THE CHANGING GLOBAL ENERGY LANDSCAPE
OPPORTUNITIES AND CHALLENGES FOR ENERGY UNDERWRITERS
The Changing Global Energy Landscape
Opportunities and Challenges for Energy Underwriters

Summer 2016
Contents:

1. Preface by Group Chief Executive Officer ..................................................06
2. Management summary ...............................................................................08
3. The global energy landscape ......................................................................12
4. Insurance solutions and the future of energy ............................................39
5. Conclusions .................................................................................................56
6. References ..................................................................................................57
1. Preface by Group Chief Executive Officer

Energy and power insurers are navigating turbulent waters. Sluggish economic growth, persistent low interest rates and the dramatic slump in oil and gas prices since 2014 have led to dislocations in the global energy marketplace. The glut of oil, but also the enormous overcapacities in coal, heavily affect investments into future energy capacity, causing postponements or cancellations of energy projects on a massive scale. It might well take years until an equilibrium between supply and demand is restored. As a result, energy insurers will also have to reposition themselves.

According to the International Energy Agency’s World Energy Outlook 2015, energy demand will continue to be driven by economic growth, lifestyle changes, demographics, efficiency gains and public policy. By 2040, the OECD countries will consume less energy than today. By contrast, demand from non-OECD markets will expand by more than 70%. Growth will originate predominantly from Asia. The region will be the final destination for 75%, 60% and 80% of all traded oil, natural gas and coal, respectively.

Global GDP is forecast to expand by 150% until 2040. Accordingly, the investments needed to maintain and grow global energy capacity are gigantic. The International Energy Agency predicts that over the next 25 years investments in the amount of US$ 68 trillion are required to meet the expected increase in energy demand. Almost 40% of these investments are needed to assure oil and gas supplies. 30% will be used for investments in power supply and another 30% will contribute to reduce the consumption of energy via higher end-consumer efficiency, with the latter expected to have a massive impact: In the U.S., for example, by 2040 a unit of energy input will produce 80% more output than today.

The energy mix is set to change markedly. The share of oil and coal in global energy supply will decline by 9 percentage points, while renewables, gas and nuclear power will gain in importance. Electricity will grow by 70%, faster than any of the primary sources of energy. By 2040, 50% of power will be generated from renewables in the European Union, 30% in China and 25% in India.

In addition to all these cyclical and structural changes, the business of energy and power will also become technologically more demanding as we delve into deep-sea drilling, arctic or shale exploration and obtain more energy and power from alternative sources such as solar, hydro, wind or biofuels. As a result, the industry’s vulnerability to business interruption, new forms of liability and cybercrime increases. Additional challenges emanate from climate change and resultant anti-carbon public policies.

Longer-term, these trends offer major opportunities to energy and power insurers and reinsurers worldwide. However, in the short run, margins will remain squeezed, while top-line growth will be hard to obtain. Technical profitability will thus be paramount. Insurers have to be flexible and willing to leave established tracks and expand into new markets and technologies, where growth is still at hand.
They have to embrace innovation, from predictive analytics to non-traditional risk transfer techniques, in order to remain a reliable and sought-after partner for their customers in a rapidly changing market environment. These innovative capabilities will also be essential for energy insurers to enhance their internal risk management frameworks.

In light of these environmental dynamics Trust Re is pleased to bring forward this White Paper. It reflects our aspiration to develop into our clients’ reinsurer of choice, a position we intend to deserve based on our customer centricity and value added services. These include the proactive and regular sharing of views and expertise, benefiting both our clients and us.

Trust Re hopes that you will find this research paper both interesting and inspiring. We look forward to your feedback and would be delighted to engage in a strategic dialogue with you on the future of global energy markets and the ramifications for risk managers and insurers. We feel that this sort of informed dialogue is particularly important in times of economic volatility, (re)insurance market turbulence and energy market dislocation.

Fadi AbuNahl

Group CEO & Director
Trust Re
2. Management summary

1. World energy demand is projected to grow by 30% to 50% from 2014 to 2040. This expansion is almost exclusively driven by non-OECD countries due to a combination of accelerating industrialization, population growth and the expansion of the middle class. It is the baseline scenario despite major advances in energy efficiency and the adoption of less energy-intensive economic development models (e.g. in China).

2. Technology plays an important role in the demand for as well as supply and efficiency of energy. Throughout the next 25 years the cost of renewable energy will decline across the board. Prices for solar photovoltaic will reduce by 30 - 50%, while the production of electricity from onshore turbines will cost 10 - 20% less. In the area of oil and gas extraction the outlook is different. Costs will still increase due to the geographical complexity of the exploration sites.

3. Fossil fuels will continue to dominate the global energy mix, although their share will decline to below 80%. Overall, until 2040 the combined share of oil and coal will decline by 9 percentage points. Renewables will be the fastest rising energy source, increasing its market share by five percentage points.

4. Oil consumption is expected to stagnate in OECD countries, but to surge by 75% until 2040 in non-OECD countries. India’s demand for oil will rise strongest.

5. Demand for natural gas is expected to grow by 47% until 2040, making it the second most important energy source after oil by the 2030s. Power generation will be the biggest single driver of gas demand. 85% of growth in natural gas will come from non-OECD markets, mainly China and the Middle East, in particular for power generation.

6. Renewables will account for about 35% of the growth in global energy demand as government policies and technological advances strengthen its competitive position, making it the fastest growing source of electricity generation. By 2040 30% of global electricity production is projected to be based on renewable energy.

7. The energy resources worldwide are sufficient to meet future global demand. Proven oil reserves, at current production levels, are sufficient for the next 52 years. Coal reserves are expected to last for another 122 years and recoverable natural gas reserves for the next 61 years. Uranium resources are estimated to suffice for another 120 years to meet demand.
8. World oil production is predicted to grow by 15% - 30% until 2040. By 2040 crude oil production will still account for about two-thirds of total oil production, with an increasing share coming from deep water offshore fields in the Gulf of Mexico and Brazil. The outlook for shale oil production beyond the United States remains uncertain, due to market conditions, but also technical, economic and political challenges. In the U.S., output from shale and tight gas will double and account for roughly 70% of the total U.S. gas production by 2040.

9. Power generation capacity is expected to increase by 70% until 2040. Electricity is the fastest growing form of end-user energy consumption. Demand from the non-OECD markets will account for 85% of the growth in electricity consumption, led by China, India and other developing markets. With the exception of oil, all sources for electricity generation are projected to increase. Efforts to reduce greenhouse gas emissions will continue to drive renewable energy generation. It will account for one third of the world’s electricity generation by 2040.

10. The energy sector is highly capital intensive. Up to 2040 it is estimated that the world energy sector will require investments in the magnitude of US$ 68 trillion (in 2014 dollars), including both energy supply and efficiency. This corresponds to about 2% of global GDP for that period. 37% account for oil and gas supply, 29% for power – including transmission and distribution, and 32% for end-user efficiency, mainly in transport and buildings. Against this backdrop, the longer-term fundamental outlook for energy and power insurance remains very strong.

11. Energy and power insurance premiums worldwide, including mutual and captive insurance business, amounted to around US$ 23.6 billion in 2014, up from around US$ 21.5 billion in 2010. In 2014, energy insurance premiums stood at around US$ 14.2 billion whereas power insurance premiums came in at approximately US$ 9.4 billion. Overall, the U.S. is the largest energy insurance market by far at premiums of about US$ 8.4 billion, followed by Canada at US$ 1.8 billion and China at US$ 1.5 billion.

12. Upstream insurance accounted for premiums of around US$ 7.2 billion of the energy market, US$ 2.2 billion came from midstream insurance and US$ 4.8 billion from downstream insurance. As far as power insurance premiums are concerned, in 2014, around US$ 7.3 billion were generated from conventional power insurance and US$ 2.1 billion from renewable and other power insurance, the latter being up from around US$ 1.5 billion in 2010. Key drivers of premium growth were solar and wind power.

13. The collapse in oil prices has led to severe cutbacks in production and exploration as well as squeezed risk management budgets across the global oil and gas industry. In addition, rates continued to slide as a result of an unabated influx of additional capacity.
14. As in the upstream sector, premium volumes in the downstream segment are eroding rapidly. This is not only a result of abundant capacity but also reflects an increasing reliance on captives. The competitive pressure is currently most acute in upstream markets where the pipeline of new projects has virtually dried up and drilling operations have been scaled back. In the downstream area the contrary is true: The sharply reduced cost of feedstock has boosted refiners’ margins, with business interruption values up accordingly. This offers opportunities in terms of additional premium income for downstream insurers.

15. From an overall risk management perspective, subsea drilling is a major opportunity for energy insurers. It seems to be clearly superior to traditional drilling and could arguably help mitigate some of the major environmental risks to oil drilling in sensitive areas such as the Arctic Circle.

16. On the other hand, the concentration of risks is a major underwriting challenge in most areas of energy and power insurance. The Gulf of Mexico has the largest concentration of such platforms, with large losses recorded as the result of Hurricane Katrina in 2005 or the Deep Water Horizon disaster in 2010.

17. The Tohoku earthquake and the Thai floods in 2011 as well as the more recent Tianjin port blasts in 2015 highlighted how poorly protected companies are when a natural disaster disrupts vital supply chains. However, only a fraction of this exposure can be transferred to insurance markets at a commercially viable price. This is largely attributable to information deficits concerning the specific vulnerabilities along supply chains which in the wake of ‘just in time production’ have grown significantly more complex.

