Power Struggle: Law and the Energy Sector

A REPORT BY JOMATI CONSULTANTS LLP, OCTOBER 2012

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About this Report

This is the ninth Jomati Consultants report on key issues affecting the legal sector. The report focusses on the energy sector and its growing importance across multiple practice areas and geographies.

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Disclaimer and Thanks

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Introduction

"We've got to have an all-of-the-above strategy that develops every available source of American energy. Yes, oil and gas, but also wind and solar and nuclear and biofuels, and more."

US President, Barack Obama, 23 February 2012.

There is no other sector like energy. It brings together geopolitics, ground breaking technologies that will change how we live, GDP-size levels of financing and equally massive global demand that simply has to be met. While what fuels we use to meet these needs will shape the Earth's climate. Not every lawyer has such a profound sub-text to their work, nor clients that are genuinely 'changing the world'.

The global energy sector unites a vast array of corporate and public stakeholders: from small explorer oil or gas companies listed on AIM or the NASDAQ and staffed by today's frontiersmen, to Government and Fortune 500 company-backed alternative energy projects dependent upon some of the best scientific minds of our generation. Their work ranges from pioneering breakthroughs in battery technology that will revolutionise the transport sector, to attempting to build the world's first operational fusion reactor that promises limitless electricity.

Yet, mention the energy industry and many will think of the big brand oil companies. This is a fair reaction given that seven of the 10 largest companies in the world are super majors[1]. But, the energy sector is so much more than this and has never been more diverse or complex. What President Obama said about America is true globally: the world's energy demands will only be met by multiple energy sources developed in parallel. When asked the question: 'What will be the power sources of the future? CO_2 emitting hydrocarbons, expensive nuclear, or intermittent but clean renewables?' The answer really is: 'All of the above.'

What this presents to the legal sector is an incredibly rich and diverse group of clients whose domestic and international needs continue to grow, from protecting IP related to the chemicals used in hydraulic fracturing or the latest super-efficient solar panel, to advising corporates on the global patchwork of energy regulation, to supporting banks, funds and Sovereign Wealth Funds with their billions of dollars of financing and investments in the energy sector. In a period of slow economic growth this makes energy doubly important.

If the world is embracing an 'all of the above' strategy then law firms' energy practices will need a very wide knowledge base to be credible. As clients often say, they prefer a legal adviser who understands the economic and political context their legal issues arise within. But, clients can also be very short sighted, especially in the often ideologically charged energy sector. This further demands law firms have a wide understanding of the whole sector if they are to avoid advisory missteps. For example: oil companies can be sceptical of environmental impact, an attitude that can backfire spectacularly; or wind turbine makers can assure investors that subsidies are here to stay only to see them cut due to a political decision, perhaps triggering disputes. This means law firms will need to make their own assessments of the competing energy sector rivals, their agendas and the regulatory landscape if they want to add real value to businesses whose futures could turn on a key strategic assumption.

This report therefore has three aims: to sort out the truth from the 'spin' delivered by the competing energy businesses as they struggle against each other for market share; to assess the future trajectories of these competing technologies; and to consider how law firms' main practice areas can profit from the ever-growing battle to meet energy demand.

[1] See Appendix A.

Chapter One: The Big Picture

The Next Energy Crisis?

Global energy production has been growing fast, doubling in the last 40 years to meet demand (see table 1). The world now consumes energy equivalent to 156,000 barrels of oil each minute to keep the lights on and the traffic rolling[2]. A huge population increase from 3.7 billion people in 1970 to over 7 billion people today has driven this demand, as well as higher levels of economic development around the world, especially in Asia.

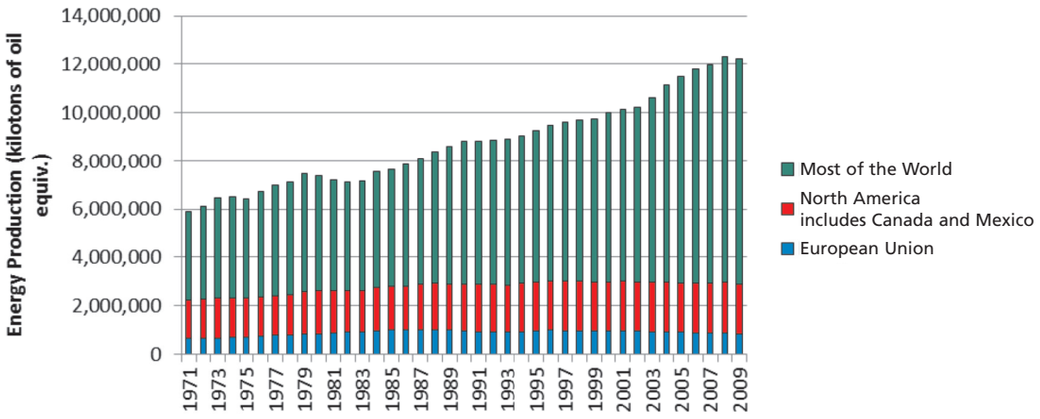

Table 1: Total global primary energy production by region, 1971 to 2009. World Bank data. (North America includes Canada and Mexico).

Does this mean that we soon face a new 'energy crisis'? Does this signal a return to the supply shocks of the 1970s when a barrel of crude oil rose from $1.8 in 1970 to $11.58 by 1974[3], and by 1980 had reached $36.80? Are we again going to embrace concepts such as M. King Hubbert's[4] 1956 'peak oil' theory that oil reserves were peaking and would soon run out, pushing prices to economy-crushing levels? Some people will no doubt panic when they juxtapose the unquestionable facts of growing demand and limited resources. If energy prices are high today with 7 billion people, what will the situation be when we reach 9 billion in 2050, especially after the level of economic development has risen far higher in the developing world? How will we cope?

As we examine in this report, we believe that although demand for energy will rise in many countries, global needs will be met regardless of population growth and urban development. This is because high energy prices create positive side effects[5]: it becomes profitable for investors and corporates to explore and develop new energy supplies, which inspires and funds new technology whether in hydrocarbons, solar or wind, or nuclear energy to help meet this objective. This energy investment cycle played a major role in saving the West from the energy crisis of the 1970s (see table 2).

[2] For those that have lights to turn on, of course. Around 2 billion people, or 28% of world population, still have no mains electricity, at least officially. Some of the 'disconnected' pirate electricity from the grid, while many in the world's developing cities will have power eventually. This will further increase energy demand globally.

[3] Oil price data, source: BP. The crisis was triggered by Arab nations cutting off oil supplies to the US after its support for Israel following the Yom Kippur War in 1973. The Iranian Revolution in 1979 extended the crisis.

[4] A seminal thinker on 20th Century energy policy and a senior geologist for Shell in the US. He died in 1989.

[5] A more subtle effect, is that energy use becomes more efficient over time. See Chapter Seven.

Table 2: The Energy Investment Cycle.

America and other countries stepped up exploration for oil and gas, such as the UK in the North Sea. New drilling and deep water rig technology was developed out of necessity and also out of hope of a return. New energy trading and exploration relationships were formed with ex-Soviet Russia and former USSR states, as well as in Africa and South America. With perseverance and creativity the oil companies extracted and secured sufficient supply. Prices came down. By 1998 a barrel of oil was just $12.70, a third of the price it had been in 1980. Efforts to produce what were now called 'renewables' also promised to provide extra supplies of what appeared to be clean, limitless energy. Optimism returned to the energy sector. Human ingenuity and the profit motive had beaten the 'finitism' of the doom mongers[6].

Will the energy investment cycle pull us through the current period of high demand for energy and high oil prices, currently at around $110 per barrel of Brent crude? We believe it will. In fact, it already has done so in some parts of the energy sector, as can be seen by the success of gas fracking in the US (see more later). Today, as well as meeting growing demand with equally growing levels of ingenuity, we now face an extra challenge: man-made global warming[7]. Now we must not only meet demand needs by producing more energy, we must reduce CO_2 emissions too. We will come back to this conundrum in Chapter Five.

China and the New Energy Consumers

The world outside of the EU and North America saw its energy production increase by 82% between 1999 and 2009. China has been central to this change, (see table 3). The US Energy Information Administration (EIA) estimates that China has already surpassed America as the most power hungry nation on Earth. This occurred in 2010 when China consumed 104.6 quadrillion BTU of energy compared to the US's 97.8 quadrillion BTU. By 2035 China will be using 70% more energy than the US. This has several interesting outcomes:

- China, which is already extremely focussed on finding new sources of oil, coal and other primary energy abroad, will increase its outbound search for supply.
- Exporters of energy may eventually see China as a better client than the West.
- World events that impact energy imports, whether environmental or geo-political, may become more important to China than to America.

[6] Naturally, all hydrocarbons are finite, but the question is can we keep efficiently extracting and using reserves of oil, coal and gas until we can develop sufficient alternative power sources to take over? That answer, in the 1970s and early 1980s, had been a confident no. Today, the answer for many is more likely to be yes, (more on this in the following chapters).

[7] For the record, Jomati accepts the scientific evidence for man-made global warming. We prefer science to simply deciding to deny that the CO_2 emissions of 7 billion people have no impact on global temperature. Though the argument that we are all 'doomed' if we do not stop using carbon-based fuel needs to be treated with a healthy dose of scepticism.

- In the long term, China will need greater foreign investment to fund its energy needs in terms of supply, domestic transmission and generation capability.
- China will also seek to increase its renewable energy production to reduce the need for imports of coal and oil.
- As occurs when any customer becomes larger than all the others, China will be able to exert its buying power on the energy market in ways that would have seemed unthinkable a decade ago.

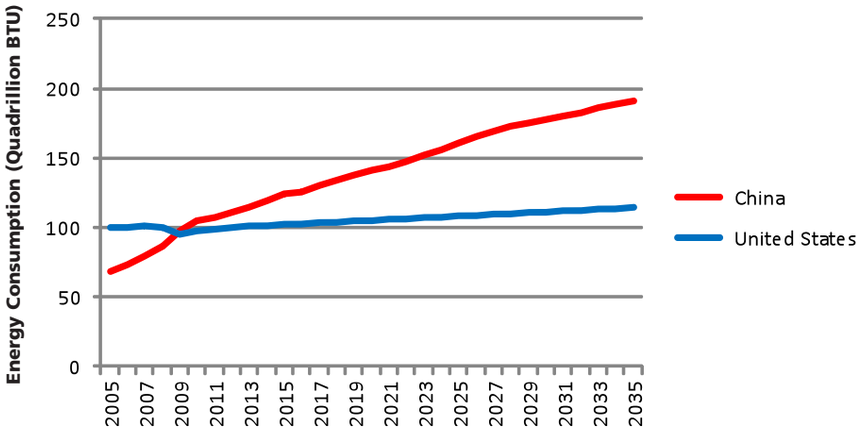

Table 3: China versus US primary energy consumption, EIA data and predictions.

But this story is not just about China. The whole of the developing world is seeing mass urbanisation and this is having a huge impact on energy demand (see table 4). Those that can afford them are buying cars; ceiling fans are now replaced with energy-sapping air conditioning; and IT is proliferating in homes and offices. The developing world will slowly ascend to the consumption levels of the US and EU. The problem is that the total population of the US, EU, Japan, Australia and Canada is 'only' 1 billion. The combined population of China, India, Africa, South America and South East Asia is 5.5 billion people. If even half of these people lived like those in the West, and consumed energy as we do, then demand will rocket in the coming decades. If all of these billions one day live the 'Western lifestyle' then we really will need to pull together as a planet to meet total energy needs.

One might believe the poverty in many of these regions will keep such demand down. But the truth is that in the huge slums of South America or India, where people are too poor to pay for electricity, energy is consumed by pirating from the grid on a huge scale. The UN estimates that the global slum population by 2030 will be around 2 billion people. By way of comparison with the developed world, America's Nevada Power, a private energy supplier, found in 2007 that around 1% of its total electricity supply was stolen via piracy each year[8]. In developing countries the level could be far higher. Piracy is therefore an additional strain on global supply.

[8] 29 May 2008, Las Vegas Sun.

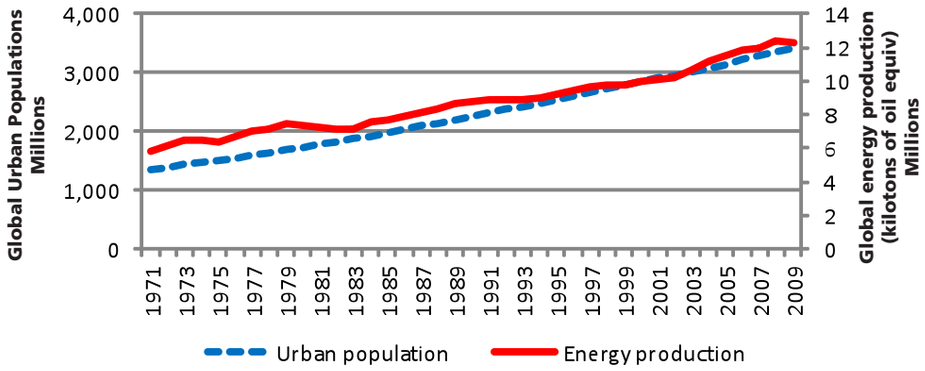

Table 4: Total global urban population versus global energy production. World Bank data.

Law Firms and the Energy Sector

As can be seen, some of the future energy sector growth will be outside the West, though it is important to note that Western companies and investors will be key players in this development. Plenty will change in Western markets too, from updating old power plants, to installing new renewable capability. Below are some specific areas for law firms to consider:

- 'Pure' energy law, that is to say the regulatory and contractual law that relates to agreements between different parties in the exploration, production, sale and transmission of energy, covering structures such as Power Purchase Agreements is fundamental to the sector's legal needs. Developed and developing markets are also continually modifying energy regulation as national needs evolve. One important sub-set of regulatory law that is open for continual change is subsidies, often in relation to renewable energy. In some cases an entire re-writing of the laws is taking place, such as the UK's 'Energy Bill 2012'[9] that will be the biggest shake up of the national energy market for decades and could be a model for other countries.

- Project Finance in the energy sector will also see huge on-going activity from the private sector as well as direct public investment. In many cases new energy projects will be arranged via Public Private Partnerships (PPP). Cross-border projects, such as gas and oil pipelines, will also demand complex multinational negotiating skills to support the financing and return on investment agreements of such multi-party projects.

- Capital markets play a vital role in the energy sector. The largest energy businesses require huge amounts of capital to develop, while smaller energy companies require up-front funds to support exploration or the development of new technology.

    - The NASDAQ has around 360 energy companies listed on the US exchange, with a market cap of around $2.2 trillion as a sector group. A small but important group of these are Chinese companies, such as CNOOC Limited, as well as alternative energy companies such as China Ming Yang Wind Power Group Limited. The NYSE also has around 250 oil and gas companies listed.
    - In the UK the FTSE hosts a number of very large energy and utilities companies. Around 20% of the FTSE 100 is related to the energy sector.

[9] See more later in Chapter Five.

- The smaller UK growth exchange, AIM, sees a very high level of energy company activity with around 90 oil and gas companies listed, many of which are explorers or at the cutting edge of energy technology. There are also energy industry service companies and dozens of mining companies, although only a few are specifically energy related, such as Uranium Resources. AIM also attracts a number of foreign energy companies seeking capital without the sometimes exigent listing requirements seen in the US.

- 26% of M&A globally is directly within the energy, mining and utilities sector (see table 5), or $557bn worth of deals per annum. The values are high in part due to huge general mining deals, but a proportion of the mining deals are related to energy resources such as coal or uranium. This is not a single year phenomenon either. In 2010 and 2009, around 25% of all major M&A deals globally were also in the energy, mining and utilities sector by value. By number of deals it is a little lower than other sectors, but deals are often larger. Also, energy-related M&A activity will spill over into other sectors, such as transport, technology and construction, so the total impact of energy as a sector on corporate work is probably far greater. Work advising investment banks on deal finance in this sector will have a correspondingly large value.

Sector	*2011Announced Deal Value $bn*	*% of Global M&A*	*Number of Deals*
Energy, Mining & Utilities	557.1	25.6%	1,148
Industrials & Chemicals	365	16.8%	2,511
Financial Services	270.8	12.4%	1,088
Pharma, Medical & Biotech	197	9.0%	953
Consumer	183.3	8.4%	1,651
Technology	145.3	6.7%	1,326
Telecommunications	102.7	4.7%	150
Business Services	89.8	4.1%	1,550
Real Estate	80.7	3.7%	207
Transport	51.1	2.3%	385
Leisure	48.2	2.2%	454
Media	42	1.9%	393
Construction	28.5	1.3%	450
Agriculture	9.8	0.4%	149
Defence	7.1	0.3%	40
Total	**2,178.40**	**100%**	**12,455**

Table 5: Global M&A deals by sector, 2011, (ranked by announced deal value, MergerMarket).

- Private equity funds play a proactive role in developing the energy sector with strategic acquisitions. There are hundreds of private equity funds that focus on the energy sector. Some of the better known funds include: First Reserve; Riverstone Holdings; Natural Gas Partners; ArcLight Capital; and Lime Rock Partners. Many of these funds focus on the service companies that support the energy sector, from helicopter operators that service oil rigs to specialist drilling businesses.

- Sovereign Wealth Funds such as Singapore's Temasek also play an important role in the energy sector. For example, this year, RRJ Capital and Temasek purchased around half of the $1.34bn shares in Kunlun Energy Company from PetroChina, which controls gas interests in Thailand, Indonesia and China.

