will be a subject of much debate. Release may not necessarily require escape to atmosphere – an area which insurers will want to exclude – but release outside reservoir boundaries into adjacent minerals or other reservoirs would introduce exposure to costly remediation.

This area will no doubt raise the ever-vexing issue of legal costs on both sides of a given legal action. Additionally, risks of leakage may consequently mean closure of a storage facility and replacement with another facility: this would entail significant consequential losses and additional costs.

A number of insurers are actively engaged in formulating viable responses to these and other CCS issues and what risks they can cover at this embryonic stage of CCS and associated technology. Currently risks 1) & 2) are not considered as insurable – except for usual cover for general liabilities (for example personal injury from a sudden rupture of a CO2 pipeline), but not environmental liabilities.

The risk of class actions from climate change plaintiffs is too great and one which would lead to significant and drawn-out defence costs. Similarly, the volatility of ETS prices and the sheer volumes involved will be problematic without a cap on such liability, assuming the quantum question can be resolved.

Environmental Liability is insured via specialist sectors, viz, ‘the Environmental Impairment Liability (EIL) market’. In the UK Chartis (formerly AIG), Liberty, ACE, Chubb and XL have an environmental capacity. Further markets exist, including Zurich who are taking a leadership role in the thinking that supports CCS risk-sharing and do underwrite environmental risks in the US.

It is likely that no single insurer would take the risk unaided. Therefore a combination of markets ‘layering’ the risk or a pool of market capacity will need to be formed. This may result in a bespoke policy wording for these risks being borne, leading to a number of possibilities:

- **Risk Pool**
  Either as a pure pool of commercial insurers, as, for example, a P&I club in the Marine insurance market or potentially as a Government-backed collective, for example, Pool Re/Nuclear Re. The Pool acts as commercial insurance but financial security is shared.

- **Risk Fund**
  A commercial mechanism to pay ‘premiums’ into a fund which is then available to fund the risks associated with CCS storage issues. The fund is bespoke, funded by operators but can involve insurance companies through ART to fund, for example, the initial shortfall or excess risks.

- **Bonds/Escrows/letter of credit, etc.**
  Bonds and Escrows are commonly used for landfill liability in waste management for the financial provisions under the Environmental Protection Act. Other forms of credit have been proposed but not accepted by regulators. The scale of storage liabilities may make these forms unpalatable (to operators) or unacceptable (to the regulator).

- **Government self insurance**
  For the shorter-term liabilities, pre-handover to the regulator, this would detract from the commercial nature of the operations. Long term storage liability post-closure and landfall will be retained by the government in the UK.
Typically, insurance works on many premium contributions being collected to pay out the risks of the few who suffer losses. Initially, CCS may be the reverse of this with few premium contributions for a single (catastrophe) risk. Typically, insurers are therefore reluctant to take on such new risks until some form of track record exists or they have a comprehensive risk analysis. For commercial development to move forward the relevant support mechanism must be found through; the pricing economics of carbon storage, the guarantee of financial risk funding at the commencement of injection, and the ultimate limitation of liability for the developers. Whilst, ultimately, governments may be the ‘insurer of last resort’ the insurance industry does have prior experience and knowledge to support effective mechanisms for CO2 abatement.

Key insurability points are:
- Climate change laws in general are emerging and insurers will adapt to changes in the liability régime;
- CCS legislation requires some form of financial provision to deal with liabilities, which could include insurance;
- The liabilities associated with pollution can be partly covered in the insurance market;
- The liabilities associated with most parts of the CCS chain are readily insurable but, due their scale, the storage liabilities are a different issue;
- Storage liability issues will require pooling of market resources and potential government involvement (for example as per the UK terrorism risk pool – Pool Re).
AN ADJUSTER'S PERSPECTIVE
WIND POWER – A LOSS ADJUSTER’S PERSPECTIVE

The ongoing debate about whether climate change is taking place and the conflicting demands of supplying electricity to industry and homes with the need to protect the environment has led many countries to focus their attention on wind power. In order to generate sufficient amounts of electricity to meet the increasing demand, future wind farms will need to be much larger than those constructed to date. With planning and regulatory controls often presenting hurdles – along with public opinion being divided about the merits of wind power – the viability of building large-scale projects onshore in many countries is questionable. Accordingly there is an increasing trend towards offshore construction.