18. Although digitisation opens up a great potential to make better risk management decisions and improve operating efficiency it also conjures up the risk of a major incident caused by a cyber-attack. Globally, it is estimated that cyber-attacks against oil and gas infrastructure could cost companies close to US$ 2 billion by 2018. With the digital connectivity of industrial control systems in the energy industry, it is possible to conceive of a cyber-attack wreaking havoc on the scale of Piper Alpha, Exxon Valdez or Deepwater Horizon.

19. Effective insurance cover against cyber risk remains elusive – not only in the energy space. There are still major obstacles to traditional insurability, such as the difficulty in developing accumulation scenarios or the exposure to wilful acts. So far, almost all policies issued by the upstream and downstream energy markets contain a cyber exclusion as underwriters are unable to assess and quantify cyber risk.
20. Another risk management challenge is the significant legislative momentum affecting the operations of energy companies. Environmental Law imposes strict liability for clean-up and third party damage from all operational phases. Increasing public awareness of environmental matters has put operators under unprecedented scrutiny. This awareness is both driven by structural developments such as the rise of shale oil and gas extraction and specific high-profile disaster events such as the Deepwater Horizon/Macondo loss in the Gulf of Mexico in 2010.

21. A major constraint to the provision of adequate liability insurance for the energy industry is capacity. Many claims in recent years have exceeded US$ 1 billion, including clean-up costs and subsequent pure financial losses. Widespread pockets of underinsurance or even uninsurance are being exposed as energy operators’ profits drop and balance sheets (and, as a result, retention capabilities) weaken.

22. There is also an increased demand and need for environmental liability and risk assessments/risk engineering services. Fracking, for example, increases environmental legal liability exposure whilst sophisticated technologies which control the drilling are increasingly vulnerable to failure. Another growing challenge is climate risk, particularly at a time when producers are stepping into environmentally sensitive areas such as the Arctic Circle.

23. Against the backdrop of a rapidly changing operating environment in the energy sector the value proposition of energy insurance is undergoing various adaptations. For example, energy producers increasingly expect support in building more resilient business models, e.g. through the adoption of Enterprise Risk Management (ERM) frameworks and meaningful cyber insurance risk propositions.

24. Also, client needs associated with renewables are becoming increasingly complex. Adequate insurance and risk management instruments are vital to de-risk cash flows and can be seen as a prerequisite to ensuring a sustainable growth of renewable energy. This implies an increase in the estimated annual expenditure on risk management services in Renewable Energy Technologies (RET) including insurance solutions to up to US$ 3.7 billion in 2020, a fourfold increase within 10 years. Total investment in new renewable power capacity built worldwide through 2040 could exceed US$ 10 trillion.

25. The growing demand for risk management and insurance services reflects structural changes in renewable energy markets. Owners and developers are keen to tap into new sources of funding, including from institutional investors such as pension funds who almost desperately search for yield in the protracted low-interest environment. To make investors feel more comfortable of this asset class projects must be de-risked, from early stage construction to operation.
3. The global energy landscape: Status quo and outlook 2040

3.1. Key market drivers
The development of the global energy market is determined by economic, political, technological and societal factors such as GDP growth, changes in population and lifestyle, new regulations, technological advances and other specific factors influencing energy demand and supply.

World energy demand is projected to grow by 30% to 50% from 2014 to 2040. The outlook variations are largely due to the extent to which adopted or declared public policies have been taken into consideration. From 1990 to 2013 world primary energy demand has increased by 55%. Going forward, net growth will be driven almost exclusively by the non-OECD countries due to a combination of accelerating industrialization, population growth and the expansion of the middle class. Demand in the OECD countries is expected to remain largely unchanged compared to the level of 2013, because of the mature economies’ focus on low energy-intensity industries, improvements in energy efficiency and slower economic and population growth.

Real GDP growth assumptions by region

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Exhibit 1: World Energy Outlook 2015, OECD/IEA

China and India to account for 50% of global GDP growth until 2040
A key driver of future energy demand is GDP growth. World GDP is projected to grow about 150% from 2013 to 2040, at a compound annual rate of 3.5% (see Exhibit 1). The OECD countries are expected to expand by 1.9%, with the U.S. likely to slightly outperform, benefiting from healthy population growth. China and India will account for about half of the world’s GDP growth throughout the period. By 2040 China’s GDP will exceed the European and North American OECD countries’ total by about 120% and 60%, respectively. India’s economy will be about the size of OECD Europe.

Global population to grow by about 1.8 billion people
According to the latest UN projections the world population will expand by 0.9% annually from 7.2 billion in 2014 to 9 billion in 2040. Africa will grow fastest, while India will overtake China as the world most populous country by the mid 2020s. Russia, Germany, Korea and Japan will see their populations decline. China’s population will peak in the late 2020s. Urbanisation will continue. By 2040 63% of the world’s population will live in urban areas. In addition, the population will continue to age, with the share of people below the age of 15 years declining in all regions, while the share of those above 64 years increasing everywhere. Both trends will strongly impact the amount and type of energy the world’s population will consume.

The decoupling of economic growth and energy demand
The annual average growth in energy demand is expected to slow. While from 2000 – 2010 demand grew at about 2.5% per annum, it is forecast to increase at less than 1% in the 2030s, as a result of a decoupling of economic growth, energy demand and energy emissions. Some markets are undergoing structural changes, such as China, which transitions from an energy-intensive, manufacturing driven model to a greater focus on the services sector, which requires less energy input, but contributes a higher share to GDP growth (see Exhibit 2). Mature markets are reaching a saturation point in their consumption. And all markets adopt more energy efficient technologies. As a result, energy consumed per dollar of GDP will decline by 45% - 50%, depending on the underlying scenario.

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2 World Energy Outlook 2015, IEA/OECD, p31ff; World Oil Outlook 2015, OPEC, p6ff
3 World Energy Outlook 2015, IEA/OECD, p61
Exhibit 2: World Energy Outlook 2015, IEA/OECD

As a result of China’s economic transformation, the country will need 85% less energy to generate each unit of future economic growth than during the past 25 years. Conversely, in India, which is expected to outpace all other regions and grow at an average annual rate of 6.3% from 2013 – 2040, the manufacturing sector is expected to play a more prominent role. Across the research period, around one quarter of the growth in global energy demand will come from the sub-continent. Its population is set to increase to 1.6 billion people. An additional 315 million people will be living in the cities where today still 240 million people lack access to electricity. Europe and the United States, by comparison, are well advanced in their deindustrialization. Their services sector is the key determinant of the level, nature and efficiency of energy consumption.\(^4\)

Technology and public policy drive efficiency gains

Technology plays an important role in the demand for as well as supply and efficiency of energy. As such it affects pricing. Public policy and the cost of carbon emissions greatly incentivise the pace of technological innovation. Generally speaking, it depends on scale, as in the area of renewable energy, or scarcity, as in the oil and gas markets, which makes the deployment of more expensive exploratory technologies more feasible.

\(^4\) World Energy Outlook 2015, p22; p38
Throughout the next 25 years the cost of renewable energy will decline across the board. Prices for solar photovoltaic will reduce by 30 - 50%, while the production of electricity from onshore turbines will cost 10 - 20% less. In the area of oil and gas extraction the outlook is different. While the exploration of tight oil benefits from the rapid technological advances and increasing know-how, costs will still increase due to the geographical complexity of the exploration sites (see Exhibit 3).

Exhibit 3: World Energy Outlook 2015, IEA/OECD

Technology is closely linked with energy efficiency. According to the International Energy Agency (IEA), energy demand expanded on average by 2% annually between 2005 and 2014. However, by 2014, the growth had declined to 0.7%. It would have been three times higher without any efficiency improvements.

Increased efficiency is more often than not the result of tighter regulation. In the OECD, measures to curb consumption and enhance efficiency in transport, buildings and industry, limit the demand growth to 60% of what would otherwise have been expected. In 2014, restructurings and improvements in China’s industrial sector alone accounted for 25% of the global efficiency gains within that particular year.

3.2. Global energy demand by source

According to the U.S. Energy Information Agency, OPEC and International Energy Agency, fossil fuels will continue to dominate the global energy mix, although their share will decline to below 80%. Overall, until 2040 the combined share of oil and coal will decline by 9 percentage points. Renewables will be the fastest rising energy source, expanding by 2.6% annually, and increasing its market share by five
percentage points. Among the fossil fuels, natural gas will grow fastest, overtaking the demand for coal, the world’s slowest growing source, by 2030 and increasing its overall share by about 2 - 3 percentage points (see Exhibit 4).

Renewables grow fastest, coal use plateaus, natural gas surpasses coal by 2030, and oil maintains its leading share


Oil consumption expected to stagnate in OECD countries, but to surge by 75% in non-OECD countries

Demand for oil will increase by 15% until 2040, according to the central scenario of the IEA, climbing from about 90 million barrels per day (mb/d) to 103.5 mb/d. While the EIA expects an increase to 121 mb/d OPEC sees demand expand to 110 mb/d. Demand currently benefits from low prices but will slow over the forecast period due to decelerating economic growth in some key economies, declining population growth, efficiency gains, tighter emission policies and rising cost of extraction.5

The rising demand for oil is primarily driven by the transport sector – accounting for more than 60% of the increase – and the petrochemical industry. In power generation and the building sector its use will decline due to cheaper or more efficient alternatives. As demand growth concentrates in the transport and petrochemical industries, recycling standards or tighter policies on fuel efficiencies – as they already exist for cars, but less so in the areas of freight and shipping – will have a strong impact on consumption.