- IP is of critical importance to the energy sector. From horizontal drilling techniques to improved solar cells, innovation is central to securing future growth in the sector. Current technology may also be insufficient to meet future global energy needs. Patents are therefore the unseen backbone of the energy sector and cannot be underestimated in importance. According to the Clean Energy Patent Index for the US, patents in just this sub-set of the energy sector have rocketed from 1,000 clean tech patents a year from 2006 to 2008, to over 2,300 in 2011. The three top areas of clean tech for new patents were fuel cells, which led by a large margin, followed by solar and wind. The oil and gas industry also greatly value their patents. As the Canadian 'Oil & Gas Network' specialist publication[10] states: 'The need to protect R&D investment dollars drives patenting.' IP that improves energy efficiency, both in production and end use, will also be increasingly important.

- Environmental law/land rights. Understandably, environmental issues are always critical to major power projects, whether regarding nuclear plants and waste, to potential for gas fracking to generate litigation, or oil drilling. For example, BP's Deepwater Horizon disaster is ample proof that environmental damage can carry a huge financial cost and generate significant legal work. Meanwhile, France's Total has recently warned of the reputational and financial risks to the company of drilling for oil in the Arctic (see more later). Power stations and wind turbines will require ownership or long term leasing of the land, but fracking will also depend upon who owns the rights to subterranean assets. Regulation related to CO_2 emissions will also continue to develop, often with great variance globally. Energy companies may face very strict rules in Europe, but face little or no limits on CO_2 emissions in some developing markets. This creates complex corporate environmental responsibility issues for large energy companies.

- Litigation driven by corporate disputes is highly likely to occur in the energy sector where huge financial commitments need to be made against a backdrop of constantly shifting positions on Government subsidies, changes in policy and sudden swings in primary energy prices. Many major exploration projects use complex joint ventures, as we have seen in Russia, and the potential for parties to fall out is always high. Litigation related to environmental damage is also ever present and disasters such as Fukushima and Deepwater Horizon both show what havoc the energy sector can do to a region's economy when safety systems fail. We will also increasingly see ownership disputes over oil and gas deposits, especially offshore. The Arctic is one area of concern (see more below), but the Mediterranean is also increasingly liable to see territorial resource disputes following the development by Israel of the Tamar gas field off its coast. The US Geological Survey[11] believes this field is part of a far larger deposit of offshore gas that stretches from Egypt to Turkey, passing along the way Israel, Cyprus, Lebanon and Syria. There is also ample room for disputes to arise from pressures on bilateral and multilateral investment treaties, especially when one nation's Government decides it has agreed to unfair terms or that it is not getting its 'fair share' from the deal. Litigation is also an area where even the largest oil companies believe they need expert external legal advice, no matter how large their inhouse teams are.

[10] http://oilgas.net/feature-article/700/value-oil-%2526-gas-patents

[11] www.ft.com/cms/s/2/1dbda574-f16d-11e1-a553-00144feabdc0.html#axzz2696mpYxy, 31 August 2012, FT, 'Field of Dreams: Israel's Natural Gas'.

Chapter Two: Oil Futures

Given our current dependence, one would expect the oil industry to keep its dominant position almost indefinitely. It is certainly hard to imagine oil losing its vital importance any time soon, but its position is not God-given, and small signs of future change are now appearing. Below, we consider the future trajectory of the oil industry.

The Case Against Oil

The most significant challenges facing oil are its high cost (see table 6) and its high pollution levels; it is the second greatest CO_2 emitter after coal[12]. Its high cost is not likely to reduce in the short to medium term. Fears over Iran persist and though some predict bombing its nuclear program would not result in a major oil spike[13] there is no telling what the long term repercussions could be for the transit of oil tankers in the Gulf. Growing demand in the developing world for oil will also continue to increase price pressure.

That means today's high prices could remain for a long time to come. This will trigger innovation and exploration, but it will also drive more countries over the long term to seek alternatives to oil and develop lifestyles and modes of transport that use far less, or no oil at all. In the meantime dependence on oil is costing developed nations dearly, loading down already weakened economies.

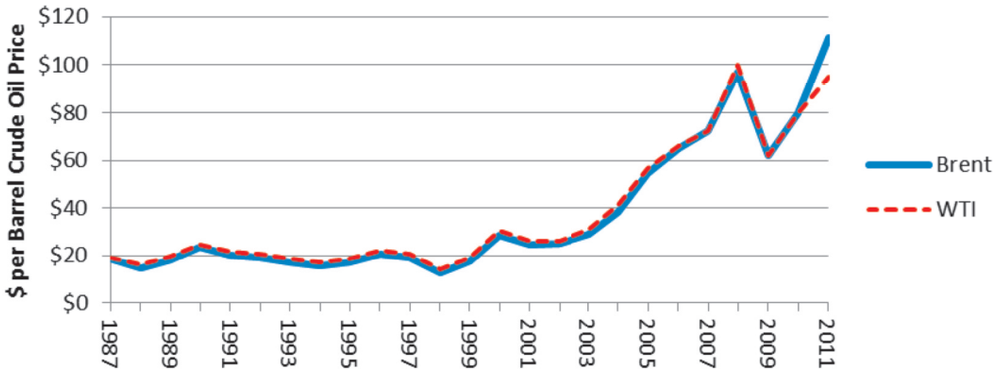

Table 6: WTI and Brent crude[14] from 1987 to 2011 showing quintupling of oil prices. EIA data. In September 2012, WTI and Brent crude were around $90 and $110 respectively.

Oil's role in electricity production will also be limited if prices remain so high and its primary use, for fuelling transport, faces the development of advanced all-electric cars (see more below), that will eventually compete with the 125 year old internal combustion engine (ICE).

Oil rich countries such as Saudi Arabia still rely on burning oil to supply electricity. Even the UK and Japan, which are not oil rich, still maintain a handful of very large oil-powered plants. Most surprisingly given its cost to the economy, the US maintains hundreds of small oil-fed power plants, many in the 10 MW range. However, unlike the UK and Japan, oil imports from Canada's oil sands fields to the US may mean that these 'guzzler' electricity generators may keep

[12] The issues surrounding global warming and CO_2 reduction are examined in Chapter Four.

[13] JP Morgan commodities research paper, referenced, FT, 10 September 2012. The JP Morgan argument is that strategic oil reserves would be released if an attack took place. This could briefly lower prices. It also notes Iran's share of global oil production is a few percent and can be replaced. But, this ignores the impact on exports of oil from other Gulf States that would be affected by Iranian retaliation in the Strait of Hormuz, which could go on for months.

[14] Two of the main global oil indices are Brent in the North Sea, and WTI, or West Texas Intermediate. Brent, at least over recent years, has tracked higher than WTI.

running[15]. Likewise continued growth in US shale oil from North Dakota will also help. Even so, burning difficult to extract oil to generate electricity appears inefficient, polluting and adds extra emissions.

Another important factor for oil's future is how much is consumed by transport needs. In a highly mobile country such as the US, transport absorbs 28% of all energy (see table 7). Most of this transport is via ICE-powered private vehicles using petrol or diesel. Less dependence on ICEs or cuts to the use of private vehicles will reduce the demand for oil. As we explore below, the improvement of engine efficiency, greater use of hybrids and electric cars will also help the situation. And there are signs that car use in some developed countries is now slowing. For some years now 40% of households in London have not owned a car[16], while 25% of all British homes overall do not have one either. Public transport makes up this mobility gap, and due to its high levels of efficiency consumes far less energy per person. This could go further. But greater change may depend on people's willingness[17] to leave their cars behind, as well as Governments 'nudging' people via a mix of incentives and deterrents, such as congestion charging zones.

Area of Demand	*Percentage of Total Primary Energy Consumed*[18]
Electric Power Supply	40.1%
Transport	27.8%
Industrial Uses	20.6%
Residential and Commercial Uses	10.8%

Table 7: US Primary Energy Consumption by area of demand. (US DoE 2009)

In the developing world the issue is not getting people to stop using their cars, but to stop them buying cars in the first place. But that seems highly unlikely, especially as many Chinese car companies are at least partially State-owned and would like to build a buoyant domestic car market. Instead we may see Chinese car makers, like those in the West, gradually pioneer electric vehicles. If China also followed this route and succeeded, the long term downward pressure on oil prices would be significant. Though, it would need to build sufficient electricity capacity to meet the demand for electric cars, so this evolution would come with its own costs.

A competitive, reasonably priced all-electric car may not be that far away given recent advances. We must not discount either the possibility of a 'quantum leap' in battery technology that would transform the electric car industry in a few years. A sign of the times comes in the shape of all electric high speed car racing to be launched as Formula E in 2014. The global tournament is backed by the Federation Internationale de l'Automobile (FIA), which also runs Formula 1 car racing. Its aim is to push current technology to the limit and help find breakthroughs in battery technology. The prototype electric racing cars made by France's Formulec can reach 140 mph and accelerate from 0 to 60 mph in three seconds[19], which is competitive with most consumer level ICE cars today.

[15] Canadian oil exports were dealt a blow in January when the Obama administration delayed approval for the Keystone XL oil sands pipeline from Canada to Texas, which could have greatly increased overland exports of oil into the US. A campaign to promote domestic oil production, save local jobs, as well as environmental concerns, appears to have won the argument, for now. (Fuelfix.com, 18 Jan 2012). The decision has been moved to 2013 and may still go in Canada's favour.

[16] Transport For London, 'Travel in London' Report, 2009, section 9.9.

[17] 2% of all journeys in London are now made by bike. Ibid. Section 7.2. This is highly likely to grow.

[18] Primary energy means energy that is still in a 'raw' state, e.g. oil is a primary energy, which is converted into motion in vehicles, while electricity would be a product of primary energy from a coal or gas power station.

[19] www.ft.com/cms/s/0/f8f4a4e2-f039-11e1-93fa-00144feabdc0.html.

Even without something spectacular coming from Formula E or a university science lab, the sector is already seeing interesting advances. For example, the 2012 Third Generation of the Smart[20] all-electric car has an 87-mile range and can fully charge from empty in under an hour, which is technically sufficient for many urban car users. Engine power has increased by 83% and range boosted by 28% compared to the first model in 2007. Yet, in comparison, a moderately priced ICE family car will manage 300 miles on a tank of petrol and the time it takes to 're-charge' is a couple of minutes at the petrol pump. Electrics at the mass market price point therefore still need to catch up. But electric cars are improving very quickly. This process will not stop, just as ICEs did not stop improving. Other major auto-makers are developing their own all-electric models, including: Toyota's RAV4 EV; Nissan's Leaf; Ford's Focus Electric; Honda's Fit EV; and Mitsubishi's 'I'. A number of luxury[21] all-electric cars with long ranges are also made by a variety of smaller companies. Combined, all this engineering talent will very likely make advances over the coming years. By 2020 one could not rule out electric cars breaking through.

Even if electric vehicles take a long time to engage the mass market, oil use could flatten or decline in the West due to the increased use of hybrid vehicles, as well as the increased use of biofuels such as ethanol (see Box A). One other critical area is ICE efficiency. Engineers have already made significant progress improving miles per gallon and by 2008 the average ICE was 50% more efficient than in 1950. The EIA believes that on-going efficiency improvements, expected to be around another 40% in the next 25 years, will at least off-set any extra oil consumption due to future growth in vehicle use[22]. Meanwhile the Obama administration is not leaving things to chance. This August new US Corporate Average Fuel Efficiency regulations were published that demand improvements in fuel efficiency, with the aim of the average ICE reaching 54.5mpg in 2025[23], or almost double today's average. Interestingly, the new regulations also set out incentives for natural gas-powered vehicles, mainly to tap into the US's large frackable gas reserves (see more later).

BOX A: Ethanol

It could be argued that oil's current predominance was a quirk of history. The ICE was not designed exclusively to be petrol driven, but rather by a number of different fuels. Ethanol, an organic fuel, was much favoured in early 20th Century America, and could have become dominant if it had not been for the Temperance Movement and its desire to outlaw 'the demon drink'.

From 1919 Prohibition banned the production of ethanol fuel in the US as it was classed as an alcohol product. Henry Ford[24] was a strong supporter of ethanol and his first production cars ran on it. In 1906 tax on ethanol was abolished making it an incredibly efficient fuel for the technological revolution taking place in Ford's workshops. But by the time Prohibition had ended in 1933 petrol engines were completely dominant and only now in the 21st Century is ethanol use seeing significant growth outside of countries such as Brazil (see more later). Once industry and Government had invested heavily in oil, and petrol engines, over 14 crucial years of car development, ethanol's moment had passed[25], though it may return one day. How different our global politics and energy sector would have been had ethanol become the 'standard fuel' for car transport and not oil. One can only wonder.

[20] Smart cars are a subsidiary of Germany's Daimler, a company that traces its automotive roots to 1890 when Gottlieb Daimler and Wilhelm Maybach created their own company to develop the ICE.

[21] There are a number of all-electric car manufacturers producing very high end vehicles, such as the Tesla, which see ranges up to 300 miles, but at $100,000 are not realistic alternatives to the average consumer. Engineers have shown that rivals to ICE cars can be built, what they have yet to show are vehicles that will reach the mass market. Until then the ICE will rule the roads and keep upward pressure on oil prices.

[22] EIA, 'Annual Energy Outlook 2012'.

[23] www.ft.com/cms/s/0/caea2c60-f13e-11e1-a553-00144feabdc0.html.

[24] Henry Ford's first production vehicle, the Quadricycle, ran on ethanol. In 1906 tax on ethanol was abolished making it an incredibly efficient fuel for the technological revolution taking place in Ford's workshops. In 1908 the Model T Ford was launched with a hybrid engine capable of using ethanol, gasoline or kerosene. For more on oil's rise to dominance see Daniel Yergin's 'The Quest', published by Allen Lane.

[25] The Dust Bowl from 1931 to 1939 that decimated US agricultural production did not help either.

The Case for Oil

We believe that over the very long term demand for oil will diminish rather than increase, and so too its price and therefore the incentive to explore and drill for it. However, the world's energy sector is very much dependent on oil for now and for a significant period to come, regardless of the harm done by CO_2 emissions, pollution and very high prices. Some of the reasons for this robustness are:

Supply Remains Huge – M. King Hubbert said in 1956 that world oil reserves stood at 1.25 trillion barrels, which suggested terminal decline would soon set in. Today, experts suggest there still remains 1.47 trillion barrels left, and that is more than 55 years after Hubbert's warning. By our estimates, based on public data, that gives the world around 43 years' worth of proven oil reserves that are technically retrievable[26]. Given that demand will grow over the medium term that gives perhaps 30-plus years of oil on current reserves. Such a short timeframe seems rather worrying, i.e. many of us could be growing old in a world without oil as its mainstay. But, this prediction misses a huge factor: the discovery or development of new reserves. Not long ago the Gulf of Mexico was untapped by deep water offshore rigs. After deep water drilling began in earnest in the region in 1979 there are now 30 deep water rigs operating there[27]. Many of Africa's oil fields were also barely exploited 20 years ago, in part because of civil war, such as in Angola. Now the oil industry is exploring the Arctic (see Box B) as well as deeper inland and off-shore around Africa. The message is: reserves keep growing.

North American unconventional supplies are also swelling[28], both in the US and Canada. Canada's oil sands, or natural bitumen, reserves total around 175 billion barrels[29], the third largest oil reserves in the world. This reserve alone is sufficient to permit the US and Canada to maintain current oil use for the next 20 years without even touching oil in the Gulf of Mexico or importing from outside North America.

Then there is US shale oil, which has been developed following advances in gas fracking. Shale oil wells cost around three times as much as standard oil wells to operate, which dampens their attractiveness, but wells in North Dakota are delivering. At present North Dakota's many shale oil wells are providing around 0.55 million of barrels per day[30]. The EIA forecasts that US shale oil production will reach a peak of about 1 million barrels per day by around 2020.

Technology and Infrastructure already in Place – Countless billions have been invested into filling stations, refineries, pipelines, tankers and tanker ports, exploration technology and rigs and drilling systems. As noted earlier, the oil companies are among the largest businesses in the world and many are State-backed. Simply put, the oil industry is now so committed it cannot turn back, rather it must keep exploring and keep finding new supply; which if the last 100 years is any guide it will keep achieving.

Governments Want the Tax Revenue – Oil is a 'cash cow' worth billions in tax revenues, even for a country such as the US which taxes 'gasoline' at the pump very lightly. Companies the size of ExxonMobil with profits of $41bn a year even with the most aggressive tax planning still provide a healthy stream of public revenues. In the UK, where fuel tax and VAT on petrol constitute around 60% of the pump price, strong consumer demand for oil boosts the budget, no matter how much the Government would like to meet its CO_2 emission targets. For nationalised oil industries in the developing world that need to keep revenues flowing back to the Government the need is even more compelling.