The government of the United Kingdom has set itself a target of producing one third of the country’s electricity from wind power by 2020. In order to achieve this it has given the green light to the development of nine huge offshore wind farms on sites around its coast. In excess of 25GW of power will be generated from these sites. The United Kingdom is not alone in its thinking with other countries including Germany, The Netherlands, Sweden, Belgium, Spain and the United States considering similar offshore wind development policies.

To achieve the goal of wind power delivering sufficient reliable electricity to meet in meaningful part the demands of a modern industrialised country is a huge challenge: larger capacity turbines will need to be constructed further offshore and in deeper water. The capital cost of construction is significant and in many instances completely new offshore transmission networks will be needed. A taste of what is to come in the future for the United Kingdom has already started with the construction of the world’s largest offshore wind farm to date, currently underway 20 kilometres off of the east coast in the Thames Estuary. Once completed, the turbines from this single wind farm will generate as much electricity as is currently generated from offshore turbines around the world.

There is no real difference between how a wind turbine operates on or offshore. The power of the wind hitting the leading edge of the turbine blades turns them which rotates a shaft located inside the nacelle at the top of the turbine tower. The majority of turbines have a gearbox located on the shaft which converts the slow speed rotation into a higher speed which is sufficient to allow electricity to be produced in the generator, also located in the nacelle. The wind farm’s transformer then converts the electricity to a higher voltage for onward distribution into the grid network. The most obvious difference between the infrastructure of an offshore wind farm to that of an onshore one is how the electricity is transferred from the individual turbines to the grid network. This is the use of sub-sea cables to interconnect the various turbine arrays as well as to export the electricity back to the coastline.

Wind turbine manufacturers are clearly set for a major increase in the demand for their product as a new cycle of project development begins. The very first cycle of development saw turbines with small capacity (400KW) going into commercial operation. Until the manufacturers and their sub-suppliers were able to harness the reliability of the component parts, turbines were plagued by breakdown problems associated with gearbox and generator failures. A period of relative reliability followed until the late 1990s and early 2000s when, as demand for wind energy began to gather pace, a further cycle of development began with an increase in turbine size to 1MW and above. This appeared to set in motion a further period of component failure problems which seems linked to the increase in scale required to meet the growth in capacity. Turbine sizes of 2.5MW and 3.6MW are now commonplace and there are also turbines of 5MW in commercial operation. Mechanical breakdown of nacelle components remains a major reason why a turbine might fail.
The insurance industry has developed policies which have assisted wind farm owners in relation to the Construction phase of a project and for the Material Damage and Business Interruption losses which flow from operational mechanical breakdowns. Not surprisingly, however, the industry has responded to some of the cyclic trends which have emerged and imposed more restrictive terms and higher deductibles in certain instances: this is not likely to change. With the scale of the future projects both on and offshore expecting to comprise hundreds (rather than tens) of operational turbines it is unlikely that a single turbine breakdown from component failure would be a risk that the owners will consider cost-effective to insure.

The new phase of wind farm development will ultimately result in projects both on and offshore equating in size to traditional power plants. This means that a larger amount of power generation capacity and the income derived from it will be at risk. Unlike a standard thermal power plant where a small number of large capacity turbines are operating, the new generation of wind farm will be made up of hundreds of individual turbines. The loss of one turbine is thus less significant for a wind farm owner than the loss of a single steam turbine for the thermal plant owner. Conversely, however, in the event that the thermal plant suffers a loss of a Main Generating Transformer on one unit generation will still be possible from the remaining turbines which do not share such resources. It is not unusual for an entire wind farm's capacity to be routed through a single transformer which means that a failure of this resource will mean the loss of an entire wind farm's generating capacity.

Failure of a 132KV export cable which connects a traditional power plant to a grid network onshore is serious. However, such a failure poses far less of a challenge to that faced when such a cable is sub-sea and delivering the capacity of a large number of offshore wind turbines back to a shore-based grid.