5 World Energy Outlook 2015, OECD/IEA, p62
World Oil Outlook 2015, OPEC, p11
Today’s largest oil consumer, the United States, will see its oil consumption decline by about 25% until 2040, due to higher efficiency standards for passenger as well as heavy duty vehicles. By contrast India’s demand for oil will rise strongest, in particular towards the second part of the research period, followed by China, which will overtake the U.S. as the world largest oil consumer in the 2030s. However, that demand growth will slow down, as population growth and vehicle sales level out. Europe’s oil demand, already below China’s since 2015, will drop below the Middle East’s (in the 2020s) and India’s (in the 2030s), due to slow economic growth and a declining population (see Exhibit 5 for a regional view).


Digression – Will the oil price rebound?

From 2010 to 2014 the oil price was relatively stable and traded at the historically high level of around US$ 115 per barrel. By mid 2014, prices started to decline and dropped to just below US$ 30 per barrel by mid-February 2016. The collapse in prices was caused by a drastic slowdown in demand, particularly due to slower economic growth in China and the country’s beginning transformation into a less energy-intensive service economy. In addition, due to the appreciation of the U.S. dollar demand for oil (which is traded in dollars) dropped in emerging markets and the European Union.

On the supply side, the U.S. and Iraq expanded their levels of production whilst output in natural gas increased, too. Still, when OPEC met in November 2014, it decided to not rebalance the market through a cut in its output, thereby increasing the pressure on the non-OPEC countries to reduce their production. In fact, OPEC’s production has remained stable or even increased, as OPEC members, dependent on oil income, sought to maximize revenue and preserve market share.
Declining investments set to have a long-term effect

According to the IEA’s definition, the future oil price is determined by the pricing level needed to stimulate sufficient investment in supply in order to meet projected demand. Based on this assumption, a price in the range of US$ 80 – US$ 120/barrel is needed to enable supply to meet demand. After the price slump in 2014 and 2015 it will take some time until the market rebalances, as increased demand, driven by lower prices, will meet with lower growth in supply, as investments in extraction and exploration dwindle.

The IEA predicts that, by 2020, the oil price will have reached US$ 80/bbl and will continue to rise to US$ 128/bbl by 2040. Similarly, OPEC expects that the oil price will increase to US$ 80/bbl by 2020, when rising demand and slower non-OPEC growth will eliminate the current oversupply. As supplying a barrel of oil will gradually become more expensive, OPEC expects that by 2030 nominal prices will have risen to US$ 123/bbl and will increase to more than US$ 160/bbl by 2040. The U.S. Energy Information Agency (EIA) also predicts a similar development in the short-term, with projected prices reaching US$ 80/bbl by 2020 and continuing their rise thereafter to US$ 141/bbl by 2040, according to its central scenario.6

As OPEC leaves its output unchanged, non-OPEC producers are reducing their investments which eventually will translate into lower production in Canada, Brazil and Russia, while U.S. tight (‘shale’) oil production remains surprisingly resilient and continues to add further capacity.


The ‘lower for longer’ oil price scenario

In addition to their respective central scenarios, the International Energy Agency (IEA), the OPEC and the U.S. Energy Information Administration (EIA) also explore low oil price scenarios which are based on the assumption that a market balance will not be reached by 2020, as production by the non-OPEC countries remains high and flexible while the largest oil producing countries, such as Saudi Arabia, maintain a high output to protect their market share and fight a further substitution of oil. According to the IEA’s low price scenario, for instance, prices will oscillate around US$ 50 – 60 until the 2020s and will only later increase to more than US$ 80. This scenario also assumes lower economic growth, which would also have a dampening effect on oil consumption.

More importantly though, on the supply side, the U.S. tight oil production assumes a key role, because its production has proven quite resilient to the low price environment in 2014 and 2015 as production cost has declined considerably. According to IHS, a research firm cited by the Economist, ‘the amount of oil produced per dollar invested will rise by 65% this year’. As a consequence, 80% of the new capacity created in the U.S. is profitable at US$ 50 – 70 per barrel. If this price falls below this threshold, shale production contracts, or, likewise, if it rises above, production expands. American shale producers may become the new swing producers in the global oil market, The Economist concludes.

This effect becomes even more pronounced as the contribution of tight oil to the world’s oil supply increases. According to the U.S. Energy Information Administration, American oil output will increase to more than 10 million barrels per day by 2030. However, the EIA also emphasizes that, at its current production of roughly 4.3 million b/d, U.S. tight oil production was equivalent to just about 10% of the estimated 45 million b/d production of the non-OPEC countries in the first quarter 2016. Given the long investment cycles outside of shale, the current decline in investments – triggered by the low oil price – will have long-term effects as delays and cancellations of projects, in particular with high development costs, will continue for several years and affect future exploration capacity.

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Coal: The world’s largest energy demand story comes to an end
Demand for coal will grow by about 10% through 2040. While the power sector accounts for 60% of coal consumption, the share of coal in electricity generation will fall from 41% to 30%, most notably in developing Asia (from 68% to below 50%). The remaining growth results from industrial demand, mainly from India and Indonesia, while the use of coal in buildings recedes dramatically as households (mainly in China, due to efforts to reduce pollution) switch to cleaner sources of energy.
As China’s economic growth slows and the country transforms from a manufacturing to a service economy, the world’s largest energy demand story in recent decades comes to an end. In addition, the country is introducing policies to curb the use of coal in an effort to reduce pollution and address climate change. According to the IEA projections, China’s coal demand has already peaked in 2013 and will only move sideward to 2040. While in power generation, the use of coal will still rise until 2030, its use in the industrial sector is projected to fall by more than 30% until 2040.

India will replace China as the growth driver for coal, overtaking the U.S. as the world’s second largest coal consumer. Industrial consumption will triple as India grows its manufacturing sector. Coal demand in the OECD markets will decline almost uniformly. In the U.S. consumption will drop by more than 30% and in the EU by more than 60%, driven by a mix of lower natural gas prices, an increasing use of renewables in power generation and tighter emission regulations (see Exhibit 8).8

8 World Energy Outlook 2015, IEA/OECD, p65
Change in demand by fuel and selected region in the New Policies Scenario

Note: The change in demand through to 2040 is the sum of the two time periods shown.

Exhibit 8: World Energy Outlook 2015, OECD/IEA
Natural gas to account for world’s largest increase in primary energy consumption
Demand for natural gas is expected to grow by 47% until 2040, making it the second most important energy source after oil by the 2030s, when it is projected to overtake coal. Power generation will be biggest single driver of gas demand, followed by a more intensive use in the industrial sector, due to the relatively moderate cost of gas and its high fuel efficiency – making it an ideal replacement for the more carbon-intensive coal and liquid fuels. 85% of growth in natural gas will come from non-OECD markets, mainly China and the Middle East, in particular for power generation. The U.S. will remain the world’s largest natural gas consumer, while in the European Union demand might have peaked already in 2010 (see Exhibit 8).\(^9\)

Renewables expected to be the fastest growing source in power production
Renewables will account for about 35% of the growth in global energy demand as government policies and technological advances strengthen its competitive position, making it the fastest growing source of electricity generation. The IEA predicts that by 2040 30% of global electricity production, more than 15% of global heating and about 5% of transportation will be based on renewable energy.

Non-hydropower energy will be the fastest growing source for new power generation, both within the OECD and non-OECD countries. The contribution of wind and solar to the global energy mix will multiply sevenfold. However, as OPEC forecasts, their overall share will remain low, reaching only around 4% by 2040. The U.S., Brazil and the European Union are key markets for bio-fuels, while China and India are catching up. In addition, bioenergy will play a larger role in heating and cooking, in particular in Asia and Africa, while photovoltaic will be used for electricity generation.\(^{10}\)

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\(^9\) World Energy Outlook 2015, OECD/IEA, p66
\(^{10}\) World Oil Outlook 2015, OPEC, p9

The COP 21 Agreement

At the 21st Session of the Conference of the Parties of the United Nations (COP21), which took place in Paris in late 2015, 195 nations agreed to a common framework to keep the rise of the global temperature well below two degrees celsius within this century and, going forward, to even limit the temperature increase to 1.5 degrees above the pre-industrial level, as this is a significantly safer defence line against the impact of climate change.

The nations committed to binding, nationally determined contributions (NDCs) to reduce the impact of climate change and to pursue domestic measures to achieve them, report on their progress and to undergo an international review. In addition, the countries agreed to submit new NDCs every five years, with the intention to demonstrate a progression towards more ambitious goals.\footnote{Center for Climate and Energy Solutions, Outcomes of the U.N. Climate Change Conference in Paris, December 2015}
Exhibit 10: World Energy Outlook 2015, OECD/IEA

### 3.3. Global energy demand by sector

Energy is consumed by the end-user either through the buildings, the industrial or transportation sector. Throughout the next 25 years the relative share in energy demand of these three sectors is expected to remain largely unchanged, with the industrial sector accounting for more than 55%, and transportation and building for 25% and 20%, respectively.\(^\text{12}\)

**India’s industrial sector to drive growth in energy consumption**

Demand from the industrial sector is expected to grow by 40%, or 1.2% annually (according to the EIA), slower than in buildings and transportation. Industrial demand for energy, driven by the expansion in infrastructure and economic growth in the non-OECD countries, will be strongest in the form of electricity, followed by natural gas. India alone will account for about 50% of the growth. Demand from North-America will remain almost unchanged, while it will decline in Europe, Japan and South Korea (see Exhibit 11).