[26] CIA World Factbook. Based on a total of 1.47 trillion barrels of oil in reserve, and consumption at around 34 billion a year.
[27] The number of deep water rigs in the Gulf of Mexico had seemed threated after the Deepwater Horizon disaster of 2010, but rigs are numerous and now busier than at any time previously. 10 April 2012, Reuters.
[28] The same cannot be said for North Sea oil, which is now in long term decline, even if some explorers are moving into the area to develop harder to reach reserves that other companies have abandoned.
[29] CIA Data, estimated 2011.
[30] http://oilprice.com/Energy/Crude-Oil/US-May-Hold-Large-Reserves-of-Shale-Oil-but-is-it-Economically-Out-of-Reach.html

Developing World Demand – as noted above, car ownership in the developing world is growing. By 2020 if only around 20% of Chinese people own a car, with a population expected to reach 1.38 billion at that point, China will have 276 million private cars. Many of these vehicles will be petrol- or diesel-powered. To a lesser extent this pattern will be mirrored all over the developing world, creating huge growth for private cars and therefore more oil. As noted, rapid introduction of mass market all electric cars could make a significant impact here, but that seems unlikely for now. The use of hybrid cars could also have a significant impact, especially if their prices dropped to match other mainstream models and therefore see widespread use. But, most are too costly for China and India.

BOX B: The Arctic, Oil in the Snow

In 2011 the US Geological Survey[31] estimated the Arctic may be home to 30% of the planet's undiscovered natural gas reserves and 13% of its undiscovered oil. Global warming has made exploration here now possible. Ironically, extracting further oil and gas here will speed up warming and hence make it even easier to extract hydrocarbons. Environmentalists are enraged; oil companies and many countries near the Arctic are quietly excited. To the US, Canada, Russia, Norway, Denmark and Sweden, as well as those countries such as the UK with significant expertise in oil and gas exploration in the North Sea, the opening of the Arctic has huge potential. North West and North East sea passages are also opening up as sea ice melts, making direct exports of oil and liquefied natural gas (LNG) to Asia from the Arctic a likely prospect in the future. Shell, BP, Eni, ExxonMobil, StatOil, GazProm and Rosneft are all investing in the region, though their efforts to extract oil have not been always successful so far[32].

The Arctic Council members, made up of the bordering nations such as the US and Russia, are generally in agreement that the UN Convention on the Law of the Sea, and accepted principles on resource ownership on a nation's continental shelf, should be used here. Where the Arctic becomes a legal minefield with potentially untold levels of legal input needed is the risk of catastrophic accidents. If, for example, something similar to the Deepwater Horizon disaster occurred in the Arctic and millions of gallons of oil turned part of the Arctic into a cold black mess, killing wildlife and destroying environments the global backlash would be enormous. Total's CEO, Christophe de Margerie, has gone so far as to warn[33]: 'A leak [in the Arctic Circle] would do too much damage to the image of the company'. Liabilities include four million people who live in the Arctic Circle, plus thousands of miles of coastline. Perhaps the UN even would feel the need to declare a moratorium. These are early days, but international lawyers should expect to hear more and more about the Arctic. One global law firm, Norton Rose[34], keen to get an early start has already formed an Arctic group, more are sure to follow.

[31] http://www.bbc.co.uk/news/business-14728856, BBC News, 31 August 2011.
[32] 'Shell suffers fresh blow to Arctic hopes', 17 Sept 2012. FT. Sea ice, a short period available for drilling in the Arctic conditions and equipment failure have made Shell's drilling efforts especially difficult.
[33] 'Total warns against oil drilling in Arctic', 26 Sept 2012, FT.
[34] www.thelawyer.com/norton-rose-canada-launches-arctic-group/1013609.article

Law Firm Impact

M&A/Corporate – The oil industry provides a wide variety of corporate instructions for law firms, though advising Western super-majors on mergers to create 'mega-majors' seems unlikely. Equally unlikely will be national oil champions of Asia and South America being open to Western merger and these will remain protected. What we will instead see is continued, and perhaps increased, levels of joint ventures and special agreements between majors and national oil companies, often with a partially State-owned regional player seeking the oil technology and expertise of Western companies to develop new deep sea or difficult to reach fields. There will also be considerable work in relation to smaller and medium-size oil explorers and support companies as they spread into new regions, with private equity likely playing a key role in buyouts or strategic investments. We will see the super majors taking over some of these explorers in order to secure new supply, as well as a continued flow of oil field stake acquisitions and offshore lease agreements around the world. Conversely, we may also see some oil companies disposing of less productive parts of their business as certain fields are exhausted, though we may not see many super majors carry out disposals to match BP's current stream of multi-billion dollar asset sales as this has been driven by the need to provide funds for its Deepwater Horizon damage claims and potential fines. Overall, oil sector M&A will continue to become more global as well as bringing together parties that previously had rarely worked together as they explore the South Atlantic, sub-Saharan Africa and the Arctic.

Corporate Finance – For developing market oil companies there will likely be a continuation of IPOs to help fund growth, as we have seen with China oil majors. Explorers will also continue to look to growth markets such as AIM and the NASDAQ to gain sufficient finance to keep drilling for oil supplies in new regions. Also, as we have seen with the Falklands, (more below), there is the added risk of sovereignty issues and perhaps even armed conflict needing to be factored into any law firm's signing off on a public listing of an explorer. The super-majors that are now attempting to develop high cost locations such as the Arctic still have huge cash reserves, though large scale development there in the future may trigger the need for extra share and debt offerings.

Project Financing – Governments from Africa to those with a sea border onto the Arctic Circle will be looking to invest more in infrastructure to support the oil industry, from ports to refineries. Despite the billions of dollars such projects cost many countries will see supporting the growth of their oil industry, whether purely through State funds, or via public/private partnerships, as something both necessary and that will more than pay for itself in the long term when set against a backdrop of high oil prices.

Litigation/Disputes – With increased competition for new drilling sites and the number of joint ventures between Western and developing nations likely to increase, the potential for commercial disputes in the oil industry is likely to increase. Spats with Russian companies, especially with BP, have been well documented, but could become more common globally. There is also the very real risk of oil exploration entering an escalatory phase for disputes over territory. Take the Falklands for example. Positive exploration results for the local developer FOGL[35], which licences the drilling in the region, and the growing number of UK and US companies, such as Noble Energy, moving there have led to increasing hostility from Argentina's Government which claims the 'Malvinas' and understandably wants any oil revenues it believes are 'naturally' theirs. To complicate matters Argentina's recent nationalisation of YPF, after forcibly taking Spanish Repsol's 51% stake in the company, appears to be a precursor to a major joint venture with Venezuela's PDVSA to explore the sea bed bordering the Falklands' territory[36]. Another interesting area will be the growing disputes

[35] Falklands Oil and Gas Ltd.

[36] www.telegraph.co.uk/finance/newsbysector/energy/oilandgas/9457323/US-risks-Argentine-wrath-as-as-American-firm-signs-Falklands-oil-deal.html. 7 Aug 2012, The Telegraph.

between China and Japan over the Senkaku islands in the East China Sea. The real interest, in what are generally uninhabited islands, is the oil and gas reserves that are within or near to potentially justifiable economic exclusivity zones[37]. For now the hydrocarbon finds in the Mediterranean have been natural gas, but if oil were also to be developed we could see an even higher potential for resource ownership disputes. A key question will be how such disputes are resolved and a likely answer will be by arbitration, and likely referring to the 1982 UN Law of the Sea Convention, though this convention is far from clear cut when two nations dispute each other's borders, or where overlapping claims on Exclusive Economic Zones at sea or over the continental shelf can involve multiple nations, as is the case in the Mediterranean. Moreover, many nations in the Middle East have not signed and ratified the UN convention, nor has the US.

Intellectual Property (IP) – Technology has always been critical to the development of the oil industry. The patents owned by oil majors, down to the smallest rig service company, are very valuable and need IP protection and licencing. Increased joint ventures with foreign partners that share the technology may further complicate matters. IP will relate to all aspects of the oil sector, from brand names, to the drilling equipment used for deep sea oil fields, to innovative safety equipment and features to prevent spills and blowouts.

Environment – After BP's Deepwater Horizon disaster in the Gulf of Mexico no one in the energy industry should play down the financial impact of a major polluting incident. The total bill, so far, for the 2010 spill and other related damages, including loss of life, comes to $38bn[38]. The US Department of Justice has also accused BP of gross negligence leading to the disaster, though BP strongly denies this allegation. As noted above, an oil spill in the Arctic of similar proportions would have massive implications, perhaps not initially financially but the 'PR nightmare' could lead to bans on drilling and huge losses of investment. Risk analysis, compliance and insurance issues in relation to environmental damage will be increasingly important to the oil industry. A complicating factor will be that the Arctic is set to be exploited by many different parties, each with their own interpretation of what constitutes 'environmental harm'.

[37] 'Anti-Japan protests across China over islands dispute', 19 August 2012, BBC News.
[38] www.guardian.co.uk/business/2012/jul/31/deepwater-horizon-bp-847m-dollars, 31 July 2012, The Guardian.

Chapter Three: Gas Giants[39]

Natural gas is far more plentiful in terms of extractable supply than had once been thought, primarily due to hydraulic fracturing techniques; it is cleaner than oil and coal and produces less CO_2 emissions; and improved liquefaction methods have made gas a raw energy source with significant global export potential. As we examine below, on face value natural gas does appear to have a great future, but the reality is more complex and hydraulic fracturing's success globally is far from certain.

The Expansion of Gas

Gas fracking, also known as hydraulic fracturing, has opened up huge supply in a number of countries, with the US leading the development and reaping most of the rewards so far. This growth in supply has in turn reduced gas prices at least in the US, with Henry Hub one month gas futures down to $2.78 for August 2012. This is down from $13.60 in June 2008, and lower than the more usual price of around $4 since the financial crisis began. This price drop has been great news for consumers, both small scale and industrial. But, the rapid price drop due to a supply glut has upset some investors and energy companies have had to write down their fracking assets. Other countries from Poland in Europe to Mexico and Argentina in the Americas also have huge potential for development. But it is China that has the largest potential shale gas supplies in the world (see table 8).

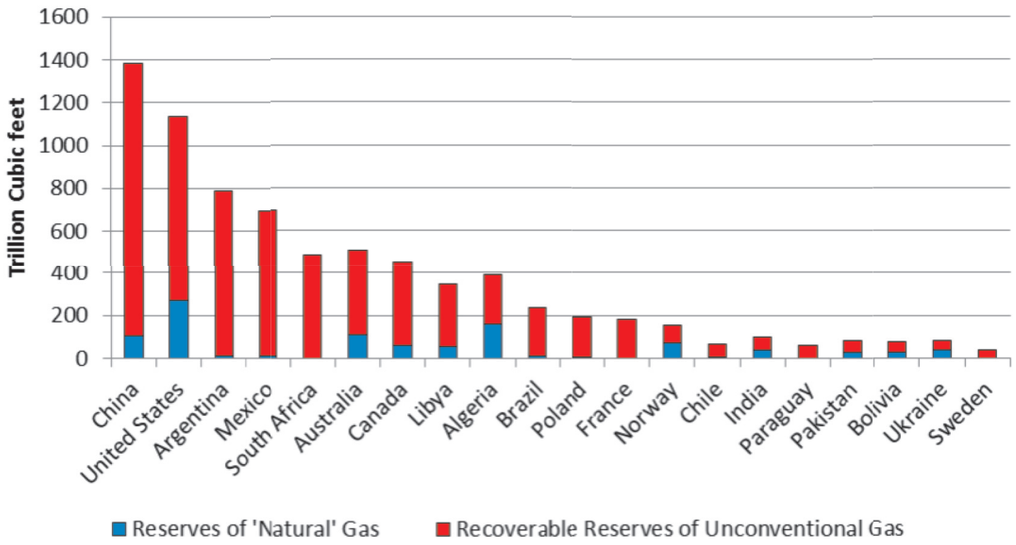

Table 8: Top developers and potential developers of gas fracking[40]. EIA data. (This does not include Russia, Qatar, or other countries that will likely continue to focus on their very large conventional gas reserves rather than resort to fracking).

Advances in LNG transport, such as super large gas tankers, and improved processing and regasification plants have made gas a more easy to export energy asset creating a global market that before had relied heavily on regional pipeline connections, which understandably have limited range and are very complicated to develop and finance. I.e US gas from fracking can now be exported by sea to any market with a sufficiently large port and the right processing

[39] This chapter includes a special section on coal, see Box C.

[40] The UK's natural gas production, derived from North Sea gas fields, peaked in 2000 and has been in general decline since then. However, there is growing data, though sometimes disputed, that the UK could have significant shale gas reserves. An EIA estimate places UK 'frackable' reserves at 20 trillion cubic feet. This is less than half of what Sweden has or about 2% of US shale gas reserves. However, this estimate could be revised upward upon further exploration. A more recent study, noted below, claims there are 40 trillion cubic feet.

capabilities[41]. Such a commercially attractive scenario will also be available to other nations that tap their unconventional gas reserves such as Argentina. Meanwhile, countries that had limited export capability due to reliance on pipelines, such as Russia, could if they desired widen the number of export partners.

For pragmatic Governments, which need to keep the lights on but still reduce emissions, gas is very attractive. Natural gas releases 0.23 kg of CO_2 per/kWh of energy, as compared to coal's 0.37 kg and petrol's 0.27 kg. Gas is therefore around 40% less CO_2-producing than coal. This is not a game changer for ecologists, but sufficient for many nations. Of course, renewables such as wind supposedly produce no CO_2. But the reality is they need back-up power stations to cover periods when the wind does not blow, so building more continuous power gas plants is doubly useful. Gas power plants can also be 'fired up' quickly providing electricity during peak periods, as and when needed, something renewables are incapable of.

As with most forms of energy, it is among non-OECD nations, or the developing world, where gas growth will be highest, at around 70% to 2035 (see table 9). These nations will see population growth and industrial development that will demand ever greater supplies of fuel to power their burgeoning electricity grids. For the OECD nations fracking simply gives extra energy security and opens up export opportunities, in part to the developing world.

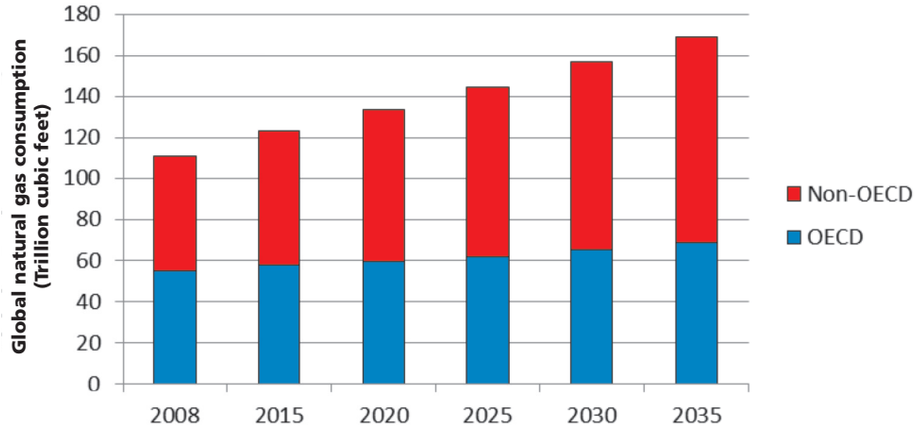

Table 9: Global consumption of gas to 2035, EIA data (2011).

Fracking and Oversupply

Gas fracking, the process of extracting gas from previously impenetrable rock formations using high pressure water pumps and new horizontal drilling systems, has come a long way. Deliberately fracturing rock where gas deposits were held was experimented with in the US as far back at the 1940s, however, the inability to drill horizontally prevented rapid development of extraction. It was not until the late 1990s that the horizontal drilling technology was sufficiently developed. At the same time far more advanced seismic imaging systems reached the market and made the exploration and drilling process easier to conduct. Against a backdrop of rising energy prices in the 2000s fracking now had everything it needed to grow as an industry in the nation that pioneered it: America.

[41] Given its low local price this may occur more in the US than elsewhere. The global trade of US gas may eventually bring US prices closer to world prices in the medium term.

Shale gas and other unconventional gas types have helped double the world's extractable gas reserves, and extended the world's current supply of around 60 years' worth of gas to around 120 years, based at current usage levels[42], by adding an extra 6,622 trillion cubic meters to potential supply. Population growth up to 2050 will initially reduce this timespan, though after 2050 world population may shrink again[43]. Also, as we have seen with other energy types, mankind has a tendency to both find more supplies and find new ways to extract previously un-extractable deposits.

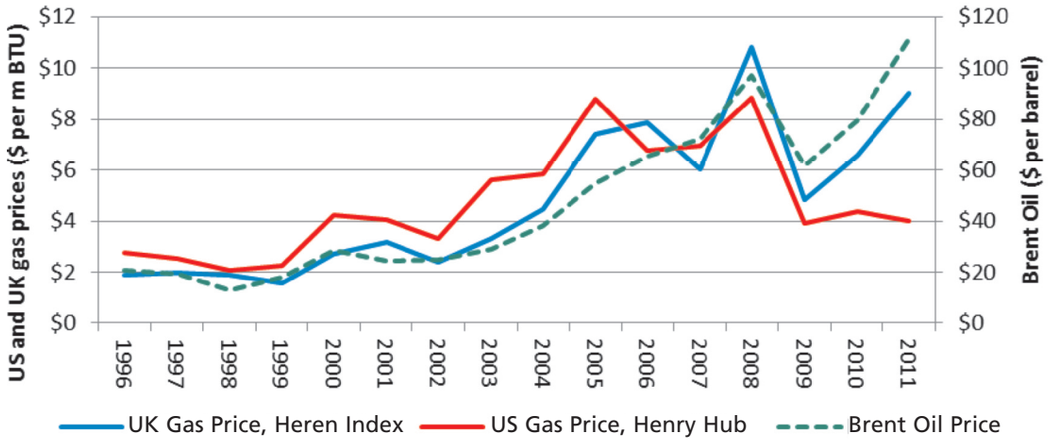

Table 10: US and UK gas prices, versus Brent Oil, all prices in US$ annual averages. Data: BP.