It is, therefore, the inability to despatch the electricity generated from part or all of a wind farm which presents one of the greatest potential causes for losses.

This is the risk which the insurance industry has already been required to respond to and where the handling of the claims has presented some common problems which arise when dealing with equipment manufacturers. In addition, some unique problems present when a repair is performed offshore.

High Voltage Transformers are highly complex components (the reader is referred to the Special Report on the relatively recent ‘bunching’ of such claims). It is sometimes said that transformer failures will either occur during the first few months of its operation or in the period leading up to the end of its design life. The 25 year period in the middle may well be uneventful provided the required maintenance is performed. If a transformer is suspected of having suffered a failure the immediate difficulty faced is ascertaining if damage to the active part (the windings) has occurred as these are housed within a steel tank which is filled with oil. Although there are a number of tests which can be performed to determine whether a short circuit within a winding has occurred these may not always reveal the true picture. It is often necessary to remove the transformer to a factory environment in order that a full inspection of the windings can take place. The decision to remove a transformer from a site sets in motion a chain of events which inevitably takes time to complete. The transformer has to be disconnected from the switchyard, drained of oil – and then specialist transportation arranged which often requires permits to be obtained for road movements in many countries. Add an offshore dimension to this task and the timescale will be longer. The factory inspection will reveal the extent of the damage and will determine whether a repair is possible or if replacement is necessary.

It is not unusual for repairs which may take the form of single, double or three phase rewinds to take several months to complete. During this time the turbines will be idle unless an alternative transformer can be brought into use which (in the absence of a compatible spare being readily available) is very often not possible. While the wind turbines are idle it is necessary to maintain the integrity of the remaining components, particularly those in the nacelle, and this can involve a considerable cost if it is necessary to provide temporary power for auxiliary heating systems. The manufacture of a new transformer will take significantly longer, adding to the downtime and additional cost. There are a limited number of high voltage transformer manufacturers in the world and the demand for their products is such that securing a factory slot for the provision of a replacement takes a lot of negotiation, even when it is the subject of a warranty claim.
IT IS NOT UNUSUAL FOR AN ENTIRE WIND FARM’S CAPACITY TO BE ROUTED THROUGH A SINGLE TRANSFORMER.
Outside of a warranty claim it is likely that all manufacturers will quote similar lead times for an ex-works delivery and price ranges will vary considerably. Manufacturers are reluctant to use the valuable factory space carrying out repairs as this impinges on the throughput of new products. Finally, the number of companies who only perform high voltage transformer repairs and not manufacture is limited.

Planning in advance for a high voltage transformer failure and the mitigation of the downtime it creates is possible; however it does come with a price tag. There is a natural reluctance for any business to purchase expensive equipment which it may not need and in the case of a High Voltage Transformer a strategic spare could be standing idle for many years before it is called upon. With the scale of the projects planned for the future this reluctance might well be overcome if strategic spares are acquired for use across a wider number of projects. It is often frustrating to find that a spare transformer has been located which could assist in mitigating a loss only to find that it is for some reason incompatible due to some slight difference in specification. Sometimes commercial terms are a barrier to the use of a spare if it is owned by a competitor reluctant to part with it or because they are unable to in view of their own insurer requirements. It seems plausible that in the future these hurdles could be overcome if some standardisation of the specifications used is introduced and if a number of developers combine to purchase strategic spares which might be held in a pool for mutual use as and when required.

In line with the key equipment manufacturers such as transformers the sub-sea cable industry is set to experience a marked increase in demand for the services they perform. This would include the supply and manufacture of the cable to the supply of vessels and personnel who perform the cable laying itself. There are a number of different types of cable needed on an offshore wind farm. Turbines are arranged in arrays and they are connected electrically by Inter Connecting Cables. Each array of turbines is connected to a sub-station platform which requires a Platform Connection Cable and ultimately the Platforms are connected to the shore by the main high voltage export cable. This can often be several kilometres in length.

Damage to any one of these cables could mean a series of turbines being unable to despatch the electricity generated and in the case of the export cable this may mean a group of turbines on more than one array standing idle. No sooner has the cable-laying operation been completed on one project then the vessels and personnel utilised are demobilised and committed to the next job – making it difficult to re-engage them quickly. Even if they can be re-engaged the lead time for the manufacture of the XLPE or EPR insulated cables can be many months.