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Growth in China’s energy demand for its industry sector, which still exceeds all other countries, will flatten out towards the mid-2030s, as it shifts its fuel consumption from coal to natural gas and electricity. India’s industrialization, by contrast, is fuelled by a rising coal consumption, making it the second largest coal consumer after China by 2040.

**Growth in transport energy consumption almost entirely driven by non-OECD countries**

Energy demand in transport (by road, air, water or pipeline), according to the EIA, will increase by 1.4% annually until 2040. 85% of the demand will be met by oil, down from 96% in 2012, with road transport the leading source of demand. Higher efficiency requirements contribute to lower oil demand. However, there is a risk that the lower oil prices will change consumer demand to purchasing vehicles which are less energy efficient. Aviation is the second largest oil consumer in the transportation sector, increasing by two thirds until 2040. Electricity and bio fuels, although heavily supported by government policies, will only account for about 5% of the energy consumption in the transport sector by 2040. Natural gas, by contrast, is projected to increase its share from 3% to 11% by 2040 (see Exhibit 12).

About 94% of the growth in the transport sector will occur in the non-OECD countries, driven by rising standards of living and increasing freight transport to meet increasing consumer demand for goods and services. In the OECD countries, by comparison, established patterns of consumption, slower economic and population growth as well as efficiency gains lead to an almost unchanged demand for the next 25 years. According to the World Oil Outlook, in the OECD countries, by 2040, the number of passenger vehicles will have increased by 125 million, compared with about 1 billion in the developing countries.
Commercial vehicles will increase by 47 million in the OECD markets compared with 230 million in developing and emerging countries.

Buildings sector to benefit from growing population in non-OECD countries

Energy consumption in the buildings sector, which includes both the residential and the commercial segments, will grow by roughly 25%, according to the IEA, due to higher income, demographic and structural changes as well as a growing population. In the residential sector, demand is driven by a higher average floor space per capita and, simultaneously, a lower number of people per dwelling, and subsequently higher energy demand per household. This is particularly true in the non-OECD countries, where demand is forecast to treble while in the OECD countries it is expected to increase by less than one third.

In terms of fuel, in the residential sector the use of natural gas will decline in the U.S. and Europe, while it is forecast to increase globally. Similarly, oil consumption will decline worldwide by one quarter, while the use of electricity will increase almost uniformly, surpassing natural gas as the most commonly used source of energy.

In the commercial buildings sector, electricity and natural gas will account for about 86% of the energy delivered in 2040, up from 81% in 2012.13

13 World Energy Outlook 2015, OECD/IEA, Sectoral trends, pp75 - 78
3.4. **Global energy supply**

The energy resources worldwide are sufficient to meet global demand, but they are not inexhaustible. In addition, they are not distributed evenly and their supply thus depends on large investments in exploration, extraction and production as well as distribution and storage (for energy reserves and production, see also Exhibit 20).

According to the IEA technically recoverable oil resources were 6’100 billion barrels of oil. 2’800 barrel are conventional oil (crude and natural gas liquids [NGL]), 1’900 billion barrels extra heavy oil and bitumen, 1’100 billion barrels of kerogen oil and 350 billion barrels tight oil. Proven oil reserves stand at 1’700 billion barrels, sufficient at current production levels for the next 52 years.

Coal reserves of 970 billion tonnes are understood to last for another 122 years at current production rates. 70% are steam and coking coal, the rest lignite. 25% of the resources are located in non-OECD Asia, with 13% in China and a combined 9% in India and Indonesia. The U.S. holds 26% of reserves, Russia 17% and Australia another 11%.

The recoverable natural gas reserves stand at 780 trillion cubic metres. The amount of recoverable unconventional natural gas is still subject to current and future revisions, which will also depend on current pricing. Proven natural and conventional gas reserves were estimated at 216 trillion cubic metres, sufficient for the next 61 years and mainly located in Russia, Iran and Qatar.

Renewable energy sources, including bioenergy, hydro, geothermal, wind, solar and marine are still plentiful and fairly well spread worldwide. As costs for exploitation are expected to decline, the amount of economically viable resources will increase. Finally, uranium resources are estimated to suffice for another 120 years to meet demand.14

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14 World Energy Outlook 2015, OECD/IEA, Energy resources, p78 - 80
OPEC expected to expand its production share in the long-term

World oil production is predicted to grow by 15% - 30% until 2040, increasing from about 90 million barrels per day in 2014 to 105 million to 120 million b/d by 2040, depending on the source of research and the underlying scenario applied (see Exhibit 13).  

According to the IEA, by 2040 crude oil production will still account for about two-thirds of total oil production, with an increasing share coming from deepwater offshore fields in the Gulf of Mexico and Brazil. Increases in natural gas liquids (NGL) and unconventional oil account for all the net growth in oil production until 2040, coming mainly from the Middle East, North America, Africa (Angola and Nigeria) and Russia. The outlook for tight oil production beyond the United States remains uncertain, due to market conditions, but also technical, economic and political challenges.

The United States has led the current increase in production. However, towards the end of the research period, the emphasis will shift to the OPEC countries in terms of growth in oil production. Due to the prevailing market conditions, investments were cut in non-OPEC countries, in particular in Russia, Brazil and Canada, leading to a reduction in production towards the end of this decade for the non-OECD countries (excluding the U.S.) of 3.8mb/d.  

The U.S. tight oil output remained surprisingly robust, reacting

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For the underlying scenarios see:  
World Energy Outlook 2015, OECD/IEA, 2015;  
World Oil Outlook 2015, Organisation of Oil Exporting Countries (OPEC), October 2015;  

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15 For the underlying scenarios see:  
World Energy Outlook 2015, OECD/IEA, 2015;  
World Oil Outlook 2015, Organisation of Oil Exporting Countries (OPEC), October 2015;  

16 World Energy Outlook 2015, OECD/IEA, 2015, p81
quite flexibly to pressure from lower prices. By 2040, production is expected to increase to 7.1 mb/d, up from 4.6 mb/d in 2015.\textsuperscript{17}

Overall, the IEA predicts an increase in OPEC oil production from 37mb/d in 2014 to about 50mb/d by 2040 (see Exhibit 13). Not all countries will equally well digest the impact of the current low oil price environment. Some have built financial buffers for such market conditions, while others are now struggling to raise the necessary resources for investments required for future oil production. Saudi Arabia is expected to regain its status as the world’s largest producer by the mid-2020s, while the UAE, Qatar (NGLs and gas to liquids after 2030) and Kuwait will all increase their production.

Some OPEC countries struggle to realize the potential of their resources, either due to challenges concerning political stability and security or because they face obstacles in raising the necessary investments for the production. This situation can be observed in Venezuela, Angola and Nigeria.\textsuperscript{18}

### Long-term liquids supply outlook in the Reference Case

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\textit{Exhibit 14: World Oil Outlook 2015, OPEC}

\textsuperscript{17} Annual Energy Outlook (AEO) 2016, Early Release, U.S. Energy Information Administration, May 2016

\textsuperscript{18} World Energy Outlook 2015, OPEC/IEA, p80 - 83
Iran returns to the market

Iran will strongly benefit from the lifting of the sanctions, but it needs to secure the technology and the investments to modernize its upstream capabilities. Due to the sanctions, in combination with under-investment, Iran’s crude output has nearly halved since 2011 and was a mere 2.8 mb/d in 2014, supplemented by an increasing volume of NGLs. Once the sanctions are lifted, output growth will come first from bringing production back towards the existing capacity limit. Next, large-scale investments are needed to raise the country’s productive capacity beyond 3.6 mb/d, back towards the levels achieved in the past – Iran’s production peaked in the 1970s at just over 6 mb/d.19

Digression – Tight oil and shale gas: The U.S. as a new net energy exporter

In April 2015 the U.S. Energy Information Administration (EIA) announced that the U.S. will cease to be a net importer of energy. This brings to an end a period which actually commenced in the 1950s, due to a combination of efficiency gains and abundant domestic fuels, namely natural gas and oil and, in addition, an increased use of renewables.

In particular, the rising production of tight (shale) oil (see also Exhibit 7), which started in 2000 and expanded to roughly 25% of the U.S. liquid fuel supply (including imports) by 2015, has become a key driver of the increasing independence of the U.S. from oil imports. In May 2015 U.S. tight oil production had reached 4.6 million b/d and has declined to 4.3 million b/d by February 2016 as a response to the low oil price. However, U.S. tight oil production has proven more resilient and flexible to declining oil prices than initially anticipated because production costs have come down considerably, while operators’ knowledge about production reservoirs has expanded rapidly.20

The share of net imports in U.S. energy consumption had already declined from 30% in 2005 to 11% in 2015. Before 2020, the country will become a net exporter of natural gas, largely because of its growth in liquefied natural gas exports. Depending on the development of oil prices, energy resources and economic growth, the EIA expects imports and exports to balance out by 2028. By 2040, U.S. energy production is expected to exceed consumption, allowing for an export of energy equal to 4% of consumption (see Exhibit 16).

Assuming a higher oil and gas price the U.S. could already become a net exporter in 2019, while in case of a lower oil and gas price it might remain a net importer until 2040.