As can be seen in table 10, gas prices have largely tracked oil prices up to 2009. From then US Henry Hub gas prices seem to dislocate from the wider oil/gas relationship that has ruled hydrocarbon prices for decades. US prices in 2009 fell due to the financial crisis, but then stayed low. In 2011 UK gas was on average 120% more expensive than in the US, primarily because of fracking supplies. This success and lower price hurt energy investors that have had to write down their fracking assets. For example, BHP Billiton this August took a $2.84bn write down on its shale gas holdings[44]. As noted in Chapter One, this will probably lead to a slowdown in extraction investment, though investment in LNG infrastructure may not be so affected. We may also see efforts to remove supply bottlenecks by improving the US gas pipeline network enabling more of this unconventional gas to reach a wider domestic and export market.

The EIA estimates that if regulatory and environmental concerns are overcome then natural gas prices in America even in 2035 will only be $7.10, in 2010 dollars, or in other words still cheaper in 20 years' time than gas was priced in Europe in 2010. In August 2012 gas from the US had fallen even further, with Henry Hub front month futures prices down to $2.80, far lower than consensus predictions from even one year ago. This underlines just how large the gas glut is in the US. This in turn lowers the costs of production for energy-heavy sectors such as manufacturing, thereby giving the US a new competitive advantage.

[42] Global gas consumption is around 112 trillion cubic feet per year. Unconventional reserves are 6,622 trillion cubic feet.
[43] Economic development tends to produce smaller families, and by 2050 the developing world will be very developed compared to today.
[44] Reuters, 3 August 2012.

Gas is so cheap now in the US and Canada that it is increasingly looking like an alternative to oil, especially for goods vehicles. Iran, Argentina, Brazil and China all have over a million natural gas vehicles each at present[45] and North America could follow suit. There are currently plans in Canada for Shell to spend $250m on an LNG plant and a string of filling stations. It has dubbed the project the 'Green Corridor' because gas-powered vehicles produce less CO_2 and little or no particulate matter[46]. If it is successful Shell intends to roll out similar schemes around the world. The US already has a fleet of over 120,000 compressed natural gas-powered vehicles[47] or NGVs, mostly municipal buses and refuse trucks, operating on circular routes that allow them to return to be refuelled at a depot. However, with more natural gas filling stations along major roads, NGVs' range could be greatly expanded and could see far wider public interest.

Elsewhere, fracking has had an uneasy beginning. In France, which has notable unconventional reserves, after granting two licences to Total and the US-based Schuepbach Energy, the Government backtracked in 2011 and banned the practice. This is despite France having the 12th largest shale gas reserves in the world. In the UK, where the potential is far smaller and reserve estimates range between 20 to 40 trillion cubic metres of recoverable supply, there remains continued debate and last year the Government ordered a temporary halt to further hydraulic fracturing until it was sure it was safe to continue. Parts of the North West of England have fracking potential, but are heavily built up. There are also target areas in the more affluent South, but the Government can expect to see local residents launching well-organised campaigns against such development. Minor earth tremors caused by fracking in 2011 in the North West created a disproportionate level of alarm and criticism considering no damage was apparently caused. The problem now is that even if there is no damage caused by fracking many people believe there will be and so concerns over the effect on nearby house prices have grown. A recent report[48] on the potential for fracking in the UK also doubted the financial benefits of the industry in the UK: 'While the [shale gas reserves] in place may be very large, the production rate per well is likely to be low, a fraction of the claims in the press.' The report then pointed out that different rules on ownership of underground assets in the UK to the US meant landowners would not see the same benefits. Tighter regulation in the UK would also add to costs and limit development of 'industrial scale' fracking. Unconventional gas extraction in the UK therefore will have an uneasy future even if fracking grows.

In western China, there are huge potential fracking opportunities, but water is scarce and water is essential for fracking. Lack of water is also becoming an issue in the US where the country is experiencing its worst drought since 1956[49], putting pressure on fracking operations to scale down operations, or invest in water recycling to conserve supplies. Concerns have also been raised over the chemical additives used in fracking's hydraulic fluids. Some US studies have concluded there is 'no danger' from the chemicals used, but confirm fracking can lead to high levels of methane in the water supply. This latter phenomenon has led to some farmers in the US, whose farms draw from local water basins, to see flames shooting out of their kitchen taps[50]. But that may be the least of the fracking industry's worries. The US Institute of Medicine, a non-Governmental body, announced in April it would be examining fracking's impact on health after receiving complaints about 'nausea and respiratory issues' from people living near drilling sites.

[45] Natural Gas Vehicle Knowledge Base. www.iangv.org/current-ngv-stats, refers to statistics for 2011.
[46] Financial Post, 22 May, 2012, http://business.financialpost.com/2012/05/22/truckers-test-lng-as-transport-fuel/?__lsa=de4c2cdb
[47] See 45.
[48] 'UK will miss US-style shale gas transformation', 25 Sept FT, 2012. Report referred to by the Energy Contract Company.
[49] Bloomberg, 'Drought Helps Fracking Foes Build Momentum For Recycling', 23 July, 2012. www.bloomberg.com/news/2012-07-23/drought-helps-fracking-foes-build-momentum-for-recycling.html
[50] See video of flaming water taps in Pennsylvania: www.dailymail.co.uk/news/article-2182179/Sherry-Vargsons-blames-fracking-flammable-tap-water.html

LNG: A Liquid Market

The ability to turn natural gas into a liquid via extreme cooling enables an industry previously restricted by geography to develop a global market for its products. LNG has seen tremendous growth over the last few decades. Consider this statistic: in 1970 the global LNG trade was 3 billion cubic metres, but by 2011 it was 331 billion cubic metres. This can be explained primarily by huge leaps in LNG technology.

Experts believe the LNG trade will grow to 880 billion cubic metres by 2030[51], or over 165% growth. In turn the industry will need far more LNG tankers, with ship numbers rising from around 350 tankers today up to 900 vessels by 2030. At present many carriers hold around 130,000 m^3 of LNG. But ship builders are already preparing carriers with a capacity of 260,000 m^3, which will be truly massive. This process has already led to the creation of the Q-Max line built by a group of Korean chaebol including Samsung, Hyundai and Daewoo, which are built to be the maximum size possible that will fit Qatar's docking facilities[52], hence the name Q-Max. A total of 14 of these 345m long behemoths are planned. This will produce work for law firms in relation to financing, insuring, building and chartering these ships.

	2001 Imports (bn cubic feet)	*2011 Imports (bn cubic feet)*
Canada	139	1,078
United States	3,978	3,457
France	1,431	1,661
United Kingdom	107	1,888
China	0	1,109

Table 11: Gas imports in five markets, (source: EIA). Note how US imports have fallen.

When twinned with the development of fracked gas reserves one has what could become a trade in fossil fuels that closely mirrors that of oil, with gas being traded across the planet and with many nations on the supply side and many more nations on the demand side of the equation. For example, in 2001 China was not importing gas, but ten years later imports had leapt to 1.1 trillion cubic metres per year in 2011.

BOX C Coal: Going Underground.

Coal was the fuel that powered the industrial revolution, first in the UK, then across continental Europe and North America. But, in most of the West coal is in decline. While in Asia, especially China, the reverse is true and coal use has grown at an incredible rate since 2000 (see table 12). This has led to huge imports of coal from around the world, including South America, such as Colombia. The UK's and China's coal consumption was the same in 1965 when British industry was still mass producing cars and heavy machinery, and relying on coal as a primary fuel for electricity. At this time China was just launching its 'Cultural Revolution' under Chairman Mao. Thirty-seven years later, the UK uses 1.7% of the coal China does, and this is the country that pioneered the coal industry, though population difference is a huge factor.

[51] Royal Haskoning/Ocean Shipping Consultants, 'Global LNG Trade & Trends to 2030', March 2012: www.maritimerh.com/maritime_docs/osc_press_releases/Press_release_LNG_2012.pdf

[52] Qatar is the world's largest producer of LNG, having around 25% of the supply market.

Fighting against this Western decline in coal are proponents of carbon capture and storage or CCS technology, which promises to filter out polluting particulates and bury, or 'sequester', underground the high levels of CO_2 that coal produces. One of the first major CSS projects was in Weyburn in Canada that started in the early 2000s[53] where CO_2 from related coal gasification (a process that synthesises 'coal gas' from solid coal), was pumped underground. At first it was seen as a success, but a 2011 report by MIT[54] stated that a survey had found: 'Weyburn was leaking CO_2 at the surface after gas bubbles, algae blooms and dead animals were found around a manmade pond on a farm around the injection site'.

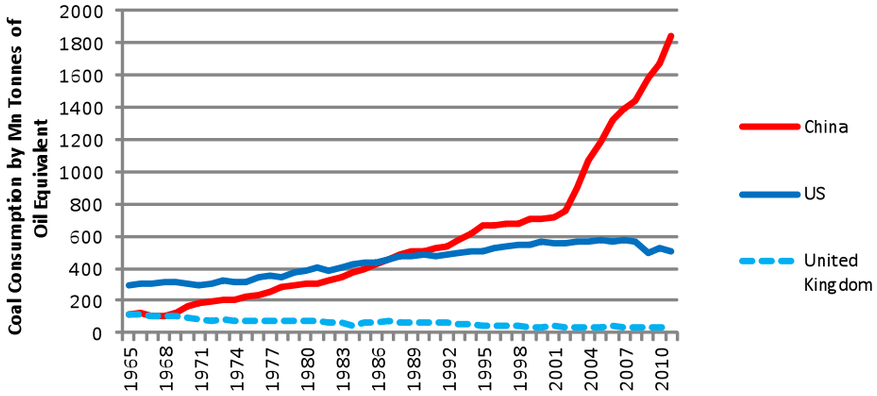

Table 12: Development of coal consumption, 1965 to 2011. BP data.

One incident does not disprove the value of a technology, but the report adds weight to claims by Greenpeace made in 2008 that CSS wouldn't work. The Greenpeace report[55] also stated that CCS processes consume significant levels of energy and are expensive, thereby undermining any gained efficiency from using coal power. Even so, many in the US would like to see greater use of abundant coal reserves rather than less and CSS may be the means to permit this.

Surprisingly, one Western nation now expanding coal-based power is Germany[56], which is also the 'greenest' in Europe and recently scrapped its nuclear programme (see more below). The nuclear shortfall will need to be met somehow and some Germans believe sufficient CSS technology can be developed to negate the downsides of coal. Also, low carbon credit prices (see more later) allow Germany to cheaply offset the cost of emissions. Low coal prices in Germany also support its development. This unexpected survival of coal in Germany shows just how pragmatic Governments can be to meet energy demand.

Impact on Law Firms

Corporate/M&A – Low gas prices in the US may trigger consolidation of fracking companies as reduced profits demand larger participants in the industry. In countries where gas fracking is just beginning we will see company formation, joint ventures and a variety of service companies develop and grow. There may also be restructuring work in countries where investors had expected to see rapid development of fracking but where it was banned, such as in France and Bulgaria, or as in the UK where limitations on growth could lead to company collapses. The UK fracking

[53] www.canadiangeographic.ca/magazine/JF08/indepth/weyburn.asp.
[54] http://sequestration.mit.edu/tools/projects/weyburn.html.
[55] 'False Hope', published by Greenpeace 2008, lead author, Emily Rochon.
[56] www.bloomberg.com/news/2012-08-19/merkel-s-green-shift-forces-germany-to-burn-more-coal-energy.html, 20 Aug 2012, Bloomberg.

industry is still small scale[57] and strictly licensed after a push-back from regulators in 2011 due to small 'earthquakes' near fracking sites, but which apparently caused no damage. Fracking requires significant investment in plant and so failed projects could lead to bankruptcies.

Infrastructure Investment – The primary area of interest here is development of LNG ports and re-gasification plants. Of particular interest may be the conversion of US LNG ports from import to an export function. For example, the US has only one LNG liquefaction plant for exports, in Alaska, but is now building at least two more[58]. Meanwhile it has 12 import-focussed re-gasification plants. Other countries that develop fracking may see similar patterns to the US and this could result in further infrastructure project finance in the gas sector.

Shipping – If new players such as the US do enter the LNG container market in full force then orders for carriers and LNG exports will pick-up. But this could also harm other countries' fleets that would then face far greater competition. Also, as other nations develop shale gas the value of LNG container cargoes could shrink. In terms of at sea accidents there have been no explosions of LNG carriers, despite debate about the possibility, though some leaks of LNG have occurred. Nevertheless risk planning and advice on insurance will perhaps need to address this risk as more LNG carriers cross the seas (see Q Max building programme above).

Litigation – Gas fracking had initially been seen by some at the plaintiffs' Bar as a very large and perhaps easy target, given the recorded phenomenon of earth tremors[59] and use of chemicals in the high pressure water used in the process. However, to date, there have been few court battles. One family in Pennsylvania has already sued[60] US fracker, Range Resources Corp, and other companies, after what Bloomberg reported as adults and 'children began suffering health symptoms they blamed on hydraulic fracturing for gas on their property'. But, it is understood the matter was settled confidentially. The sealing of the case has made doctors and researchers eager to know more. Interestingly, in Pennsylvania, State laws covering the disclosure of chemicals used in fracking let companies withhold information considered to be a trade secret[61]. On perhaps a less dramatic note, but which could also lead to disputes, are claims that fracking will both lower house prices in an area and deter the granting of mortgages. It could feasibly also create problems with gaining home insurance. To balance this negative picture is the fact that landowners whose land has fracking potential stand to make considerable profit from leasing or selling this land, in jurisdictions where the Government does not own mineral rights.

IP – As noted, the energy industry is fundamentally a sector based on continual technological innovation, gas fracking in particular has only developed because of a stream of developments, from special horizontal drilling systems to proprietary chemical mixes that are used in the hydraulic process of fracking. It is quite possible that as fracking spreads globally some companies will seek to copy that technology without seeking a licence. New techniques to improve the LNG liquefaction and re-gasification process will also be developed in the coming years, and they too will need protection as LNG exports become more widespread.

[57] Only four companies currently have a permit to look for shale gas in the UK. Also, as a report by Reuters points out: 'There are still no reliable figures available for the UK, and some experts doubt preliminary onshore reserve figures by private companies. Also only around 10 to 20 per cent of UK total reserves are currently deemed recoverable.' 17 April 2012, Reuters. That said, some geologists believe the UK could be a top 20 shale gas producer with sufficient investment.

[58] One of these new LNG export plants is at Sabine Pass, Louisiana, and is being built by Cheniere Energy Partners. The project has already received $1.5bn in investment from Blackstone Energy Partners L.P. and Blackstone Capital Partners. Blackstone.com press release, 15 May 2012. Credit Suisse Securities LLC acted as financial adviser to Cheniere Partners

[59] 6 August 2012, Reuters, 'Dozens of small earthquakes occurred in central Texas over a two-year period, and 23 of them were close to injection wells where waste water from energy extraction was pumped deep underground for disposal, a new study reported.'

[60] 30 April 2012, Bloomberg, www.bloomberg.com/news/2012-04-30/doctors-press-court-to-release-records-in-gas-fracking-case.html.

[61] Ibid.

Chapter Four: Nuclear Reactions

Commercial nuclear fission has been developing for over 60 years. Its proponents declare it to be clean, low CO_2 emitting, safe and extremely reliable. They argue that as fossil fuels dwindle the only option for energy security will be nuclear power because alternatives such as renewables are both inefficient and insufficient. Some go further and claim that by 2050 nuclear fusion will deliver us from energy insecurity altogether (see below). The opposing argument is that nuclear is extremely expensive and too great an opportunity cost in terms of having to reduce investment in other energy technologies, that it produces long-lasting radioactive waste, and as events in Japan last year have shown, some nuclear reactors still are not as safe as desired. Below we examine the pro- and anti-nuclear power arguments.

Nuclear Meltdown?

There are 30 nations with commercial nuclear power plants, including developing nations such as Brazil and South Africa. There are now another 19 nations either building reactors or entering into the planning process[62]. This seems very positive for the sector. But the nuclear industry is faced with some serious challenges and has a tarnished brand in the eyes of many people.

The disaster at Fukushima in Japan in March 2011 was the worst nuclear accident since the Chernobyl meltdown of 1986 and sent shockwaves throughout the energy sector. Soon afterwards, Germany, the leading industrial nation in Europe, announced it would phase out nuclear power by 2022, from which around a quarter of its electricity is produced. In June 2011, Italians voted in a referendum to uphold a previous ban on building new nuclear plants. And now Japan has announced it too will phase out all nuclear power by 2040[63]. This means the third and fourth largest economies in the world have turned against nuclear power.

Meanwhile, in March this year two German companies, E.ON and RWE, expected to build the UK's new nuclear reactors, also pulled out citing financing fears. And more recently, one of the most important figures in the energy sector, GE's CEO, Jeff Immelt[64], said nuclear power was 'really hard to justify' because of its huge costs, then added: "It's really a gas and wind world today." Altogether this is a rather toxic mix of news for the industry.

Nuclear's Standard Bearers

Despite these clearly troubling signs, more countries now seek to build nuclear reactors than ever before and many of those nations with developed nuclear power industries either plan significant upgrades to existing plants, such as France and the US, or as in China's case plan a massive expansion programme of new nuclear reactors.