Repairs to sub-sea cables are possible provided the damage is confined to a limited area. Specialist jointing kits are available which allows the damaged section to be removed: a new piece of cable is then inserted into the existing one. Jointing of XLPE and EPR cable is a task which can only be performed by specially-trained cable jointers who are few and far between. Most cable manufacturers will only allow cable jointers employed by them to carry out jointing work on their cables if they are to maintain or provide a warranty. A single, in-line joint repair offshore will involve a number of vessels and personnel being utilised to recover the damaged cable, perform the joint repair, relay the cable and to bury it in the seabed. As every day that these resources are deployed on the repair is chargeable to the insurance claim, advance planning is vital. It may be necessary to perform two joints in a cable to achieve the required result – which adds to the time and cost as from the moment that the vessels are mobilised until the moment they are demobilised the financial clock is ticking.

One of the main obstacles that confronts the cable laying and repair team is the weather. Certain tasks just cannot be performed in inclement weather or in certain tidal conditions and so an entire cable repair resource will stand idle for this period, adding to the value of the claim. It is important to try and plan a repair using the best available meteorological information. This will enable a weather window to be identified that will allow the completion of the required tasks although it is very likely that some weather downtime will always arise.
The offshore environment is a very hostile place for an idle array of turbines. The nacelle components are likely to degrade very quickly unless the humidity is controlled which entails the provision of heat. The power to the auxiliary systems within the turbine which normally provide this heat is derived from the turbine itself and so if it is unable to function these systems cannot operate. This means that temporary power supplies are needed and over a period of weeks or months these can represent a huge cost.

In the future offshore wind farm developers and their contractors will need to work together to mitigate the time and costs which arise due to damage to a sub-sea cable. In the planning phase of a project, care should be taken to try and create as much interconnection between different parts of the wind farm. Spare cable and jointing kits should be readily available and the training and development of cable jointers in conjunction with manufacturers should be a priority to avoid the reliance on the few numbered specialists that exist at the present. Pooling of resources, particularly cable-laying vessels, should also be considered.

The prospective construction spend on the development of offshore wind farms alone around the coastline of the United Kingdom is in the region of GBP 100 billion. The financiers of these and the other projects will require comfort that the insurance industry is providing the type of products which are routinely available in other sectors for the protection of revenue or the servicing of the debt and so Delay in Start Up and Advance Loss of Revenue Policies are commonplace.

Both new markets and capacity are emerging in the sector and it is important that this is sustained in the long term. This goal will be enhanced if some of the issues that have been known to arise in the past when significant claim events have happened are identified and managed early so that the impact of such an event on a future project or operational wind farm can be minimised.

Adrian Humphreys
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THE ERA OF THE POWER ‘MEGA CLAIM’

For many years the Oil and Gas industry was the sector where insurers could expect several USD 100 million+ losses to occur each year. For the Power and Utilities sector, on the other hand, conventional wisdom (whose nature we treat in our Managing Director’s introduction) has traditionally been that such events are exceptional.

In recent years this pattern has changed, and while the Oil and Gas market continues to experience a frequency of ‘mega losses’, the power industry seems to be rapidly catching up.

Intuitively one might imagine that the presence of hydrocarbons would lead to fire being the only way that a power loss might exceed USD 100 million. However, analysis of the Willis Energy Loss Data Base (WELD) shows that in fact Machinery Breakdown, Windstorm and Flood losses have all exceeded the USD 100 million mark in recent times. It is also the case that third party losses in the sector have exceeded USD 100 million although these are not recorded on WELD.

For losses up to USD 100 million, the WELD loss data on the Power industry for the last ten years for which mature data are available show a predictable frequency/severity pattern – see chart below. The chart uses data from more than 530 losses and the aggregate value of the losses on the sample is around USD 5.65 billion.

FREQUENCY AND VALUE OF LOSSES IN BANDS 1998-2008 < USD 100 MILLION

However, a very different pattern emerges when losses in excess of USD 100 million are included (see overleaf). WELD records 16 such losses over this period, with a combined value of approximately USD 4.2 billion, increasing the total losses over the period to around USD 9.85 billion.