Natural gas is the dominant U.S. energy export commodity. Crude oil and liquid fuels continue to be imported, while the country is earmarked to become a net exporter of natural gas by 2017, via pipeline to Mexico or in the form of liquefied natural gas. A terminal for LNG exports has just become operational in late 2015. The U.S. are already a net exporter of coal.21

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Coal suffering from overcapacity

While coal was the fastest growing fuel in the last decade, it will be the slowest until 2040, growing by just 10%. The large capacity overhang, which built up after China’s demand for coal peaked in 2013, has to be cut first. The U.S. are expected to reduce their production by 30%, while Europe’s output will even drop by 70%, as the region’s demand declines and its coal industry struggles to match the international competition. Non-OECD countries by contrast are mainly expected to increase their production, although China, the world largest producer, will reduce its output towards the end of the research period, ending 2% below its 2013 level. However, India will grow its production by 150%, becoming the world’s second largest producer. Southeast Asia will also expand its production by 45%, bringing it close to the U.S. level. Africa and Latin America will both increase their production by 40%, with Mozambique dominating in the former and Columbia in the latter region.

Shale gas replaces conventional gas in U.S. production

World natural gas production is expected to increase by almost 50% until 2040. Unconventional gas, such
as shale gas, coalbed methane, tight gas and coal-to-gas, will account for 65% of the growth or nearly 30% of the global production. Gas production will increase worldwide with the exception of Europe. In the U.S., the world’s largest producer, output in conventional natural gas will grow until the 2020s, when production from legacy fields becomes more expensive. Output from shale and tight gas, however, will double and account for roughly 70% of the total U.S. gas production by 2040, larger than the total gas production in any other country by 2040. Unconventional gas will also grow in Mexico and Canada. In Europe the output of natural gas will decline, while the production of unconventional gas will remain subdued by poor drilling results as well as environmental and political concerns.22

U.S. natural gas production, consumption, and trade (1990-2040)

The non-OECD countries account for 80% in the growth in natural gas production. China’s production is expected to treble. Its unconventional gas resources are thought to be the world’s largest and their exploration will steadily increase as geological, technical and market challenges are resolved. Russia’s gas production is subdued as a result of low domestic and European demand, but its production will grow once new LNG and pipeline capacity opens up the route to new markets. The Middle East’s production is also expected to increase by 65% by 2040. By then roughly 30% of the output will be supplied by Iran.23

Electricity as the fastest growing source of end-user energy consumption
Power generation capacity is expected to increase by 70% until 2040. Electricity is the fastest growing

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22 World Energy Outlook 2015, OECD/IEA, p84; Today in Energy, Most Natural Gas production is expected to come from shale and tight oil plays, U.S. Energy Information Administration, June 7, 2016
23 World Energy Outlook 2015, OECD/IEA, p83 - 85
form of end-user energy consumption, benefiting from the integration of isolated regional grids into national or even international networks. Its share in total energy consumption will increase from 18% in 2013 to 24% in 2040. Demand from the non-OECD markets will account for 85% of the growth in electricity consumption, led by China, India and other developing markets, as more people gain access to electricity, living standards rise and urbanization accelerates. In OECD countries, the electricity sector is predicted to grow by less than 10% until 2040, as infrastructure matures and the population continues to age and even decline.

Renewables increase their share in power generation to more than 10%
With the exception of oil, all sources for electricity generation are projected to increase: coal by 28%, natural gas by 61%, nuclear by 55%, hydropower by 57%, wind by almost 300% and solar PV by 500%. Coal, which is today the single largest source for electricity generation with a share of 41% will decline to 30%, although remaining the largest source, followed by natural gas. However, efforts to reduce greenhouse gas emissions will continue to drive renewable energy generation and, as a combined source of energy, it already overtook natural gas in 2014 and will account for one third of the world’s electricity generation by 2040.24


24 World Energy Outlook 2015, OECD/IEA, p85 - 88
Hydropower will account for 46% of the renewable energy generated by 2040, down from 74% in 2014, while the shares of wind and solar PV will increase markedly. 70% of the growth in renewable energy will occur in non-OECD countries, led by China, where half of the investments in power plants will go into non-hydro renewables over the next 25 years. India, according to its government, is set to become the world's second largest market for solar PV. In the OECD group of countries, 40% of the power generated will come from renewables. In the U.S. the share is expected to be 27% by 2040, while in Europe it will be 50%, led by wind and hydropower. As a result, CO2 emissions from power generation will decline by 33% until 2040, or 66% in the European Union, 50% in Japan, 45% in the Middle East or 40% in China and Russia and by 30% in India and the United States.  

Nuclear energy to be deployed more widely – mostly in non-OECD countries

Nuclear energy production will grow by about 13% until 2040, increasing its share in global energy demand by about two percentage points to 6%. Policies to reduce greenhouse gas emissions and strategies to improve energy security drive the demand for nuclear energy. While three countries have decided to phase out nuclear power, almost 40 countries are currently considering to develop first nuclear energy plants. In addition, Japan will return to the market, after it halted production following the Tohuko earthquake and tsunami in 2011. Again, growth in demand and new capacity employed will occur entirely in the non-OECD markets, led by China, while within the OECD, only South Korea will increase its capacity until 2040.25
**Exhibit 20: World Energy Outlook 2015, OECD/IEA**

**Proven reserves and production in the New Policies Scenario**

**World proven oil reserves: 1706 billion barrels**
- Middle East: 811 bn barrels
- Latin America: 325 bn barrels
- OECD Americas: 233 bn barrels
- Asia: 435 bn barrels
- Other: 48 bn barrels

**World proven coal reserves: 968 billion tonnes**
- OECD Americas: 263 bn tonnes
- Asia: 249 bn tonnes
- E. Europe/Eurasia: 238 bn tonnes
- Other non-OECD: 153 bn tonnes

**World proven gas reserves: 216 trillion cubic metres**
- Middle East: 81 tcm
- E. Europe/Eurasia: 73 tcm
- OECD Americas: 13 tcm
- Latin America: 9 tcm
- Other OECD: 9 tcm
- OECD Europe: 8 tcm
- OECD Asia Oceania: 5 tcm
- Other non-OECD: 6 tcm
Digression – Investments in the world energy sector

The energy sector is highly capital intensive. It is based on long-term and large-scale investment decisions. Up to 2040 the IEA estimates that the world energy sector will require investments in the magnitude of US$ 68 trillion (in 2014 dollars), including both energy supply and efficiency. This corresponds to about 2% of global GDP for that period. 37% account for oil and gas supply, 29% for power – including transmission and distribution, and 32% for end-user efficiency, mainly in transport and buildings.

OPEC expects that up to 2040 investments in the amount of approximately US$ 10 trillion are needed (in 2014 dollars) to meet future oil demand worldwide. About 75% or US$ 7.2 trillion of these investments are required in the upstream sector, replenishing the declining output of oil fields currently under exploitation. Most of these investments will have to be made in the non-OECD countries, where US$ 250 billion are needed annually in the mid-term. OPEC will have to invest about US$ 40 billion annually, until the end of this decade and US$ 60 billion per annum in the mid- to long-term. In terms of regions, the largest share of these investments is in the U.S., followed by the Middle East. In Latin America large investments are required to access Brazil’s deepwater fields.

Investments in the power sector are expected to amount to US$ 20 trillion until 2040. About 60% are invested in new power generation capacity, while the remainder is used for transmission and distribution. Incentivised by policy, a lot of the investments in the largest electricity-consuming countries will go into increasing their capacity in renewables and low-carbon supply. 60% of the investments in power generation account for renewables, led by China (wind, hydro, solar), followed by the European Union, the U.S. and India.

US$ 22 trillion of investments will serve to enhance energy efficiency, mainly improving the efficiency of light duty vehicles, and also buildings, such as household and office appliances as well as lighting, insulation, space heating and cooling (see Exhibit 21).
Exhibit 21: World Energy Outlook 2015, OECD/IEA
4. Insurance solutions and the future of energy

The following chapter addresses the role of insurance and risk management solutions in shaping the future of global energy. As outlined in the previous chapters we assume that, until 2040 at least, fossil fuels will remain the dominant source of energy, with its share projected to decline from 85% to 78%. Having said this, energy underwriters should also prepare for a significantly bigger role of power generation as a source of energy demand, and an increasing relevance of renewable as well as nuclear energy in the global energy mix.

4.1. Overview of the global energy and power insurance market

According to Finaccord’s 2015 Global Energy and Power Insurance Review, energy and power insurance premiums worldwide, including mutual and captive insurance business, amounted to around US$ 23.6 billion in 2014, up from around US$ 21.5 billion in 2010. In 2014, energy insurance premiums stood at around US$ 14.2 billion whereas power insurance premiums came in at approximately US$ 9.4 billion. Overall, the U.S. is the largest energy insurance market by far at premiums of about US$ 8.4 billion, followed by Canada at US$ 1.8 billion and China at US$ 1.5 billion.

Upstream insurance accounted for premiums of around US$ 7.2 billion of the energy market, US$ 2.2 billion came from midstream insurance and US$ 4.8 billion from downstream insurance. From 2010-2014, on the back of rising exploration and production, upstream energy insurance premiums have been growing at twice the rate of midstream premiums while downstream premiums declined between 2010 and 2014. As a result, competitive pressures on rates, terms and conditions were most pronounced in downstream business.

As far as power insurance premiums are concerned, in 2014, around US$ 7.3 billion were generated from conventional power insurance and US$ 2.1 billion from renewable and other power insurance, the latter being up from around US$ 1.5 billion in 2010. Key drivers of premium growth were solar and wind power.