Data from the World Nuclear Association (WNA) states that China is building or has planned 76 new nuclear reactors. Globally there are an estimated 433 'operable' nuclear reactors and according to the WNA there are now 65 new reactors being built around the world in countries as diverse as Argentina and India (see table 13). As can be seen, some nations are fully committed to constructing more plants. Others, such as Saudi Arabia, have made impressive proposals, but whether these proposals are realised is a different matter.

[62] In comparison, the number of nations with nuclear weapons stands at nine: US, Russia, UK, France, China, India, Pakistan, North Korea and Israel. Iran also may be working towards one.

[63] www.ft.com/cms/s/0/f9961e7c-fe3e-11e1-8228-00144feabdc0.html, 14 Sept, 2012, FT.

[64] 30 July 2012, FT. Also, Immelt's comments may need to be seen in the context of commercial self-interest. GE's revenues from nuclear are less than 1% of the total, and much of that is via a joint venture with Japan's Hitachi. In contrast, GE controls around 8% of the global wind turbine manufacturing market, and would understandably wish to grow this further. Source: IHS.

COUNTRY	*REACTORS OPERABLE*	*REACTORS UNDER CONSTRUCTION*	*REACTORS PLANNED*	*REACTORS PROPOSED*
Argentina	2	1	1	2
Bangladesh	0	0	2	0
Brazil	2	1	0	4
Canada	17	3	2	3
China	15	26	51	Up to 120
Egypt	0	0	1	1
France	58	1	1	1
India	20	7	18	39
Indonesia	0	0	2	4
Kazakhstan	0	0	2	2
Korea (South)	23	4	5	0
Malaysia	0	0	0	2
Mexico	2	0	0	2
Pakistan	3	2	0	2
Russia	33	10	17	24
Saudi Arabia	0	0	0	16
South Africa	2	0	0	6
Thailand	0	0	0	5
Turkey	0	0	4	4
UAE	0	1	3	10
United Kingdom	16	0	4	9
USA	104	1	13	13
Vietnam	0	0	4	6

Table 13: Selected nations' nuclear plans and proposals for reactors. (WNA data, Sept 2012). Red denotes realistic potential for very high growth in nuclear sector.

The global investment, not to mention advisers' fees, if all planned and proposed reactors around the world are built could be huge. Though, when governments choose to fund, build and manage the entire project of establishing nuclear reactors by themselves the input of external advisers may be far more limited. Costs for reactors vary significantly, not least because estimated costs often escalate as the project develops. However, recent nuclear reactors in the West have been priced at around $10 billion each, or about the price of a state-of-the-art aircraft carrier. In addition, many billions will be spent updating old reactors, and then many more billions will be spent decommissioning and dealing with nuclear waste.

The huge cost of building nuclear reactors could eventually deter some countries despite their stated plans. While, for those nations that do go ahead the huge cost will be passed on to the consumers through taxes or higher electricity bills. For example, some predict the UK[65] could face a doubling of already very high energy bills. That would also cause political problems for governments. Another critical area of cost, and one which is key to this industry, will be an increased demand for uranium. The three largest producers[66] are Canada, Australia and Kazakhstan. If all the new reactors planned are built then one can expect uranium prices to rise far higher.

[65] www.ft.com/cms/s/0/3dda6692-d29d-11e1-8700-00144feabdc0.html, 'Warning of electricity prices doubling', 23 July 2012, FT.
[66] Other smaller uranium producers include Niger, Namibia, Russia, Uzbekistan and the US.

Nuclear power therefore has a complex future ahead of it. More nations may give up on nuclear like Japan and Germany. Some that have plans may give up, or scale back, because of costs. Yet, countries such as France and the US, where nuclear power is integral to an 'all of the above' energy strategy will likely maintain their reactors for decades to come. Nuclear power is growing overall, but it is losing some important markets as it does so.

Fusion: Reaching for the Sun

Fusion reactors would be incredibly important not just to the energy sector, but to the world economy. Over the long term fusion could provide limitless electricity that gave out little or no CO_2 emissions. Fusion reactions produce the most energy in ratio to fuel used of any technology. Fusion reactors also consume a widely found resource, Deuterium, which occurs naturally in sea water. They produce very little radioactive material and cannot 'melt down'. The main downside would be the initial building cost, but once paid for nations would be looking at a future of endless, low cost energy that had no intermittency and little or no CO_2 emissions. The main question then would be how many of these reactors could a country afford to build and how quickly? True energy independence for rich nations would be a realistic scenario, at least for those that could raise the $100bns required.

For now, fusion reactors are experimental and cannot yet deliver a net power gain. Much rests upon the success of the publicly-funded $20bn, International Thermonuclear Experimental Reactor, or ITER, in Cadarache, France paid for by a coalition of countries including the US and UK. ITER scientists expect to see commercial fusion reactors by 2050. Accordingly, fusion energy is not a short or medium term option, but could, if the technology works, be an energy game-changer in the long term.

Installing fusion reactors around the world would be a slow process due the high costs, but as more and more fusion capacity accumulated its impact on the energy sector would gather momentum. Initially the cost of electricity for consumers would not be lowered, and may be far higher, as fusion reactor building costs will inflate bills. But, over the long term electricity costs would drop, and then keep dropping, as build costs were amortised. This would have a number of long term impacts:

- Industrial production would become less expensive as energy costs for manufacturing would be reduced, just as improved coal mining in 19th Century Britain acted as a catalyst for the Industrial Revolution.
- Arguments against electric cars due to the cost of electricity, which would also have come a very long way by then, would vanish and our roads would be replaced with humming, cheaply-recharged traffic.
- Global warming, if fusion could become widespread, would slow due to a reduction in CO_2 emissions.
- Geo-politics would change. For those with sufficient fusion power, concerns about security threats to oil and gas supplies in the Gulf would become a thing of the past. Only those countries too poor or undeveloped to install fusion would want to fight over oil.
- Nations dependent primarily upon hydrocarbon wealth could eventually face financial problems. Qatar, Russia and Saudi Arabia that are dependent on energy exports for income could see a steady demand drop. Though, lower demand would reduce prices and ensure some countries would continue to rely on hydrocarbons as it would be a cheaper option. Even so, 'petro-states' would be poorer.
- Exploration of the Arctic, sub-Saharan forests in Africa and other fragile locations would likely decrease[67] as the high cost to explore 'frontier hydrocarbons' would no longer be economical.

[67] At least, exploration among Western companies would cease. Some African nations, perhaps not having the economic resources to develop their own fusion power, would continue to rely on oil production and consumption, becoming a 'hydrocarbon holdout'.

Impact on Law Firms

Regulation – From continually developing rules on subsidies to the way that energy production agreements should work in relation to the nuclear sector there will be a significant volume of regulatory work as the next generation of nuclear plants are built around the world. Health and safety regulation will also clearly play a part in this advisory area. In nations where decommissioning will grow, such as Japan and Germany, there may also be interesting regulatory work as private companies seek to reduce the cost of closing down their reactors.

Corporate/M&A/Joint Ventures – Nuclear is understandably a fairly restricted sub-sector when it comes to the corporates which build and maintain reactors, or that deal with nuclear waste. That said, building projects are huge, complex and demand multiple specialised contractors and suppliers. If nuclear grows globally as expected we could see interesting growth in nuclear related corporates via acquisitions and cross-border joint ventures.

Corporate Finance/Project Finance/Trade Finance - Funding the building of nuclear plants will require tens of billions of dollars, and as can be seen, much of the new builds will be in the developing world. However, the developers will often be Western companies with the French playing a major role. Building reactors is a huge and long term undertaking and providing the finance for such projects will be a challenge in the current market. What will make such work especially interesting will be the potential clash of interests from multinational backers, both public and private. Equally, European or US nuclear companies making huge investments abroad will also want sufficient financial backing from their governments to insure them against set-backs.

Litigation – Wherever there are companies making huge financial commitments, such as to build several nuclear power stations for a country, and where the energy market is in a constant state of flux, there is significant potential for litigation when parties seek to change the terms of agreements or even pull out of commitments after market conditions or political decisions make continuing untenable. In one recent case in the UK, Germany's E.ON and RWE pulled out of promises to build nuclear reactors, in part due to fears over capital investment. In this case, as far as we understand there has been no litigation yet[68]. However, given the dozens of planned reactors around the world there are ample opportunities for similar changes of heart to cause disputes. There could also be some interesting disputes in relation to compensation from companies operating plants in nations such as Japan where the Government has ordered the end of the industry.

[68] 'Nuclear giants RWE and E.ON drop plans to build new UK reactors,' 29 March 2012, The Guardian.

Chapter Five: Renewing Renewables

Is the 'Green Agenda'[69] losing credibility and does this signal the decline of renewables? In this troubled economic climate global warming can seem a low priority for governments. Some potential world leaders are also far from sympathetic to supporting renewables. US Presidential candidate, Mitt Romney, has declared that he would end wind power subsidies if he came to power[70]. Other senior Republicans go beyond the economics and deny man-made climate change exists, calling it 'a hoax'[71]. Arguments that inherently intermittent renewables are a poor investment, or that without subsidies they could not survive, are also increasingly widespread. And yet, from the evidence we have seen, renewables are far from on the way out. In fact, they appear likely to play an ever greater role in nations' 'all of the above' energy plans both in the US and globally. Below we examine renewables' future.

Holes in the Green Agenda

Regardless of one's view on global warming, it is a valid question for any citizen told to contribute more to renewables via their energy bills or taxes, to ask why it is their responsibility to fund this particular business sector. After all, aren't the companies providing wind turbines and solar panels private businesses? As seen in table 14, subsidies and support such as special tax breaks, just for 2010 in the US, were significant, totalling $6.6 billion for renewables in relation to electricity production. Wind power was the biggest winner.

Energy Source	*Subsidies and Support*[72] *in 2010 US$*	*% of total US Electricity Production Subsidies*
Coal	$1,189m	10%
Natural Gas and Petroleum	$654m	5.5%
Nuclear	$2,499m	21%
Renewables:	$6,560m	55.3%
Biomass	$114m	1%
Geothermal	$200m	1.7%
Hydropower	$215m	1.8%
Solar	$968m	8.2%
Wind	$4,986m	42%
Other	$75m	0.6%
Transmission/Distribution	$971m	8.2%
TOTAL:	**$11,873m**	**100%**

Table 14: US publicly funded subsidies and support for electricity production in 2010, EIA data. (Note: other direct and indirect subsidies may also benefit the energy sector but are not included in this table which focuses on electricity production).

Now, in the UK and other European countries, subsidies for green energy are being cut. For example, subsidies for wind power in the UK are to be cut by 10%[73], although some in Government had wanted cuts of 25%. Spain carried out solar power subsidy cuts in 2010[74].

[69] A diverse set of pro-environmental aims, anchored around a key idea: reaching a 'No-Carbon' future.
[70] 2 August 2012, The Guardian.
[71] Republican Senator James Inhofe told the US Environment and Public Works committee, for which he is the ranking member: "Climate change is a hoax perpetrated on the American people". 2 August 2012, The Guardian.
[72] This includes: direct Government expenditure, tax breaks, research and development grants, Federal Electricity Support and loan guarantees. To give some context to this total of around $12bn, it is less than 2% of the US annual defence budget of $700bn per annum.
[73] www.bbc.co.uk/news/business-18979330, 'Renewable energy: Onshore wind subsidy to be cut by 10%', 25 July, 2012.
[74] 'Spain announces 45% cuts in solar subsidies' - Infrastructure Investor, 1 August 2010.

The UK's proposed new Energy Bill[75] is also indicative of the direction of travel for renewables and is being watched by many other nations as a possible model for reform. One of its key aims is to provide low carbon energy producers long term revenue certainty via a strike price system, known as 'contracts for difference'. This may sound positive for renewables, but it is claimed by some that the system will favour bigger producers such as nuclear plants, which are also classed as low carbon producers.

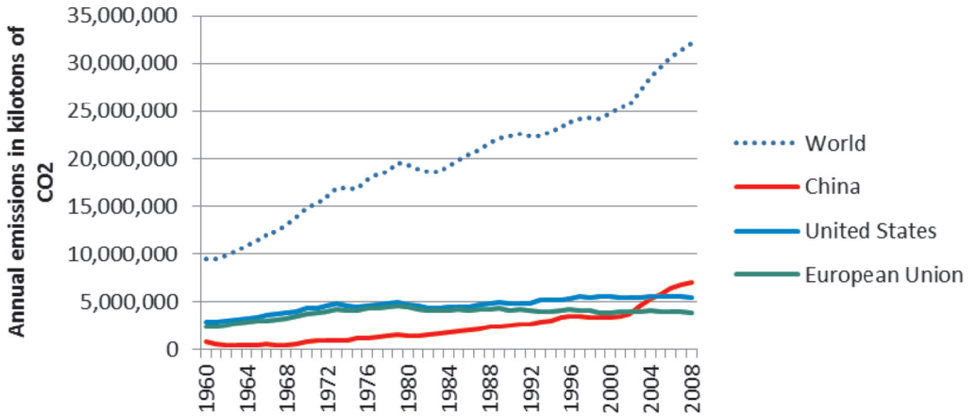

Table 15: CO_2 emissions by key nations and regions, plus world total, (World Bank Data).

Leading nations have also back-tracked on carbon trading, with only the EU maintaining anything resembling a market for carbon credits. Even so the European market is regarded as now mostly illiquid and the value of these credits have fallen because of a glut in supply and very few buyers. The EU's carbon credits have fallen from €30 per ton of CO_2 in 2008 to around €6 today, with predictions they could fall well below €5 per ton. Part of this decline also has been caused by a slowdown in economic growth in Europe, which means growth in emissions in the West has either slowed or stopped entirely. Though, global emission rates have kept rising (see table 15) largely driven by Asia, which reflects continued economic growth and more fossil fuel use.

The main challenge to carbon credit trading is that a global market does not yet exist. If anything support for a global carbon market is shrinking, at least in terms of intermediaries. For example: JP Morgan sold its ClimateCare carbon permits business in August 2011; while in 2010 the Chicago Climate Exchange (CCX) ceased its trading of carbon emissions; and Singapore-listed trader, Noble Group has 'limited its activity' in the carbon market due to lack of liquidity.

Adding to the sense of back-tracking on carbon reduction is that expected commitments, such as the aim to keep global warming below a 2C rise by limiting CO_2 production, have been abandoned by the US[76]. Though, the European Council reconfirmed in February 2011 the EU objective of reducing greenhouse gas emissions by 80-95% by 2050. Even so it is a step few other nations want to attempt, especially developing ones with growing CO_2 emissions.

Another apparent 'nail in the policy coffin' is the failure of the recent United Nations Conference on Sustainable Development this June, billed as the make or break summit for global warming and green energy. Previous meetings of the so-called Earth Summit saw world leaders attend in large numbers, this time the leaders of Germany, UK and America did not come. The Summit's stated plan to create a dedicated UN Environmental Agency, on a par in terms of power and reach with the giant UNICEF, also failed.

[75] UK Energy Bill, May 2012: www.decc.gov.uk/en/content/cms/legislation/energybill2012/energybill2012.aspx
[76] http://www.bbc.co.uk/news/science-environment-19161799. 7 August 2012, BBC, 'US criticised on 2C climate 'flexibility' call'.

And finally there is the growing realisation among investors and politicians that most renewable energy is so intermittent it may make far less impact on fossil and nuclear power than first thought, at least for now[77]. Solar power is little use in winter or evenings. Wind power is notoriously sporadic. This demands that the grid has sufficient power stations available to make up for the power deficit left when renewables are not working to at least meet base demand. It also makes matching peak demand far more complicated as renewables could drop out at a random time just as demand picks up. A country that did not have fossil or nuclear back-up in place could face blackouts, something no developed nation could countenance. Take away subsidies from the equation and some investors begin to seriously doubt the benefits of renewables.

The Second Age of Renewables

Can we therefore conclude that the public, governments and industry are losing interest in green issues? Was Rio 2012 the turning point of support for renewable energy from which there will now only be decline? Will our wind farms be torn down in a few years' time and our solar panels recycled? The short answer is: no. There are multiple reasons why:

- Once build costs have been invested it would be wasteful to mothball the thousands of renewable projects around the world, totalling billions of dollars in investment. Regardless of one's views on global warming, these projects generate electricity and will continue to do so for decades and without requiring any costly fuel.
- After a certain period these projects, whether wind, wave or solar, will become highly profit generating once build costs are covered. To some investors, as well as governments that think long term, this is still attractive.
- Any contribution to total energy output that is not overly expensive must be welcomed, though 'cost' is a contested point in a market where subsidies and the need for back-up capacity are involved.
- Efficiency (see more next chapter) will continue to grow and technology will improve, making renewables more productive.
- The long term trend is for renewable energy to be less expensive, for example the steady reduction in cost of solar panels due to Chinese manufacturing investment. This gives the opportunity to produce electricity with a higher profit margin or without subsidies, again a likely attraction for investors.
- Reducing CO_2 emissions may seem a minor issue compared to economic crisis, but we will come out of this depression eventually and the green issues will rise up the political agenda again.
- When leading industrial nations such as Germany state the majority of its electricity will be provided by renewables by 2050, they mean it[78]. If they can achieve this without major grid failure, and if any country can achieve this it is Germany, then renewable power will be given a new lease of credibility.
- A number of countries, including Denmark, UK, China, US, Spain and Germany, see renewable energy as an important sector of their economy and want it to both generate jobs and earn profits from export of goods.