This means that 3% of the losses by number have been responsible for a staggering 43% of the total value, figures that should give concern to both owners and insurers.
Of the 16 Mega Claims identified, eight (50%) were the result of fires or explosions. More surprisingly perhaps natural catastrophes contributed five losses with flood providing three and wind two (surprising as the plants were presumably designed with these particular perils in mind). Machinery Breakdown was responsible for two losses while a dam collapse was responsible for one.

An examination of the cause of loss (see Figure 1) for all incidents shows that machinery breakdown is the dominant cause of loss across the entire sample, with fire second.

However, if we break the entire USD 9.65 billion down by quantum (Figure 2) we find that fire is the most costly peril with Machinery Breakdown second.

The data used in this analysis were taken over a 10 year period up to the end of 2008 (post-2008 data is not yet regarded as mature). This notwithstanding, there was a significant Hydro loss in Russia in 2009 and a further Mega Claim in the USA in 2010, both of which appear to be consistent with the trend of a loss in excess of USD 100 million in the power sector every eight months or so.
3% of the losses by number have been responsible for a staggering 43% of the total value.
ANALYSIS OF THE TREND IN POWER TRANSFORMER FAILURES

The impact of large power transformer failures results in the inability to use the asset for long periods which itself causes disruption to the power system or loss of a generator. The down times of the transformer vary from a minimum of six months (if the transformer can be rewound) or up to 18 months lead time for a new transformer. This results in machinery breakdown losses and Business Interruption losses that can run to millions of dollars per week.

Over the last 20 years, losses of this type in excess of USD 1 million average out at four per annum. However, there has been a relatively recent trend, peaking in 2008, where the losses have increased – as the graph below shows.

Moving from loss frequency to severity, the above insurable losses can be quantified in monetary terms (separating Property Damage and Business Interruption) as below.

Source: Willis loss register

Source: Willis loss register
The 2008/09 spike is more clearly in evidence. Some of the losses in 2008 and 2009 were recorded as high voltage coil damage. It is believed that these one or two extra annual failures can be attributed to a failure mechanism occurring in major power transformers around the world based upon a phenomenon called corrosive sulphur. This issue – whilst now understood by industry – is still causing a few transformer failures around the world due to its slow non-reversible failure mechanism. The failures often occur in the high voltage winding. A cut-away drawing of the transformer is shown to the right highlighting the high voltage winding.

The failure process can take years to propagate with a typical failure mechanism caused by copper sulphide deposits forming semi-conductive paths through the layers of insulating paper surrounding the copper conductor. It is not unusual for the copper sulphide to have migrated up to five or six layers of insulating paper (known as kraft paper).

Generally the copper sulphide deposition process takes place from the inside layer of paper to the outside layer of paper. Some transformers have up to eight layers depending upon the operating voltage.

Assuming that the process continues, the inter turn voltage then slowly starts to cause partial discharge activity between the inter turns of the high voltage coils. These partial discharges create gases such as hydrogen to be released into the transformer oil.

Clients have reported that the volume of hydrogen released may not be produced until near-failure. If the process continues unhindered the partial discharge activity continues, building up carbon tracks within the kraft paper layers. Eventually the inter turn voltage causes the partial discharge activity to develop into an avalanche condition.

A power arc occurs in the contaminated turn region causing severe damage to the paper insulation and supporting press board. The transformer is switched out of service by a protection device called a Buchholz relay. The surge is due to the high volume of gasses produced from the vaporised oil and the transformer is rendered inoperable.

The area of the damaged paper insulation often affects several turns where oil flow is low and there are localised ‘hot spots’. In the winding stack there may be more than one affected area with the winding discs containing the turns showing varying degrees of contamination. The copper sulphide reaction process described above is slow and non-reversible.