For 2018, Finaccord forecasts that global energy and power insurance premiums will increase to around US$ 24.6 billion under a ‘lower for longer’ oil price scenario and to around US$ 26.2 billion in the event of a high oil price scenario. The difference is attributable mainly to lower investments in the upstream energy (oil and gas) segment. As far as power insurance is concerned, the future price of oil has little impact. The outlook includes assumptions concerning key trends such as the possible growth of hydraulic fracturing (fracking), deepwater drilling, Arctic development, solar power and wind power, and on the other hand, continued excess underwriting capacity.

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4.2. The anatomy of the oil and gas markets – Some key figures

The key sections of the global energy (oil and gas) insurance market are comprised of (1) Upstream, incl. offshore construction, (2) Downstream, (3) Onshore construction and (4) Liability.
Exhibit 23 illustrates the accelerating pace of premium evaporation in the oil and gas upstream insurance market. From 2014 to 2015 alone, premium volumes have dropped from about US$ 3 billion to US$ 2.3 billion. At the same time, overall losses (insured and uninsured) have picked up.

The collapse in oil prices has led to severe cutbacks in production and exploration as well as squeezed risk management budgets across the global oil and gas industry. In addition, rates continued to slide as a result of an unabated influx of additional capacity (see Exhibit 24). There is still underwriting appetite for upstream energy business as the segment, except for years with major Gulf of Mexico events, has displayed consistent levels of technical profitability.

Upstream energy capacity
(largest amount of insurance available in the market, excluding Gulf of Mexico Windstorm)


Offshore construction capacity (excluding Gulf of Mexico Windstorm)
Exhibit 25 shows a similar pattern of increasing capacity for the offshore construction sub-sector. The resultant pressure on rates is exacerbated by falling oil prices and a general dearth of offshore construction projects.


Downstream energy losses and estimated global downstream premium volume

Downstream markets impacted by increased retentions

As in the upstream sector, premium volumes in the downstream segment are eroding rapidly. This is not only a result of abundant capacity (see Exhibit 27) but also reflects an increasing reliance on captives. A major difference to the upstream space, however, is a very benign record of losses which offers market participants some relief.
The energy liability market’s capacity in 2016 has reached a new peak at an all-time high of US$ 3.1 billion. This outcome reflects first and foremost relatively attractive levels of profitability in this sub-sector, the desire of management teams and boards to diversify beyond short-tail property insurance and the abundant supply of cheaply priced reinsurance capacity. A particular feature of the energy liability market is a confluence of eroding rates and increasing exposures, as a result of tightening environmental regulations and spiralling global litigation costs.
4.3. Trends shaping global oil and gas insurance markets – Challenges and opportunities

The oil and gas insurance line of business is a very mature market place with established client-insurer interaction and a risk-centric underwriting approach. It is sometimes described as one of the most volatile classes of insurance. Risks associated with energy production and distribution frequently lead to large scale losses. Facilities are often concentrated in some of the planet’s most hostile environments, with enormously severe natural disaster exposures, as evidenced, for example, by the 2004/2005 hurricane season in the Gulf of Mexico. This particular experience led to major changes in the market such as a more technical approach to underwriting, including new terms such as aggregate sub-limits or a more careful differentiation between new and old drilling platforms.

4.3.1. The impact of volatile oil prices

Demand from insureds is under pressure; upstream sector hardest hit

Even though energy insurance premiums primarily depend on asset values, the severe decline in oil prices since 2014 has brought about a host of challenges for energy insurance markets. Demand from insureds is under pressure. An increasing number of clients have opted for lower programme limits and higher self-retentions, despite the fact that the decline in oil prices has reduced the scope for a ‘natural’ hedging of exposures: In the years prior to 2014, market reactions to reduced oil production as a result of natural disasters increased revenue for the larger oil producers so that production losses on some disaster-hit rigs were (partially) offset by revenue gains on other sites. In today’s over-supplied markets, this mechanism is much less relevant and should prompt insureds to retain less loss of production risk. Having said this, the competitive pressure is currently most acute in upstream markets where the pipeline of new projects has all but dried up and drilling operations have been scaled back. In addition, lower oil prices have led to a fall in business interruption costs in the upstream segment, with adverse effects on insurance demand.

Opportunities for downstream and electricity generation insurers

In the downstream area the contrary is true: The sharply reduced cost of feedstock has boosted refiners’ margins, with business interruption values up accordingly. This offers opportunities in terms of additional premium income for downstream insurers. The decline in the price of oil is also a boon for oil-fuelled downstream producers, such as electricity generators, decreasing their costs.

4.3.2. Consolidation of client markets

The current turmoil hitting the global oil and gas industry is very likely to lead to a wave of consolidation as a means of taking excess capacity out of the market. This implies that demand for energy insurance capacity will come under additional pressure. To a major extent, the power generation market has already gone through a similar development, with the emergence of ‘super utilities’, particularly in Europe, providing both generation and distribution services, and growing by acquiring electricity, gas and/or water utilities.
In order to be able to service larger customers in the businesses of energy and power insurers will have to be able to transact insurance and offer relevant services on a global scale. This also includes the challenge of developing sophisticated propositions for captives which deal with the wholesale market.

**4.3.3. Changes to the risk landscape**

Another important driver of change, entailing both challenges and opportunities, is a rapidly evolving risk landscape. In this context, technological progress is of particular relevance. Rapid advances have translated into an overall lower risk profile. One example is the usage of subsea infrastructures as opposed to traditional platform-based field infrastructure.

*Improved risk management based on subsea*

A subsea completion is generally defined as a "system of pipes, connections and valves that reside on the ocean bottom and serve to gather hydrocarbons produced from individually completed wells and direct those hydrocarbons to a storage and offloading facility that might be either offshore or onshore".\(^{27}\)

Statistics reveal that such completions operate relatively smoothly after the initial installation. In addition, they offer environmental benefits. Subsea completions also have economic advantages compared to field developments such as bottom-founded structures (platforms, etc.), an advantage which grows with increasing water depth.\(^{28}\)

The potential of subsea is particularly enticing in harsh environments, like the Arctic or high risk areas where humans should not operate. Putting installations on the seafloor avoids problems such as freezing temperatures and storms. Also, it reduces threats to human life and health as fewer workers are required compared with traditional oil rigs. If subsea technology proves to be reliable, it could accelerate industry exploration in the Arctic, where experts believe about 13 percent of the world’s undiscovered oil reserves to be located.\(^{29}\)

From an overall risk management perspective, subsea completions are a major opportunity. They seem to be clearly superior to traditional drilling platforms and could arguably help mitigate some of the major environmental risks to oil drilling in sensitive areas such as the Arctic Circle.

The standard methodology for assessing drilling risk has remained almost unchanged over the past 30 years since it was first used in the Gulf of Mexico. It sets a rate for each foot drilled assuming that the deeper you drill, the greater the risks and the more expensive any remedial action. But the methodology does not take into account the very different conditions that exist today in different drilling environments

\(^{27}\) NPC (2011), p7

\(^{28}\) Ibid, pp26ff. and Osmundson (2011)

\(^{29}\) Palmer (2014)
— in shale gas fields or the Arctic, for example. Drilling in the Arctic is relatively shallow, but the remoteness of the location brings its own challenges to any remedial action. Therefore, the energy insurance industry needs a fresh approach to assessing the drilling risks energy companies face in different environments, and charge premiums accordingly.

**Concentration of risks augmented by interconnectivity**

The concentration of risks is a major underwriting challenge in most areas of energy and power insurance. For example, when an offshore energy loss occurs the physical damage part of the oil rig is covered by the Energy Physical Damage (PD) policy, but many other covers can be triggered simultaneously. Examples include bodily injury and oil pollution. This is most obvious in the case of natural catastrophes but it can also occur with interconnected offshore facilities. The Gulf of Mexico has the largest concentration of such platforms, with large losses recorded as the result of Hurricane Katrina in 2005 or the Deep Water Horizon disaster in 2010. Transocean owned Deepwater Horizon deep-water rig was contracted to BP to drill the Macondo well offshore of Venice, Louisiana. During cementing operations there was a sudden uncontrolled release of gas that led to an explosion which resulted in a fire requiring an immediate evacuation of the rig. The rig collapsed and sank to the seabed two days later and was an Actual Total Loss. The Transocean insurance package responded by paying for the total loss of the rig (US$ 560 million). The well released hydrocarbons for three months resulting in a major pollution incident and 5 million barrels of oil spilled. There were many policies triggered by the disaster, including property damage, control of well, pollution, D&O and business interruption.30

The scope for accumulation has steadily increased in recent years as vessels, storage locations and platforms grow bigger, more sophisticated and interconnected.