Some observers also see the current withdrawal of subsidies in some countries as a 'coming of age' or a 'removal of stabilisers' allowing the industry to mature and operate in a real market, which can only strengthen renewables in the long term. This is an optimistic view, as many companies will no doubt go bankrupt, but those that survive may indeed be stronger. Let us now consider some of the main forms of renewable power and the issues they face:

[77] One possible, but hugely expensive, solution would be to have a vast array of different types of renewable power working in tandem across a very wide range of locations, linked together by a central power balancing system that could continually ensure all needs were met at all times. E.g. sufficient wave, geothermal and wind power would cover the shortfalls of solar during the night. Improved battery technology would also help. But, batteries that could retain huge electrical charges for long periods sufficient to supply a national grid are only at the earliest of experimental stages (see more next chapter). What is technically possible and what will see sufficient funding to become a reality in the energy sector is not always the same thing.

[78] German Government June 2010. The German Parliament in 2011 voted to close all its nuclear plants by 2022, suggesting this commitment to renewables is even more likely to be carried through to its conclusion.

Wind Power

Total globally installed capacity of wind farms in 2001 stood at 18 Gigawatts (GW). To put that in perspective, the UK, a highly developed country of 60 million people, has an installed electricity generating capacity of 75 GW. By 2011 wind farm capacity had grown globally 12-fold to 215 GW[79], with production in around 100 countries. The total revenues of the industry are estimated at $65bn, with Asia accounting for 54% of new installations of turbines. Africa, which could benefit hugely from renewable energy, only saw 0.2% of new installations in that period, compared with around 20% each for the US and Europe. But, since 2009 growth has slowed significantly. Installed capacity 'only' grew by 20.3%, down from its highs of 41.7% per annum in 1999. Growth for 2012 may be even slower. Even so, few other industries are growing at double digit rates in today's economy. This is despite reduced subsidies and the extreme intermittency of the technology.

The challenge now is to find new markets for wind power at a time when the 'Big Five' as the industry calls them, China, USA, Germany, Spain, and India, have 75% of world installed wind capacity and when reducing subsidies are not helping growth. Hopes are rising that Brazil will see extra investment here after it reached the 1 GW threshold of total wind capacity last year. Africa as a whole, i.e. all 54 nations, has also reached the 1 GW barrier.

Some Western countries are still embarking on huge new wind projects, such as the UK's on-going 'London Array' which will be the largest offshore wind farm in the world when finished. The developers[80], Germany's E.ON, Denmark's DONG and Masdar from Abu Dhabi, saw the turbines of Phase One connected to the grid this February. The project has a 50 year lease from the UK's Crown Estate and will have 175 turbines and two electricity sub-stations out at sea in Phase One. The first stage costs are expected to total $2.64bn, with the bulk of this going to a group of European engineering contractors. The big question is whether there will be a Phase Two to complete the project. This scenario is emblematic of wind power at present, at a hiatus after a period of huge investment. That said, the World Wind Energy Association confidently predicts that by 2020 global installed wind capacity will have grown to 1,000 GW, or more than quadruple today's figure. Wind is no silver bullet, but it is not going away. Its technology is established and too much is invested to backtrack now.

Solar Power

There are two main forms of solar power for the commercial generation[81] of electricity: concentrated solar power (CSP) which reflects sunlight onto a single point to heat water to drive an electrical turbine; and photo-voltaic (PV) solar power which generates Direct Current (DC) electricity through electrochemical reactions within a solar cell.

Despite the obvious natural challenges solar faces, the industry has been going through huge growth. On a global scale in 2011 there was 69.4 GW of PV capacity up from 17.5 GW in 2001, a quadrupling in 10 years. Chinese efforts to capture the PV cell market have led to very low prices for solar panels. This has upset some investors, but also made large scale PV plants far more economical. Production costs have sunk so low in China that many companies there now face bankruptcy. Low prices have also led to dumping allegations (see more below). The US has been investing in solar technology for many years and that legacy has put it in second place in terms of PV power capability. But the undisputed leader is Germany, with nearly 25 GW of solar capability for a country of 82 million, (see table 16).

[79] World Wind Energy Association, http://wwindea.org/home/index.php?option=com_content&task=view&id=330&Itemid=41

[80] The European Investment Bank and Danish Export Credit Fund also played significant financing roles.

[81] In terms of residential use, PV panels are used for home generation of electricity, while 'solar thermal collector' panels use a different technique to convert solar energy into heat energy for hot water. However, there are now hybrid solar panels that combine both capabilities.

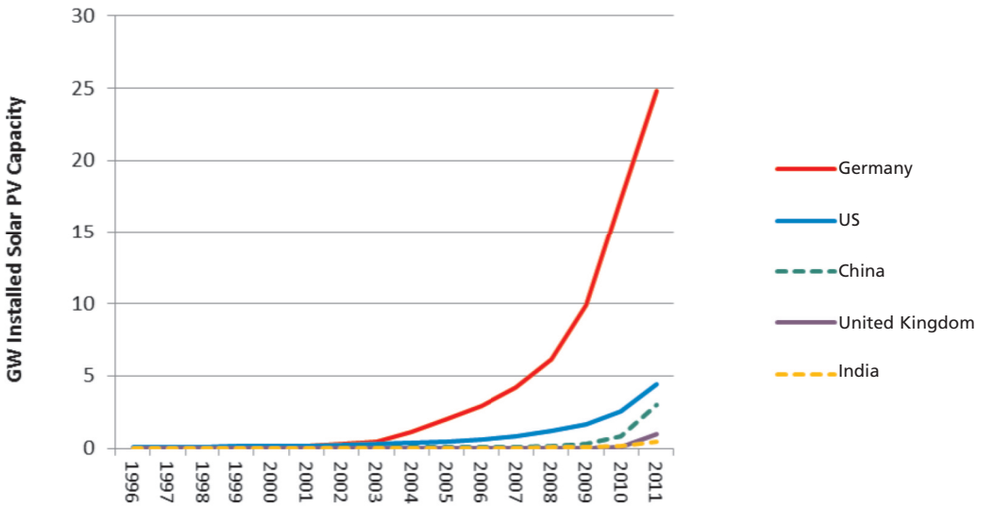

Table 16: GW growth in solar PV capacity 1996 to 2011, (BP Data, as of June 2012).

Germany's PV power investment comes despite the fact the European country experiences severe winters and regular overcast skies. Once you have deducted evenings and the darkest days of winter one clearly has to greatly discount this 25 GW figure to give a true picture of its impact on total supply. The upside is that this capacity, though far from perfect, is permanent and its 'fuel' is free forever.

In the US, President Obama has maintained strong support for solar and the Bureau of Interior and Energy has identified 17 Solar Energy Zones (SEZs) on public land, covering 285,000 acres across six US states, as key target areas for solar power farms[82]. Around these SEZs will be 'variance' areas that will also be targeted for solar investment. The Government will work with the private sector, doing all it can to help with removing red tape and giving incentives. The US's full potential for PV solar is huge, which the National Renewable Energy Laboratory[83] estimates is easily sufficient to meet all American electricity needs[84] given sufficient acreage of PV cells. Though it would need far more advanced battery and power storage technology than currently available due to night time loss of capacity, but those storage issues could one day be solved.

The outlook for US solar projects has not all been positive. A number of US solar companies have run into financial difficulties. Most embarrassing of all for President Obama is Solyndra the solar cell maker. The Californian company had been backed by a $535m federal loan guarantee, as well as by private investors. This huge loan guarantee was part of a wider economic stimulus plan by the White House in 2010, and not just focused on solar power. In May 2010 the President had visited the company and declared it was a model business for the US energy sector. By January 2011 the company was in severe financial trouble and by August last year it was bankrupt and facing law suits from its former employees[85]. Critics see it as an example of the failure of subsidies. But it was arguably also a victim of China's rapid commoditisation of PV cells, leading to margin collapse.

[82] www.pv-magazine.com/news/details/beitrag/us-opens-285-000-public-acres-to-solar-development_100007862/ 25 July 2012. One might add that solar power in Southern and Western parts of the US make a lot of sense given the long periods of bright sunlight.

[83] www.nrel.gov/docs/fy12osti/51946.pdf.

[84] If vehicles were electric too, this would also massively reduce transport energy costs. Aviation would be one of the few energy users where a PV revolution would be of little use.

[85] www.sfgate.com/business/article/Solyndra-files-bankruptcy-employees-sue-2311147.php. 21 Aug 2011. 'Solyndra files bankruptcy, employees sue'. The employees' case is understood to have now been settled, 13 Aug 2012, Bloomberg.

The UK, famous for its changeable weather, has also seen rapid growth of PV capacity, in part due to a handful of major projects coming on-line such as the 4.9 MW farm in Newark-on-Trent. Government feed-in-tariffs have had an effect too. These offer consumers with PV panels on their roofs fixed payments for every kWh of electricity produced and a lower rate payment for any energy they export back to the grid. The problem for UK solar power now is that the Government has slashed the feed-in tariffs significantly, especially for larger developments because of fears they would be exploited by big investors. This has dented interest, though solar farms of both PV and CSP types are still expected to grow steadily in number.

Then there are CSP farms, which have been pioneered in the US and in Spain, but have until recently seen far less uptake globally. As noted above, these differ from PV panels in that there is no electrochemical process, but rather solar energy is directed via parabolic troughs or other reflectors at a tower which contains water, often with a high salt content. One benefit of CSP is that the 'fluid deposit' can retain heat, allowing the CSP plant to generate electricity after the sun has gone down. It is estimated that there is now just over 2 GW of installed CSP electricity capacity in the world, a large part of which is in the US, and it is growing steadily. CSP is also set to spread across North Africa and the Middle East. A 160MW CSP project in Ouarzazate, Morocco, has just received $1bn in funding from the Government and will be built by Saudi Arabia's ACWA Power International and Spain's TSK and Aries. While, the Mayor of Mecca, Saudi Arabia, has announced plans to install a 100MW CSP plant too[86], with plans for many gigawatts more capacity over the long term. Also, an initiative run by the Destertec Foundation, backed by a number of European energy companies and professional services businesses[87], seeks to build upon the Moroccan plans and support the growth of large CSP plants across all of North Africa with the aim of supplying electricity not just to the whole region, but to also export some of this power to Europe via undersea cables.

In sum, with the hope of better technology to come and the cheapness of solar cells, along with increased interest in CSP technology, especially in developing nations, solar seems to have a very secure future globally. Indeed, if PV efficiency and manufacturing costs improve to such a level that it does not need subsidies, and given recent technological advances and price reductions this could be credible by 2020, then PV could have an even greater future.

Biofuels

Production of biofuels is growing (see table 17), especially in the US which became the world's largest producer of biofuels in 2006, primarily via ethanol mixes and biodiesel. As noted earlier ethanol is an alcohol derived most often from maize, also known as corn[88]. Ethanol is mixed with petrol, ranging from 10% to over 80% ethanol, such as E85[89]. Biodiesel is usually derived from vegetable oil such as from soya beans. It can also be used pure, when it is known as 'B100', or mixed with diesel.

[86] http://www.desertec.org/news/ 25 Sept 2012.

[87] The Foundation's official support group includes Magic Circle law firm, Freshfields Bruckhaus Deringer. Desertec claims that if we could tap the renewable energy received by desert regions the world could easily meet its energy needs.

[88] There is understandable confusion over the use in the US and UK of the word 'corn', meaning 'grain' in Old English. In the UK, corn is a collective term that refers to cereals such as wheat (genus Triticum) or oats (genus Avena). In the US corn usually refers to maize (genus Zea), whereas in the UK this is 'sweet corn'.

[89] A US brand that is 85% ethanol and 15% petrol.

Brazil's use of biofuels rose to 2010, but has since dropped. The country has a long history of using ethanol[90] given its huge arable land mass and large sugarcane crop. Having huge amounts of arable land is significant. Only when biofuels are produced in large volumes do economies of scale make them a serious competitor to oil. But arable land, water and fertilizer given over to 'fuel crops' inevitably impact food production[91]. A nation needs a very large and reliable arable zone to contemplate developing this fuel on an industrial scale unless it wants to see higher food prices and the trouble that can cause politically.

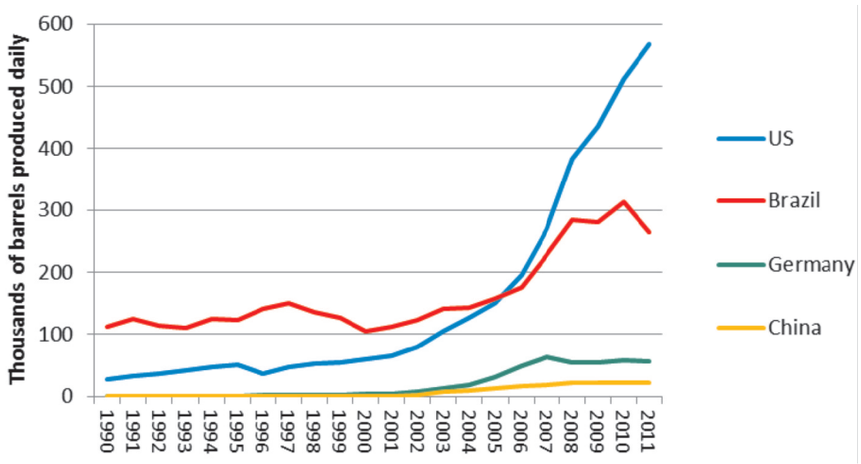

Table 17: Biofuel production in four key markets. (BP data 2012).

This factor can also have global repercussions. As the US produces around 40% of the world's corn and 37% of the world's soya beans, the continued investment in biofuels has led to calls, including from the United Nations, for America to scale back its use of crops for fuel and focus on producing food. The recent severe drought in America that has decimated crops has exacerbated the problem. But, cutting down on ethanol would be in direct conflict with the US Renewable Fuel Standard mandate which requires that up to 15 billion gallons of domestic corn ethanol be blended into the US fuel supply by 2022[92].

Biofuel's success is not guaranteed, even if it was once seen as the equal of oil[93] and even after the current US drought passes. They are generally regarded as providing less miles per gallon than petrol, i.e. ethanol is used to make oil go further, not replace it entirely and that means high oil prices still have an impact. Cars and trucks also generally need modified engines, known as a 'flex-fuel' type engines, to make use of ethanol mixes. And clearly, as most biofuels also use petrol or diesel they are not providing a long term answer to CO_2 emissions, but rather acting as a stop gap until a better technology is developed. On balance, despite biofuel's challenges, because petrol prices look set to remain high for some years to come biofuels will continue to see uptake for economic reasons.

[90] Ethanol use saw increased uptake in Brazil during World War II due to pressure on oil imports due to attacks in the Atlantic from German submarines looking for allied transport ships. 'Ethanol's first century', William Kovarik, Ph.D. Radford University, Radford, Virginia, USA. http://www.radford.edu/~wkovarik/papers/International.History.Ethanol.Fuel.html

[91] Many nations already import a significant portion of their food from abroad, but reducing a nation's farming land even further can only further reduce domestic food production.

[92] www.bbc.co.uk/news/business-19179419.

[93] See Chapter Two, Box A.

Biomass

Biomass energy is today a complex[94] and varied group of production methods, using everything from specially grown saplings to create 'briquettes' to burn for energy, to municipally collected organic waste broken down using bacteria to create methane, as well as hydrogen for fuel cells. Technically, biofuels such as ethanol are a subset of biomass energy, but in this case we refer primarily to power stations that are fuelled with organic and waste matter.

One recent example is the New Hope Power Partnership biomass plant in South Florida which produces 140 MW, mainly by burning agricultural waste. It is now the largest such plant in the US. The largest biomass plant in the world is in Finland. The Alholmens Kraft plant produces 265 MW and the by-product heat from the combustion process helps to heat the nearby town of Jakobstad. It sounds very 'green', but the Finish plant is not as clean as it seems. Only 45% of its fuel is biomass at present, with the rest made up from peat and an imported Polish pit coal. The biomass is from wood chips from Finland's huge wood and pulp product industry. Such power stations also need their biomass supply to be nearby otherwise transport costs make the entire process uneconomical.

Burning municipal waste is another method, but this has other challenges. Household organic waste rots quickly, it is also mixed in with other materials that may be toxic when combusted such as plastics. Moreover, burning waste matter produces significant air pollution including ash. In the US there are understood to be around 90 'trash burning' incinerators that generate electricity[95]. However, no new ones have been built since 1997 after public health fears were raised.

In Europe efforts have been made to build new incinerators fitted with advanced filters that capture ash and toxic pollutants. Denmark has led the way and now has around 30 such plants. Another 370 similar plants are spread across the rest of Europe[96]. However, this is partly driven by tough EU restrictions on opening up new landfill sites, rather than an eco-agenda. In effect, EU members have no choice but to develop expensive, pollution-capturing waste plants. Though, in New York, where there is also little room to create new dumping sites for refuse, but also no appetite for new incinerators, the city has to spend around $300m a year[97] to export its waste to other US States.

The big question is whether biomass and waste plants will become more prevalent, or whether they can be considered clean technology. The supply of waste from the world's great cities is certainly endless. Developing nations, like India, keen to find an alternative to huge open-air dumps and also generate electricity may increasingly turn to such technology. The problem is that building the latest biomass plants that capture the potentially toxic pollution is expensive. As with many other renewable power sources it is not perfect, but pragmatic city planners in Africa and Asia may see a greater role for this technology in the future.