**MINIMISING RISK**

Clients can minimise the risk of attack from corrosive sulphur by identifying whether the oil is potentially corrosive. There are a few tests available that involve heating a sample of the oil up to above normal operating temperatures to accelerate the phenomenon – typically 150 degrees Celsius. The copper conductors are wrapped in kraft paper to simulate a winding conductor. At the end of the test the paper is examined for deposition of copper/copper sulphide. If the paper is discoloured then the oil is determined to be corrosive.
Factors that increase the risk and the likelihood of the process continuing include:

- A low oxygen environment within the oil such as occurs on sealed transformers or transformers with an environmental seal.
- A Naphthenic mineral oil, with a content of di-benzyl di-sulphide compounds of over 30 p.p.m. DBDS is a sulphur compound known to cause problems and is therefore an indicator as to the potential risk. Other sulphur compounds such as mercaptans are more aggressive in the attack of untreated metals.
- A transformer over 100 MVA operating without forced oil circulation is at a slightly higher risk as large power transformers do not thermo-siphon well.
- A transformer operating with an average oil temperature of over 80 degrees Celsius measured at the top of the transformer. This could allow ‘hot spots’ in the range of 90 to 100 degrees Celsius within the winding stack. The significance of temperature and heat energy is that it is a catalyst necessary to enable the process to take place.
- Transformers designed in the 1990s when some manufacturers increased the current densities in the copper conductors thus making the transformer copper costs more competitive. This resulted in greater heat density.
- Transformers wound with copper conductors which are not varnished prior to being wrapped with the kraft paper.
- Transformers wound with interleaved conductors that have, by design, a higher voltage gradient where the conductors pass between the windings.
- Naphthenic oils that had not been treated with a passivating chemical. The passivator provides a boundary layer and inhibits the reaction with the sulphur compounds.
- Transformers that were poorly commissioned and did not have the level of detail required to correctly set up the transformer cooling controls.

Clients can manage the risk to transformers by testing for corrosive sulphur in the transformer oil. Once identified the process of passivation of the oil can take place. This process is performed by specialised contractors who carry out the treatment with the transformer off-load. The passivator protects the exposed metals such as copper or silver and prevents further attack from the corrosive sulphur compounds.

Clients with transformers manufactured during the last three years have a reduced exposure to this particular risk. This risk is now being controlled by the refineries producing the naphthenic oils who are now aware of the problem and control the content of the corrosive sulphur compounds.
THE RENEWABLES REVOLUTION
RISK, REWARD, RENEWABLES AND REVOLUTION: A PERSONAL PERSPECTIVE

The power world is dominated by coal, gas and nuclear, with some large hydropower in selected spots, and most people believe that it is likely to stay that way for some time. But there are more and more stirrings of a revolution, a transformation in how we generate our power. There is something deeply unpopular about each of our current big sources of electricity: nothing, mind you, that has in any way upset society’s love of electricity, but just the way we get it.

Okay, I accept that for most people the way we get our electricity is by flipping a switch, and it is very much an ‘out of sight, out of mind’ provision. Still, if you are living in a big Chinese city, and there are a lot of them, even if you can’t see the power plant you can certainly see the air, and that ain’t good. And even if you are pretty oblivious to concerns about climate change, you might at least have heard about Russia cutting off winter supplies of gas to some of its neighbours in disputes over prices. Or learned that in the UK we have gone from being self-sufficient in gas to being an importer. Or heard a lot of confusing and contradictory rhetoric around the desirability of new nuclear power plants.

Now, in this world of claim and counterclaim, it is interesting to see just how change has occurred in some places. In 2008 wind power (onshore) in Spain generated more electricity than coal for the first time, though still behind gas and nuclear. In 2009, there were many days when wind was the leading generator of power in Spain. And given a reasonable regulatory regime, the levelized cost of onshore wind power is as low as that for gas, and cheaper than everything else. So I think we have arrived at a point, at least for onshore wind, where a second form of renewable energy has taken its place among the big generators. Moreover, it is less geographically specific than large hydro.

I make this point in part to split the mass of technologies that are called ‘renewables’ – because they are very different. Some are commercial on utility scale and able to compete reasonably well at wholesale prices, others are very far from that. Some are amenable to use at small scale – for example rooftop solar photovoltaic (PV) or solar hot water – and others are only sensible at megawatts and above. Some of these technologies need scientific breakthroughs (which may indeed happen) to get to commercial competitiveness, while others can only drive down costs based on better engineering and manufacturing.