**Supply chain risk in energy production: Growing relevance but barriers to insurability persist** 31

The Tohoku earthquake and the Thai floods in 2011 highlighted how poorly protected companies are when a natural disaster disrupts vital supply chains. A more recent example is the man-made Tianjin (China) port blast. After a series of explosions in a warehouse at the city’s port, one of the world’s largest container ports, on August 13 which killed 173 people and injured hundreds, the pitfalls of a “just-in-time” supply chain (holding the right amount of inventory to meet both production process efficiency and customer demands) became clear once more. All ship calls to port were immediately suspended after the explosion as authorities investigated the blasts. Calls from cargo ships had largely resumed by August 19, but with 285 of the Fortune Global 500 companies having facilities in Tianjin global supply chains were severely affected.32

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30 IFA (2014)
31 Willis (2013)
Today, disruption to the supply chain of an energy company operating in Asia are believed to cost up to US$ 1 billion. However, only a fraction of this exposure can be transferred to insurance markets at a commercially viable price. The disconnection between supply and demand is attributable to information deficits: General downstream insurers, who in principle could offer this type of cover, are reluctant to offer more than basic levels of protection without detailed information about thousands of links in a supply chain. The stand-alone supply chain insurance market is now offering broader cover, albeit at relatively expensive rates and similarly detailed information requirements. A further complication arises from the increased scope for non-damage business interruption. Supplier insolvency, power outages, IT failures and cyber-attacks, for example, can disrupt the supply chain as severely as a fire at the suppliers’ site. In such circumstances traditional downstream business interruption cover offers little relief.

For risk managers this causes a dilemma. One the one hand, especially since 2011, supply chain risk keeps them awake at night as their Boards and managements expect them to effectively mitigate it. On the other hand, they lack the resources and the appetite to spend years assessing their supply chains in the way the insurance market demands. Brokers and other risk intermediaries are beginning to step in here and help energy firms determine their exposure to supply chain risk. They also assist in drawing up business continuity plans aimed at reducing an energy company’s supply chain risk, e.g. through revised storage strategies or by expanding the panel of suppliers. Having said this, the insurance market has so far failed to offer a truly effective risk management solution to heightened supply chain risks as the amount of information being made available by operators is not commensurate with the complexity of global supply chain risk in energy business. The industry itself has to accept some responsibility for this increased vulnerability. It was keen to cut operating costs by adopting global sourcing strategies, including suppliers in locations heavily exposed to natural catastrophe and geo-political risk. In addition, “just in time” procurement strategies in order to minimise inventory costs have gained in popularity in the energy industry, too. As a result, supply chain disruption has a far more severe financial impact today than it would have had 15 years ago.

**Daunting cyber–attack scenarios in oil and gas infrastructure**

As cloud computing, social media, big data - and state-sponsored digital espionage – grow in importance, cyber risk has become an increasingly relevant issue for many organizations. This is also true for energy companies who operate in an increasingly punitive legal environment and, more frequently, need to meet contractual insurance requirements.

Although digitisation opens up a great potential to make better risk management decisions and improve operating efficiency, it also conjures up the risk of a major incident caused by a cyber-attack. Globally, it is estimated that cyber-attacks against oil and gas infrastructure could cost companies close to US$ 2 billion by 2018. With the digital connectivity of industrial control systems in the energy industry, it is possible to conceive of a cyber-attack wreaking havoc on the scale of Piper Alpha, Exxon Valdez or Deepwater Horizon.33

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33 Willis (2016b)
The cyber risks to utility, power, and energy firms are daunting:\(^{34}\)
- Industrial control and data acquisition systems targeted by hackers
- Large amounts of customer and employee data at risk
- Vulnerability of evolving smart grid technology
- Business/service interruption or lost income
- Bodily injury or property damage

Cybersecurity risk has been on the risk management agenda of the energy industry for quite some time, given its increasing dependence on advanced technology.\(^{35}\) A single attack or glitch can lead to failures of critical infrastructure and networks, creating serious operational, financial, intellectual property, legal, regulatory and reputational issues. Ubiquitous connectivity exposes critical infrastructure to physical and nonphysical interruptions due to a technology or network failure.

Effective insurance cover against cyber risk remains elusive – not only in the energy space. There are still major obstacles to traditional insurability, such as the difficulty in developing accumulation scenarios or the exposure to wilful acts. So far, almost all policies issued by the upstream and downstream energy markets contain a cyber exclusion as underwriters are unable to assess and quantify cyber risk. Instead, a few cyber specialists have entered the scene. They offer standalone cyber products, generally only with limited cover. Therefore, there is a huge digital risk protection gap in the global business of energy. Narrowing this gap is clearly a major opportunity for energy insurers even though the way forward is challenging and prone to set-backs.

*Legal and regulatory tightening adds to environmental risks*

There is a significant legislative momentum affecting the operations of energy companies. Environmental Law imposes strict liability for clean-up and third party damage from all operational phases. More than 16,000 different environmental laws around the world create huge challenges in terms of legal compliance and potential for change of legal exposures, especially during long-term contracts.\(^{36}\)

Increasing public awareness of environmental matters has put operators under unprecedented scrutiny. This awareness is both driven by structural developments such as the rise of shale oil and gas extraction and specific high-profile disaster events such as the Deepwater Horizon/Macondo loss in the Gulf of Mexico in 2010. Against this backdrop, several legislative frameworks have been tightened recently, such as the EU’s Environmental Liability Directive (ELD).\(^{37}\)

\(^{34}\) Aon Risk Solutions (2015)
\(^{35}\) U.S. Department of Energy (2013)
\(^{36}\) Willis Towers Watson (2016a)
\(^{37}\) Ibid.
In addition, the drop in oil prices has further increased exposures as a result of mothballing, if not plugging and abandoning fields. This has led to increasing legacy liability in times of falling revenues. Also, abandoning old infrastructure or extending the operational phase of existing infrastructure heightens certain loss potentials. In general, with the operating mode switching from “new installations” to “decommissioning”, the increase in liability risk is “directly inverse to the revenue”.38

A major constraint to the provision of adequate liability insurance for the energy industry is capacity. Many claims in recent years have exceeded US$ 1 billion, including clean-up costs and subsequent pure financial losses. Widespread pockets of underinsurance or even uninsurance are being exposed as energy operators’ profits drop and balance sheets (and, as a result, retention capabilities) weaken. Energy insurers, therefore, need to think creatively about these protection gaps, which includes a careful exploration of cost-efficient Alternative Risk Transfer (ART) techniques, potentially turning a challenge into an opportunity.

**Human capital management in times of turmoil and increasing risk**

The oil price collapse has added importance to the challenge of managing human capital. Thousands of jobs were shed across the global energy industry. As a result, some companies may now lack the skills and knowledge required to continue operating, let alone the ability to capture opportunities from a potential rebound of oil prices. The retention of talent and accumulated knowledge matters more than ever as most graduates with degrees are not learning the oil & gas trade through tough field work anymore. In sum, the name of the game is to reconcile short-term survival in trying times with an organisation’s long-term health and prospects.

Another challenge is workplace security. Relevant legal and regulatory requirements have been tightened in recent years. In addition, risks from political unrest, the remoteness of locations and pandemics have heightened. Also, employer benefits need to be set to a level sufficient to attracting talent to working in hostile environments such as the Arctic Circle.

**4.3.4. The evolving value proposition of the energy insurer**

*Meeting more demanding client needs*

Against the backdrop of a rapidly changing operating environment in the energy sector, the value proposition of energy insurance is undergoing various adaptations. For example, energy producers increasingly expect support in building more resilient business models, e.g. through the adoption of Enterprise Risk Management (ERM) frameworks, meaningful cyber insurance risk propositions, a review of current risk strategies from a total cost of risk point of view and the facilitation of M&A activities, with the aim of capturing synergies and cost savings.

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38 Ibid., p40.
There is also an increased demand and need for environmental liability and risk assessments/risk engineering services. Fracking, for example, increases environmental legal liability exposure whilst sophisticated technologies which control the drilling are increasingly vulnerable to failure. Another growing challenge is climate risk, particularly at a time when producers are stepping into environmentally sensitive areas such as the Arctic Circle. Compliance failures in this area can easily translate into major hits to a company’s earnings, capital base and reputation. Finally, protection gaps in supply chain risk (including non-damage business interruption) need to be addressed by insurers in order to safeguard their relevance with energy operators.

This more complex set of client needs presents energy insurers with the opportunity of more effectively differentiating their offerings, deepening and broadening their client relationships.

**Digression – The vital importance of unrestricted access to energy reinsurance**

Traditionally, energy insurers are highly reliant on reinsurance. Cession rates in some parts of the world exceed 90%. Therefore, the current trend towards more fragmented and protected reinsurance markets gives rise to concern. Global reinsurers’ business models are based on the widest possible utilisation of geographical diversification effects. For their business model to work, reinsurers need to be able to write a large number of diversified risks in as many markets as possible. The better diversified a reinsurer is the more likely it is to withstand large catastrophic events. It will also enjoy minimal cost of capital which, in competitive markets, will be passed on to cedants and policyholders.

Discriminatory prudential provisions for cross-border reinsurers impair the strength of any local insurance market. Such measures curtail access to competitively priced international reinsurance capacity and risk management expertise. They also compromise financial stability in the face of major catastrophes, where losses may be concentrated with domestic insurers or reinsurers rather than spread globally.