[94] Although biomass energy has humble roots and is also the oldest utilised energy known to man, i.e. the wood fire.
[95] www.no-burn.org/downloads/Incinerator_Myths_vs_Facts%20Feb2012.pdf
[96] www.nytimes.com/2010/04/13/science/earth/13trash.html?pagewanted=all
[97] Ibid.

Geothermal

Tapping naturally occurring, permanent heat energy by drilling three kilometres under the Earth seems like a brilliantly simple plan. Such deep drilling is already well within current technological capability, for example Exxon Neftegas's deepest well in the off-shore Sakhalin-1 oil field in Russia is 12.34 kilometres deep. Global geothermal capacity is growing, (see table 18), up from around 6 GW in 1990 to over 11 GW today. If this fairly weak growth rate is maintained a conservative estimate would put global capacity at around 17 GW by 2035, which would represent a fraction of global demand. In comparison Germany already has 25 GW of PV solar capacity.

Table 18: Growth of geothermal capacity globally, with trend line to 2035 in red. (BP and Jomati).

This raises doubts about the sector's long term survival. After all, why should investors plough money into a technology that may see such low uptake? At present the US, which has several areas of geothermal activity, is clearly in the lead (see table 19), with the Philippines and Indonesia in second and third position.

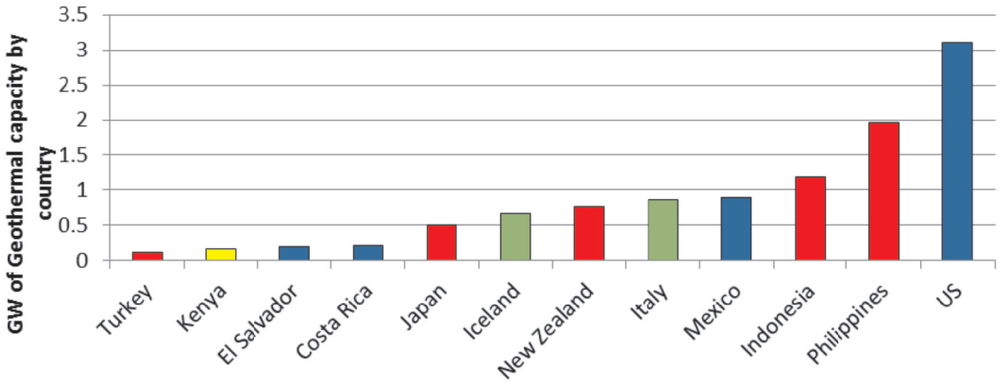

Table 19: Geothermal capacity, leading producers and world. (Red: Asia-Pacific/ME, Deep Blue: Americas, Green: Europe, Yellow: Africa).

Can geothermal grow? Certainly. The 'raw fuel' is free, the technology is already available, and the costs of such projects will reduce in time as techniques are refined. But such plants need to be built in areas of continual geo-thermal activity which mean they are often far from major urban centres making transmission a costly challenge. Finding geo-thermally active sites which are stable enough for a large power station to be built directly above them is also a challenge. No one wants to invest billions of dollars in a full scale geothermal electricity plant only to see it ruptured

by earth tremors. The future for geothermal is finely balanced then, and this apparently endless resource may not see the growth some green energy proponents would like to see[98].

Hydro, Wave and Tidal Power

Hydro power has long been a mainstay of the renewables sector, long before the word renewables referred to energy. Its growth in developing nations continues apace such as in China, where the world's largest dam, the Three Gorges, provides potentially 20GW of power. But in the West, because of environmental concerns and lack of suitable new sites, most major dam projects that could be built have been built. In the US for example, renewables have grown in output, but hydroelectric dams have decreased as a proportion of total renewable electricity generation falling from 67% in 1975 to just 30% today (see table 20). This pattern is unlikely to change in the future.

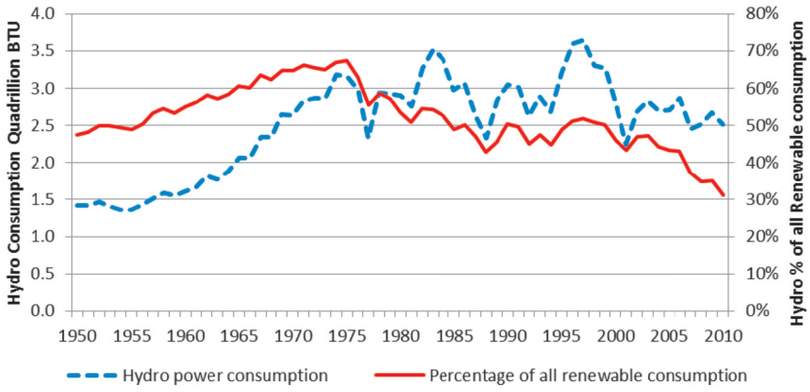

Table 20: US hydro use versus share of all renewables from 1950 to 2010, BP data.

The other great sources of water-powered energy are wave-powered turbines and tidal barrages. They have been considered for decades and countries such as the UK in particular has pioneered development here, though no full scale wave or tidal power plant is yet in operation. A UK Government report in 2012 found that 7 of the 8 major wave prototype experiments around the world were around the British coastline. The UK is also seriously considering building a huge tidal generator on the Severn Estuary. This would cost at least £30bn ($46bn) and provide 5% of the UK's electricity needs. But given the nation's dire finances this is still very much a hope rather than a reality.

Wave and tidal power is difficult to install and maintain as it must face powerful storms annually and massive underwater mechanical pressures far greater than anything a wind turbine has to deal with. Most large cities are also far from where the best wave sites are, which adds the cost of high voltage transmission cables. For now, the jury remains out on wave and tidal power and we should not expect radical change or huge investment here soon.

Renewables Conclusion

This diverse collection of 'Green' technologies is not going away. Their efficiency will improve (see Chapter Seven) and investors will adapt to subsidy cuts. Governments, whether seeking lower emissions or pragmatically tapping what 'free' raw energy their geography can deliver, will maintain renewables as part of the energy mix. No doubt some renewable companies will go bankrupt, others will consolidate, but the end result will be a healthier, more realistic

[98] One other form of 'geothermal' heating, though on a very different scale, is closed system domestic ground source heat pumps, which tap earth temperature below and around a home, then by using a compressor similar to that of a refrigerator operating in reverse it generates space heating for homes via water-filled radiators and under floor heating. This technology has room to develop further, though it does consume electricity to power the heat pump.

industry that will steadily grow in the future on a global basis. If nations such as Germany can prove their huge bet on renewables works economically that will add extra and lasting credibility to an industry that is traversing its most challenging period so far.

Impact on Law Firms

Corporate/M&A – It is a particularly uncertain period for the renewables sector and many companies will face bankruptcy due to the cutting of feed in tariffs, lower tax breaks and the end of subsidies. This will lead to consolidation and restructuring across the various industry segments. In solar, and especially in China, over production has led to serious corporate issues, with the top 10 solar energy companies having $17.5bn in debts[99]. On a more positive note, those companies that do survive may well take over smaller rivals and those with valuable IP in order to gain greater market share in a sector that is not going away, even without subsidies.

Capital Markets – Finding additional, or new, funding to keep certain renewable companies operating will be a challenge. In other cases corporate debt will need to be restructured due to an inability to pay creditors.

Litigation – With economic and changing regulatory conditions creating challenges for many renewable companies there is likely to be a significant rise in disputes too. This could range from disagreements with public authorities and regulators over allocation of funding or electricity production agreements, to disputes with investors. There are already on-going disputes between the US and China over dumping of cheap solar components and this trade spat is likely to continue for some time. For example, the U.S. Commerce Department has imposed tariffs of up to 250% on some Chinese solar-product imports, after deciding they were sold below the cost of production[100]. Chinese solar companies may face some investor suits too over allegedly improper corporate behaviour. For example, Suntech, another Chinese solar giant, is facing its biggest crisis ever. The New York listed company has lost 40% of its market value since revealing on July 30 that 560 million euros ($691 million) in bonds involved in securing the bank financing of a project in Italy may never have existed[101]. There is also, and will continue to be, ample opportunities for disputes over zoning and positioning of renewable sites, especially wind farms. Rapid growth in solar power and biomass could also trigger similar surges in planning disputes.

IP – The ability to continually improve efficiency of design (see more in Chapter Seven), or discover how to use new materials in wind turbines or solar PV cells, will remain an essential aspect of the renewables sector. For a product such as a PV cell the opportunity to have an edge on competing designs via patented technology may be the sole basis for investment in a certain company. Given the huge increase in investment in solar by certain countries there are billions of dollars dependent upon protecting new renewable IP around the world. There is also the exciting prospect of helping secure the patents of a company that may have created a 'game changing' technological breakthrough in the energy sector, for example a new kind of battery that completely changes the range and utility of electric vehicles. In some cases such developments will come from the R&D departments of major corporates, but in other cases they may be small start-ups, or university-backed projects. In the latter two cases there is therefore the opportunity of using the IP advice as a means to build a long term client relationship, though naturally fees for smaller businesses will be lower at the outset.

[99] http://usa.chinadaily.com.cn/business/2012-08/09/content_15653780.htm, 8 August 2012, USA China Daily.
[100] 17 May, 2012, Bloomberg. 'U.S. Imposes Anti-Dumping Duties On Chinese Solar Imports'
[101] USA China Daily. (as above).

Chapter Six: Energy Independence

Energy independence has a mythical position in the minds of some politicians[102]. The idea that a major country such as America would no longer need to depend on insecure, or constrained, supplies of raw energy such as oil from abroad is viewed as a liberating one. Though, supporters of this idea admit they would also need to add Canada and Mexico for this scenario to be viable, creating instead 'North American energy independence', not true US energy independence. Despite this the concept has campaign groups[103] and Presidential candidate Mitt Romney says the idea is achievable by 2020[104]. The belief is that 'independence' not only frees a country from problematic foreign relations, it removes the need for costly imports thereby boosting the economy, though as noted, the continental North American solution would effectively *increase* energy dependence between a far smaller number of countries, albeit more trusted ones. As we explore, complete national energy independence for the largest countries seems highly unlikely, at least for now.

Interdependence, Not Independence

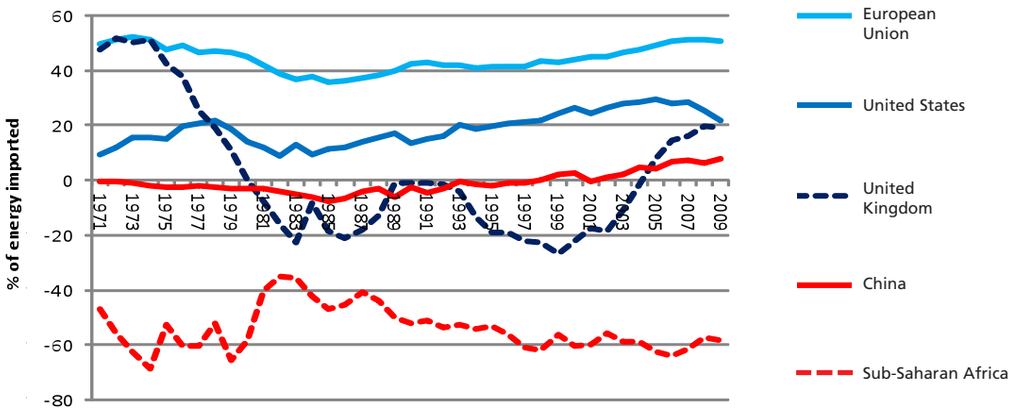

Table 21: Import of primary energy as percentage of use, (negative % means net exporter). World Bank data.

As can be seen in table 21, Europe, America and China are all net importers of energy. Whereas sub-Saharan oil producing states that have relatively low energy needs, but are major oil and gas producers, achieve energy independence. Though, ironically, these poor nations are in fact power deficient due to a lack of infrastructure[105]. For most of the world meeting energy demands is a matter of taking part in a global energy market, with countries both buying and selling raw energy, as well exporting electricity across borders.

Between 1970 and 2009 the US's primary energy imports have fluctuated between around 10% and 30% of total energy use and now stand at just over 20%. Gas fracking, shale oil from North Dakota, ethanol production and increasing investment in a wide range of renewables have not, yet, radically changed this picture. Imports from Canada continue, so do oil imports from the Middle East and Africa. Replacing 20%-plus of America's primary energy needs with domestic production in a time of profound budgetary problems for the Government, low natural gas prices that inhibit greater investment and a call for no more renewables subsidies seems unrealistic. Given that the US will see continued population expansion, improvements in domestic production and more efficient energy use are at best likely to keep imports level. As noted above. One possible solution is to fill that 20% short fall with a huge increase in imports of Canadian oil, though clearly this is not national energy independence. Nor would chaining the US to the costly to extract oil tar sands of Canada necessarily be a wise move. Once dependent upon Canada's oil sands to keep the US economy running what will happen if prices rise too high due to the supply stranglehold?

[102] For example, the allure of the concept was so great as to lead to the US Clean Energy Act of 2007 to be renamed The Energy Independence and Security Act.
[103] http://www.americanenergyindependence.com/home.aspx
[104] Of course, how this would work in practice is another matter. The long term financial and macro-economic consequences, such as the impact on a market with so few participants would have on US energy prices, are unknown. Equally, as noted in Chapter Two, oil is not necessarily a fuel of the long term future.
[105] 'Africa's Turn: Law and the Last Great Emerging Market', by Jomati Consultants LLP, March 2012.

Interestingly, it was the far smaller UK which temporarily achieved energy independence, mainly during the mid 1980s and late 1990s, due to North Sea oil and gas which is now in decline. The EU as a whole has never had energy independence and is extremely dependent upon imports of oil, gas and coal, as well as electricity, which is traded internally between EU members (see more below). China too was also energy independent, but is now import-dependent and this is likely to grow as urban development continues, despite huge domestic energy infrastructure investment, such as for new nuclear reactors (see above).

Électricité Sans Frontières

That oil needs to be imported from the Middle East and developing nations to the EU, China and US to meet demand seems a matter of fact, for now at least. But, it is not only oil that is traded. As we saw in Chapter Three, LNG exports are growing. However, electricity also looks set increasingly to be exported and imported.

	Top 20 Electricity Exporters	*Electricity Exports 2010 (bn kWh)*
1	France	66.6
2	Germany	57.9
3	Canada	43.9
4	Paraguay	43.4
5	Switzerland	32.9
6	Czech Republic	21.6
7	United States	19.4
8	China	19.1
9	Russia	19.0
10	Austria	17.5
11	South Africa	14.6
12	Spain	13.5
13	Sweden	12.9
14	Netherlands	12.8
15	Belgium	11.8
16	Denmark	11.7
17	Slovenia	10.1
18	Bulgaria	9.4
19	Poland	7.7
20	Norway	7.1

Table 22: Electricity export data. Red shows Americas, Yellow is Asia-Pacific, Purple is Africa, Green for Russia/CIS. EIA data. The majority are clearly European nations.

In Europe the largest multi-national electricity market in the world is forming (see table 22). France and the UK share a bi-directional cable across the Channel, where either country can export energy as and when needed by the other[106]. The UK and the Netherlands have also recently completed the 260km long BritNed[107] undersea power cable between the two countries and marks a new era in power exports.

[106] National Grid (UK).

[107] BritNed is an Anglo-Dutch joint venture whose undersea energy cable has been operational since April 2011. In this case the majority of the flow of electricity has also been from Holland to the UK, 3.9 TwH to the UK, compared with 1 TwH to Holland over the first full year of operation to April 2012. See: www.britned.com.

The European Commission (EC) is now embarking on the project 'of connecting more than 500 million consumers throughout the continent'. Though, arguably that has already been done without any central authority's input simply via bilateral agreements between European countries. Even so the EC says its aim is to 'fully integrate national energy markets by 2014', creating what would be the third largest integrated electricity grid in the world after that of China and India. Such a huge, interconnected market[108] ensures there is always sufficient supply and prevents the kind of incident in India this year that plunged hundreds of millions into darkness because of insufficient electricity capacity (see Box D). If India and its neighbours could work together to pool electricity such blackouts might be less likely to happen. But, political obstacles make such a cross-border energy strategy unlikely on the sub-Continent, and in other less integrated regional groups. Though, the idea could be more likely to succeed in South East Asia.

BOX D: The Largest Power Cut in History

India is a nation of 1.2 billion people with aspirations of becoming a 'super power'. It has a space programme and nuclear power, while Mumbai, Bangalore and New Delhi have seen tremendous growth and wealth creation. And yet, unlike its nearby rival China, it appears to be failing in terms of electricity provision. This was brought to the world's attention this August when a blackout affecting 670 million people hit India[109], or just under 10% of the world's population, making it perhaps the largest power cut in history.

Testament to the fact that this blackout was not a one-off is the widespread use of private generators in India. From private homes to large software companies most people that can afford to operate sufficient back-up diesel generators do so. This is the same scenario in parts of Africa. The problem with personal provision of energy is that it undermines the need for a national, long term, integrated response to energy demand. Some in India may reply that the West has had its own power problems, with the Californian power-crisis[110] of 2000/1 as a case in point. Even so, when half a nation experiences a power cut then there is something seriously wrong. Let us consider how India compares to its rival China in table 23 below.