Let’s look at some examples. The cost of the active module of solar PV has been falling rapidly. This is a combination of exploitation of research in materials science over the past 30 years, and application of manufacturing techniques, much of them learned from the semiconductor industry. And this is not incremental improvement. Rather, costs have fallen by as much as 75% in just a few years. Of course the active PV material is just a part of the finished generating kit, so the levelized cost of power from solar PV has not fallen as quickly. Nonetheless, when the price of your most costly component drops in this way, it gives impetus and motivation for getting the costs of everything else down. This will happen, and I believe happen quickly, over the coming five years. So solar PV is science-driven, and manufacturing-enabled. We are not finished with the scientific progress either. There are results just coming out of the leading nanotechnology laboratories, outcomes of research over the past decade, that promise another step change of lower cost and higher efficiency for PV.
As a deployable technology, solar PV has some interesting characteristics. Installed at household, farm, or village scale, it only has to compete with retail prices – not wholesale, in contrast, say, to large scale wind. It works both on and off grid. Where there is no grid, or the grid is very unreliable, solar PV is very attractive, even at today’s prices. Much of the geography with poor grid or no grid is very sunny. And from a risk point of view, once it is in, the risks are very low. There are no moving parts, very low failure rates, and manufacturers offering long term (for example 25-year) guarantees.

Another area where science promises to play a leading role is next generation of biofuels, biochemicals, and biomaterials. This is the third wave of biotech, following from pharmaceuticals and agriculture. It promises to take us way beyond ethanol from corn or sugar cane. And in so doing it contains the ultimate promise of addressing both our energy challenges and the problem of accumulation of waste from urban societies. We must reduce the volume of waste, but to the extent that the waste we do generate can be feedstock for our energy needs, that is a good outcome.

Biofuels are not a risk-free area. When energy crops are involved, we of course have to price in the risks of disease, weather, and the fickleness of nature in to our energy costs. And the science here is still developing – yes, there are commercial products making their way to market, but we still have a decade of development ahead of us.

But why concentrate just on fuels? Chemicals and materials are produced in smaller volumes with higher values, and there is a big effort to make more of these from biological feedstocks rather than petrochemical ones. A good mantra here is to use biology to make things that are hard to make by chemistry.

So if solar PV and biofuels/biomaterials are science-driven renewables, what are the engineering/manufacturing driven ones? Wind, wave, tidal (tidal stream and tidal range), utility scale solar thermal.

I have already said that onshore wind has had two decades of increased deployment with decreasing costs. Maintenance intervals have become better; they must become better still. Catastrophic failures have been reduced; they must be eliminated. Design and manufacturing excellence can bring the risk level of wind, both onshore and offshore, into a range where the cost of capital is commensurate with more mature power generation. And high availability, >95% over five years including planned maintenance, will make a material difference to the cost of power. These improvements in reliability will pay big dividends offshore, where the costs of intervention are inevitably higher.

For wave and to a lesser extent for tidal stream, we are still waiting for what Jim Utterback of MIT called ‘the dominant design’ to emerge. There are many devices and they are just beginning to get time in the water. Right now this is still all about risk. At this stage of development we see innovative entrepreneurial development side-by-side with heavy engineering. It took 20 years to get wind power costs down and reliability up. We should be able to accelerate this with tidal stream; a coordinated effort could cut this time in half, an intensive effort might accomplish it in five years. The society that makes this intensive effort will reap big dividends.

Some doubt the value of encouraging this sort of revolution to occur, and worry about increasing the cost of electricity. I don’t. We have the opportunity to accomplish several desirable goals – reduce greenhouse gas emissions, eliminate fuel price volatility, increase the diversity of our energy supply and improve energy security, and create new manufacturing jobs – while we create the energy infrastructure for the 21st century. Push the science, refine the manufacturing, deploy at scale that which is ready and set high standards for the next generation of technologies.

It’s as simple and as difficult as that.

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IN 2008 WIND POWER (ONSHORE) IN SPAIN GENERATED MORE ELECTRICITY THAN COAL FOR THE FIRST TIME