The most recent trend in some countries (e.g. China) to impose capital charges on reinsurance branches translates into higher reinsurance costs. Applying extra capital charges to branches undermines effective global diversification. Similarly, if domestic insurers are forced or incentivised to cede more of their risks to local reinsurers (e.g. in Indonesia) there will be a greater concentration of risk and an increased vulnerability of local insurers and the economy at large to catastrophe losses.39

**Digression – How to leverage Big Data and advanced analytics to improve risk management and underwriting**

New technologies enable quantum leaps in making better use of data. Big data and powerful (predictive) analytics can go a long way in helping energy insurers, too, enhance their understanding of their clients’

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39 Insurance Europe (2015)
risks. Examples include algorithms which facilitate the more accurate assessment of the likelihood and severity of oil spills, cyber-attacks and supply chain disruptions. The same is true for the Internet of Things, i.e. the combination of electronics, software, sensors and network connectivity with machines and infrastructure.\(^{40}\)

Generally speaking, in the digital age, traditional information asymmetries in insurance are poised to reduce. Data sourced from new and non-traditional sources makes it much easier to price individual risks based on their specific characteristics. Therefore, it is less likely that ‘good risks’ withdraw from the market so as to avoid subsidising ‘poor risks’. The scope for adverse selection diminishes, accordingly. The same is true for moral hazard. Given the availability of Big Data and sharply reduced costs of gathering information, it is much less likely that an insured will be more careless as a result of being protected. These fundamental changes will improve the efficiency of energy insurance markets, too.\(^{41}\)

**Digression – Spotlight on Africa**

According to the UN Africa’s population is expected to almost double to more than 2 billion by 2040. In combination with the continent’s vast natural resources and economic reforms these demographic dynamics will underpin Africa’s robust economic expansion going forward.

Oil and gas reserves feature most prominently among Africa’s natural wealth. The continent is the world’s second largest net exporter of oil (after the Middle East). It accounted for over 11% of global oil production over the past decade, despite recent significant volatility in production in countries such as Libya and Sudan. According to the BP Statistical Review of Energy, Africa’s proven oil reserves have grown by almost 150% since 1980, almost 8% of the world’s total.

Despite the increase in reserves, there is still massive scope for further exploration, in offshore oil in particular and concentrated in the four members of the Organisation of the Petroleum Exporting Countries (OPEC) Libya, Nigeria, Angola and Algeria. A number of other countries also offer exciting prospects, e.g. Ghana, Uganda and Kenya.\(^{42}\)

Africa’s proven natural gas reserves account for almost 8% of the world’s total, concentrated in Nigeria, Mozambique and the North African trio of Algeria, Libya and Egypt. Going forward the realization of Africa’s huge natural gas potential will depend on improvements in infrastructure such as the development of regional pipelines, the expansion of LNG facilities and policies to ban gas flaring. On this basis, the sector could see significant growth both for export and for domestic use in electricity generation.\(^{43}\)

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\(^{40}\) Willis (2016b)  
\(^{41}\) Schanz (2016)  
\(^{42}\) KPMG (2015)  
\(^{43}\) Ibid.
Of course, the decline in oil prices since 2014 has taken a heavy toll on Africa’s energy markets, too, with capital budgets and frontier exploration activity being cut. Examples include deep water exploration projects in Angola and the Democratic Republic of Congo. Nigeria has been particularly hard hit: Historically oil accounted for 90% of exports and 60% of government revenue.

Having said this, the trend of direct foreign investment into Africa’s energy markets continues, predominantly from China, but also from U.S. and UK private equity firms as well as traditional natural resource companies. They make strategic investments, taking advantage of current trading conditions, in order to capture the enormous long-term potential offered by Africa’s oil and gas reserves. In addition, there are signs of political and economic reform which help attract much needed foreign investment, especially in the domestic power sector.

In addition, as in other parts of the world, there are losers and winners from lower oil prices: While the upstream sector is going through a very difficult period, many downstream and chemical operators are benefitting from lower feedstock prices and associated higher margins which translate into higher demand for insurance.

In summary, current conditions in oil and gas markets put a premium on (re)insurers and brokers who offer distinctive sector and country expertise rather than simple capacity provision and transactional services. Clients increasingly need sophisticated analytical and risk advisory services to optimise their total cost of risk.44

A particular area of opportunity for (re)insurance and brokers in Africa is Renewable Energy Technologies (RET). Up to 2040 some 700 TWh in additional electricity generation capacity are forecast to derive from renewables, with about 50% accounting for hydro power. This compares with about 800 TWh projected for the European Union and the U.S. each (see Exhibit 19).

4.4. RET underwriting challenges and opportunities
Massive investments and investor expectations drive RET insurance markets
According to the projected global energy mix (see Exhibit 4) renewable energy (particularly hydro energy in Asia) will become increasingly relevant as a key element of future power generation. Drivers of renewable energy growth include policy incentives (e.g. support schemes) as well as more reliable and efficient technology. However, the investment risks associated with renewables are also becoming increasingly complex. Therefore, adequate insurance and risk management instruments are vital to de-risk cash flows and can be seen as a prerequisite to ensuring sustainable growth of renewable energy. This implies an increase in the estimated annual expenditure on risk management services in RET including insurance

44 Willis Towers Watson (2016a)
solutions to up to US$ 3.7 billion in 2020, a fourfold increase within 10 years. Total investment in new renewable power capacity built worldwide through 2040 could exceed US$ 10 trillion, depending on the underlying policy scenario.  

75% of capacity additions are likely to be in the solar and wind sectors, both onshore and offshore, and over half of this attributable to Australia, China, France, Germany, the UK and the U.S.

The growing demand for risk management and insurance services reflects structural changes in renewable energy markets. Owners and developers are keen to tap into new sources of funding, including from institutional investors such as pension funds who almost desperately search for yield. To make investors feel more comfortable about this asset class, projects must be de-risked, from early stage construction to operation. Growing offshore wind deployment is another reason why demand for insurance increases, reflecting their technological complexity, exposure to adverse weather and difficult geographic conditions. Operators seek risk transfer products which can be viewed as a blend of traditional insurance products and weather derivatives, covering physical damage, delays and downtimes, not just as a means of disaster risk mitigation but also in order to reduce earnings volatility.

Parametric covers, for example, are now more widely available. These can mitigate the financial impact of unscheduled downtime, for instance. The availability of such solutions has benefited from major improvements in modelling techniques. Triggers are one or more parameters such as wind speed or wave height. With advancements in grid-scale energy storage, however, output variability becomes less of a concern for grid operators and fossil fuel generators.

Increasingly, there has been a lot of research into subsidy cover that would pay out if crucial state subsidies are suddenly withdrawn from a project. Given significant recent policy changes in a number of countries, interest in these forms of coverage has increased.

4.5. Nuclear power underwriting challenges and opportunities

Scope for private sector risk pricing and transfer remains limited

Except for physical damage, nuclear power liability risks pose severe challenges in terms of insurability which usually requires the following conditions to be met: A large number of independently and identically exposed risks (law of large numbers); the expected losses should be calculable (no ambiguity) and the loss should be accidental from the insured’s point of view (limited moral hazard or adverse selection). These conditions are only partially met for small or medium sized nuclear accidents, and not at all for large scale events such as core meltdowns or the disposal of radioactive waste.

45 See section 3.4. of this report.
46 Turner et al (2013)
47 Lloyd's (2014)
48 The Geneva Association (2014)
Due to these peculiar characteristics, nuclear liability principles are based on international conventions such as the Vienna Convention (1963) and national laws (e.g. the Price-Anderson Act in the U.S.). In general, victims are relieved from proving fault or negligence of the operator. In addition, in case of an accident, all claims are to be brought against the nuclear operator who must maintain insurance cover that guarantees a minimum amount of indemnification to victims. Also, there is limited liability: Beyond a certain level of damage, responsibility is passed from the individual operator either on to the (federal) government or a mutual collective of nuclear operators, or both.

Nuclear risks are usually covered by a combination of self-insurance by nuclear operators for low-tier risks, market insurance (including insurance and mutual pools), reinsurance and a guarantee by governments above this limit.

The government’s liability is a huge contingent debt, up to one trillion euros, in the worst case scenario for a country like France, for example. Therefore, the scope for private sector risk pricing and transfer remains limited, in particular as the probability of a large scale nuclear accident is hard to assess and nuclear accidents have long-lasting consequences. From an economic point of view, the price of nuclear risk is a hidden subsidy from governments to nuclear operators. It is not fully reflected in the actual cost of nuclear energy.49

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49 Picard (2011)
5. Conclusions

As this White Paper demonstrates, global energy and power insurance markets offer a multitude of short-, medium- and long-term opportunities and challenges.

The dramatic slump in oil and gas prices since 2014 has led to well-known dislocations in the global market place, taking a particularly heavy toll on upstream producers and their insurers. As a result, dealing with these current challenges features most prominently among the priorities of boards and management teams.

However, it will be of vital importance to any aspiring market participant to continue monitoring the fundamental medium- and long-term forces reshaping the global energy and power markets. Opportunities abound as world energy demand is projected to grow by up to another 50% over the next 25 years, driven by non-OECD countries due to a combination of accelerating industrialization, population growth and the expansion of the middle class.

Therefore, despite the current turmoil, energy and power insurance will remain a ‘growth business’ with attractive prospects. This is particularly true of the natural gas and renewable energy segments, as shown in this paper.

Overall, by 2040, the energy and power sector will see massive investments of almost US$ 70 trillion, with a particularly steep growth, not only in investments but also in insurance premiums, expected in the area of renewable power generation.

In order to capture this tremendous potential insurers will have to effectively respond to their clients’ rapidly evolving risk management needs, ranging from subsea drilling, an accelerating concentration and accumulation of risks, an increasing vulnerability of supply chains, the potential and threats of digitisation to spiralling liability exposures.

For committed energy insurers with a long-term perspective this more complex set of client needs presents a major opportunity of more compellingly differentiating their offerings, deepening and broadening their client relationships.
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THE CHANGING GLOBAL ENERGY LANDSCAPE
OPPORTUNITIES AND CHALLENGES FOR ENERGY UNDERWRITERS
PERSPECTIVES SUMMER 2016