India[111]	*Data*	*China*	*Data*
Access to electricity	66.3%	Access to electricity	99.4%
People without electricity (2009)	393m out of 1.17 bn.	People without electricity (2009)	8m out of 1.3bn
Energy use (2009)	675,829 kt oil equiv.	Energy use (2009)	2,257,101 kt oil equiv.
Growth in energy consumption over 10 years	51%	Growth in energy consumption over 10 years	108%
Electricity use per capita	571 kWh	Electricity use per capita	2,631 kWh

Table 23: India versus China for electricity use. World Bank data.

What we see is that India has far less people with electricity and that its total growth in demand has been less than half what China has seen. One would then think that India should be able to cope: less people on the grid, less heavy industry than China and a lower rate of energy demand.

[108] It could be even larger than planned if Desertec's plans to connect Europe to solar power plants in North Africa are achieved too, making the EC plan multi-continental. See, 'Our Turn: Law and the Last Great Emerging Market', by Jomati Consultants LLP, March 2012 and Chapter Five.

[109] NY Times, 2 August 2012.

[110] De-regulation of the electricity market, or one might say the failure to create the right regulatory model for buying wholesale electricity in California, led to rolling blackouts and the eventual ejection from office of the long term Governor, Gray Davis.

[111] All data, World Bank, 2009 is most recent complete date.

Without getting into the complex network of relationships between local politicians, Indian States and the many private companies in this energy sector, the answer appears to be a simple one: India left investment too late. Its rival China had been carefully building up capacity for many years, with prodigious planning to ensure sufficient infrastructure was in place before demand outstripped supply and that its power stations would always remain well-resourced. China also centrally planned and made sure local government carried out Beijing's wishes. In India it was only in around 2005[112] that combined State and private sector investment in the energy sector significantly increased. Given the long build times energy projects take it is no wonder India is struggling. Now, what will soon be the world's largest country is playing a dangerous game of catch-up with one of the fundamental building blocks of economic development: energy.

Impact on Law Firms

Regulatory – The clear winner from the development of regional energy markets are regulatory lawyers, especially those working in firms that have multi-jurisdictional capability. From compliance issues to making the best interpretation of regional energy market rules to help one's clients, there are critical areas for legal input. Such complex and cumbersome sets of rules that govern energy sales across something as vast as the EU are also prone to modification, lobbying and variances in local observation and implementation.

Anti-Trust/Competition – Whether in the EU or elsewhere, wherever very large stakeholders are called upon to provide many millions of people an essential service or product the stage is set for anti-trust violations. Naturally, most regional energy markets, such as the EU is seeking to build, have free market competition at their heart. The reality is that very few companies are large enough to participate and very often their interests are identical: push up prices, or sustain high prices despite the appearance of a 'free market'.

Project Finance – Building global and regional energy markets adds an extra layer of infrastructure onto what is already an extremely project-driven industry. Nations trading electricity will need to build compatible transmission systems. LNG exporters will need new ports and liquefaction plants, importers will need new re-gasification plants. Undersea cables will need to be built and huge service contracts will need to be formed to maintain these high value interconnections. Financial backers will be a wide mix of mainstream banks, multilateral and development banks, Governments, private equity funds and SWFs. This will be high value, high prestige work upon which many countries' energy security will rest for decades.

Litigation - Litigation over energy futures trading is a developing practice area, especially in the US, where there are court battles over improper trading of futures, alleged market manipulation and breaches of warranties. It is also an area that may become increasingly complex as global energy markets expand and the structures of over the counter products develop.

[112] According to World Bank data.

Chapter Seven: The Impact of Efficiency

So often the energy debate is driven by the subject of securing more energy reserves. But a possibly more rewarding global effort could be made in improving efficiencies in power production and energy saving. Simply put, why invest billions of dollars seeking to add an extra fraction of a percentage point to world hydrocarbon supplies when a major technological breakthrough in the efficiency of gas-fired power stations or renewable energy conversion could expand energy supplies by several per cent over the long term? After all, if one could make the world's wind turbines 30% more efficient you would add the equivalent of the UK's electricity production to the 'global grid'[113]. Or, for example, why not focus more R&D money on the losses of electricity transmitted by standard high voltage cables. Today around 7% of generated electricity is lost between power stations and urban areas due to electrical resistance in cables. That is billions of dollars of raw energy, as well as billions worth of generating capacity, simply wasted because of a problem that better cable technology could address. Globally, such losses amount to the energy needs of several large countries combined.

This inefficiency also impacts prices. Improved efficiency would both widen supplies and reduce the cost per unit of producing energy. This adds an important extra dimension to a dynamic the market tends to view as only based on project cost, plus supply and demand (see table 24). The price drivers below operate within each nation's regulatory and energy policy framework.

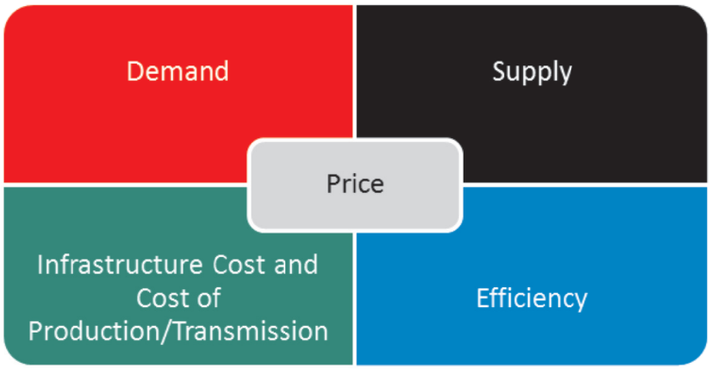

Table 24: The four constituents of energy prices.

Stretching the World's Energy

There are many stages in energy production and transmission where better efficiency can have an impact. Take a wind turbine for example. Betz's Law[114] states the best efficiency in terms of capturing wind energy while keeping the blades moving is 59.3%. More than that and so much energy is removed from the airflow that the blades stop moving. At present large wind farms reach 20% of this limit, i.e. around 12% total efficiency. Higher levels would mean more and cheaper electricity produced and many researchers are experimenting with lighter blades to try and raise this efficiency level. Scientists also have experimented with the position of turbines in a wind farm to prevent aerodynamic interference that is caused when these huge rotors are placed near to each other. Reducing friction in the turbine gear system is another target area. Altogether the hope is turbines will deliver far more electricity than before.

[113] Very roughly, the average coal-fired power plant produces 1 GW of electricity. The current total production capacity of wind farms in the world is 215 GW. In the UK, at peak times, electricity demand on the national Grid can rise to over 60 GW.
[114] The physicist Albert Betz found in 1919 that there is a theoretical limit to the efficiency of a wind turbine.

But, this is just one area that can deliver gains amid a myriad of competing energy technologies. The same goes for every sub-set of the energy sector. With solar PV cells the most expensive technology is producing at best 21% conversion rates in terms of converting solar energy into electrical energy. Again, if this could be improved the knock-on effect to electrical capacity of countries with solar power would be significant[115]. Already research teams have managed to reach 43% in the laboratory[116]. Some companies are also experimenting with 'three-dimensional' solar cells that capture more sunlight. Evolutionary steps are also taking place with new reactor technology, in part pioneered by French nuclear scientists. As with all of the above power sources, efficiency alone is not the answer, but with today's growing global demand anything that can permanently widen electricity capacity whilst making use of the same 'raw energy' supply has to be welcomed.

Below we consider two other key examples of efficiency technologies that could help change the price of energy and widen capacity.

Batteries: The Cure for Intermittency?

The ability to efficiently store electrical energy produced by renewables would be a massive step forward and make technologies such as wind and solar power far more useful. For example, during the day solar PV cells could generate electricity that would be stored until mid-evening when demand rises steeply. Electricity that is intermittently produced by wind power could also be 'stockpiled' over a number of hours until sufficient to be transmitted at peak times, rather than letting it seep into the grid at very low levels all day. Managed carefully such storage ability could greatly diminish the problem of intermittency.

However, storage of large quantities of electricity, i.e. in the Megawatt range, is only at the beginning of a very long development curve. Among those leading the way are the US-based, NASDAQ-listed, lithium-ion battery company A123 Systems. The company, which began as a start-up and has now become the largest lithium-ion battery producer in the world, installed a 500-kilowatt battery at a wind turbine in China for tests last year. This year it supplied a 2MW grid energy storage system to Ray Power Systems, also in China.

Though these are early days we should not underestimate the importance of this technology. It is the 'missing link' in the renewables process that moves such systems from inefficient white elephants in some cases, into very useful and strategic additions to the grid. How long will it be before it is ready for widespread use? It is very hard to know. But, if it can advance to practical levels investors will be very keen to support its growth.

The other key reason for developing better electrical storage systems is to find ways to make electric vehicle batteries give greater range. At present there are electrical cars with batteries that can deliver 300 mile ranges, but the additional cost to the retail price is huge. Most electrical cars have far smaller ranges of around 100 miles, which remain a major deterrent for purchasers.

Passive Heating: Decimating Energy Costs

Heating homes and offices consumes a large proportion of developed countries' energy supplies. Any step that can significantly reduce heating demand would have a major impact. Governments in many countries have sought to encourage insulation of the home, in some cases offering grants or tax breaks to do so. But, this has not made a huge impact on energy use. Another solution would be to 'build-in' energy efficiency right from a building's first design, rather than expect owners of offices and homes to invest in retroactive insulation after they have already spent significant sums buying a property. Also, if renting or leasing a property, occupiers have little opportunity to alter any structural aspect of the building.

[115] The first experimental solar cell was surprisingly made in 1839, by the then 19-year-old French physicist A. E. Becquerel. It took a further 40 years to build a solid state PV cell, and in 1883 1% efficiency was achieved. By 1954 America's Bell Labs had achieved 6% efficiency.

[116] US Government data, National Renewable Energy Laboratory (NREL).

The most radical approach to in-built insulation is the passive house[117] an architectural design concept pioneered in Germany in the 1980s, but which could see wider acceptance. A passive house is so well insulated, with thick walls and triple glazing, that it requires little or no space heating, massively reducing energy use. Comfort is maintained by an integrated heat exchanger system that also refreshes the air.

More modern passive house designs also incorporate solar panels for water heating and/or solar PV panels to provide electricity. Could all future houses and offices be built like this in the future? Yes, if there were sufficient demand to justify the extra up-front cost, though mass building of such designs would clearly reduce build costs. Governments could also use subsidies and tax breaks to encourage their development.

At present passive houses are mainly in Germany and Scandinavia and are estimated to be no more than 20,000 in total. There are also a very small number of 'passive offices' in the US, such as the Seattle head office of architects Weber & Thompson[118] which was designed in 2008. Perhaps when economic conditions improve in the West there may be a second wave of building and the key office markets of the US and UK may be perfect locations for such innovative projects, especially for businesses that wish to reduce carbon emissions. There may also be increased interest in warmer countries, as the passive house concept could also work in hot climates by keeping home and office temperatures low by preventing the entry of heat, thereby reducing the energy used by air conditioning units.

Impact on Law Firms

IP – As noted in the previous chapters, patents related to new designs are critical to the success of companies in the energy sector and designs that provide greater efficiency are equally as important. As renewable power spreads around the world there are plenty of opportunities for patent infringement. There may also be issues over branding, with certain products or architectural designs claiming certain levels of efficiency but perhaps without truly being able to demonstrate this.

M&A – As efficiency improving IP will be so important to the energy sector it is very likely that we will see increasing levels of M&A driven primarily to control patents and know-how, much as we have witnessed in the computing and web-based company sector.

Real Estate and Planning – Perhaps the most likely area to contribute legal work is in relation to new build homes and offices where developers will be looking to capitalise on the 'green credentials' of their buildings. Such developments may be able to claim Government grants, as well as needing to meet certain strict regulatory and building criteria to prove they are as green as claimed, or are meeting the ever-changing standards for new builds. One downside to this area is that commercial property is likely to stay subdued in the West for several more years. Moreover, developers of smaller office and housing builds may not see the benefit of pursuing super-efficient designs, or what have been termed 'green leases' where the landlord and the tenant commit to collaborate on reducing CO_2 emissions and insulation efficiency. However, on the large and 'mega' projects that are more likely to proceed regardless of the economic growth cycle, integrating heating efficiency, solar power and elements of the passive house design will likely become increasingly important.

[117] In German it is called 'passivhaus'. The concept was developed in the 1980s by Professors Bo Adamson and Wolfgang Feist

[118] http://greenbuildingelements.com/2008/04/01/weber-thompsons-new-headquarters-is-the-first-modern-office-building-without-air-conditioning/, and http://www.weberthompson.com/buildingshell.html.

Conclusion

What stands out first and foremost from this study is the fact that global demand for energy is growing, primarily because of the developing world and in particular because of China, as well as dozens of smaller countries seeing economic development. The second key observation is in accordance with President Obama's belief that America, and it would seem the world as a whole, will need a diversified energy portfolio to meet energy needs while also reducing pollution and CO_2 emissions. Underlining these two realities is an ever-increasing global patchwork of energy regulation, a rash of radical political decisions on the right energy mix and cutting of subsidies, and increasing levels of international trade in raw energy and electricity.

For law firms this sends a very positive message about the energy sector: growth and interesting clients. In a world where so few economic sectors can be guaranteed to see continual growth on a global scale, energy is certainly one of them. Though, this growth will not be uniform, or all of the same type in each country.

In the West we will see rejuvenation of the energy sector, not necessarily to create large increases in capacity but to replace old, polluting and inefficient technologies with new, cleaner, more efficient ones. This process will be heavily regulated and the scope for competition between rival energy technologies all seeking the support of Government and investors will be great. In the developing world there will increasingly be an ever wider number of energy companies, all struggling to be the dominant supplier of their type of energy to meet growing demand. Even in oil producers, the needs to generate electricity for a growing population will see developments in solar, wind and even nuclear. This provides a very large and diverse market for the energy practices of the world's leading law firms.

Moreover, much of the technology and investment in the energy sector is crossing borders into new legal and regulatory regimes, this favours law firms with global capability. This could be LNG trading between the US and Asia, or European companies' IP used in new Chinese nuclear reactors, or US solar companies helping Germany and Japan achieve their renewable goals via joint ventures. Likewise we see Chinese oil companies listed on the NASDAQ and US private equity funds and hedge funds investing in energy infrastructure in Asia and Africa. And that is not to mention cross-border M&A, disputes and IP-related energy sector work.

It is rare when we can give an absolute guarantee about finding new legal work in one of our reports, but it seems self-evident that as the world moves from 7 billion to 9 billion people by 2050 and more of the world's 200 nations develop modern infrastructure, the demand for energy will rise and energy companies and investors in that sector will see more activity. In turn law firms, especially ones with international reach and a wide and diverse capability that stretches across the competing energy technologies, stand to gain more work.

This scenario then creates another issue: how to compete with rival law firms also trying to grow their market share in the global energy sector. Market intelligence will be key to this effort. Knowing what is going on in the market, what are the competing technologies and business models, where they are growing, who is funding them and what are the regulatory issues facing these potential clients, is probably the best way to start any business development campaign. We hope this report has helped someway in this regard and sheds some light on one of the world's great power struggles: meeting global energy demand.

Appendices:

Appendix A: Largest Energy and Energy-Related Companies in the Fortune Global 500

Global 500 Rank	*Company*	*Revenues ($m)*	*Profits ($m)*
1	Royal Dutch Shell	484,489	30,918
2	Exxon Mobil	452,926	41,060
4	BP	386,463	25,700
5	Sinopec Group	375,214	9,453
6	China National Petroleum	352,338	16,317
7	State Grid	259,142	5,678
8	Chevron	245,621	26,895
9	ConocoPhillips	237,272	12,436
10	Toyota Motor	235,364	3,591
11	Total	231,580	17,069
12	Volkswagen	221,551	21,426
14	Glencore International	186,152	4,048
15	Gazprom	157,831	44,460
16	E.ON	157,057	-3,085
17	ENI	153,676	9,539
19	General Motors	150,276	9,190
21	Daimler	148,139	7,880
22	General Electric	147,616	14,151
23	Petrobras	145,915	20,121
27	Ford Motor	136,264	20,213
33	GDF Suez	126,077	5,566
34	Pemex	125,344	-7,358
35	Valero Energy	125,095	2,090
36	PDVSA	124,754	2,640
38	Hitachi	122,419	4,397
40	Statoil	119,561	14,055
41	JX Holdings	119,258	2,161
42	Nissan Motor	119,166	4,324
45	EXOR Group	117,297	701
47	Siemens	113,349	8,562
49	Lukoil	111,433	10,357
52	Enel	110,560	5,768
62	BASF	102,194	8,604
64	Honda Motor	100,664	2,678
65	SK Holdings	100,394	1,510
68	Petronas	97,355	21,915
69	BMW	95,692	6,787
73	Électricité de France	90,806	4,185
83	Indian Oil	86,016	882
85	Peugeot	83,305	818
90	Repsol YPF	81,122	3,049
91	Noble Group	80,732	431
92	Archer Daniels Midland	80,676	2,036
95	PTT	79,690	3,456
99	Reliance Industries	76,119	4,117

These are all the companies in the top 100 of the Fortune Global 500 that are either primarily energy companies (in yellow), or closely connected to the energy sector either because their products e.g. vehicles, are integral to the energy market, or a significant part of this business is related to primary energy products, such as petrochemicals, or building infrastructure and power plants for the energy sector (in blue). Their combined total revenues in 2011 were $7.45 trillion. If the top 100 companies of the energy sector and related industries were a country it would be the second largest economy in the world.

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