Our energy future: An economic, geopolitical and risk perspective
Risk Dialogue Series

Swiss Re
Centre for Global Dialogue
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The pictures in the publication represent the elemental forces of energy that constantly surround us—sun, water, wind, and biomass.
How can we ensure a sufficient supply of affordable energy to support future economic growth? And how can we achieve a sustainable energy mix to reduce greenhouse gas emissions? These and similar questions relating to energy security are high on the agenda of political and business leaders today, driven by such issues as high oil prices, geopolitical uncertainties, natural disasters and climate change.

These issues – of considerable concern to energy and utility corporations – are occupying the insurance industry too. Understanding the dynamics of the energy markets is essential for capturing investment opportunities and satisfying the increasing need for risk financing and risk transfer. While many analysts consider the high oil price of recent years to be a risk factor for the global economy, it has also led to rising investments in both conventional and renewable energies.

Rising prices have changed the risk landscape of the energy industry, for example through the expansion of oil and gas exploration activities to geographically extreme locations using highly sophisticated technologies. Recent natural catastrophes, such as the hurricanes that hit the Gulf of Mexico in 2004 and 2005, have prompted a surge in demand for risk protection. At the same time, risk perception and the awareness of loss potentials among energy companies have increased significantly. Demand for catastrophe cover in the energy sector is stretching the appetite of the insurance market, and there is growing interest in transferring risks to the capital markets through catastrophe bonds.

From energy exploration to business interruption following power outages; from terrorist threats to insurance requirements of new energy sources and investment opportunities: Understanding the evolution of these risks is key to the business of Swiss Re. Progress in diversifying and optimising energy consumption will come through research and development, by setting the right incentives, and through an open debate with all parties involved. The debate was given momentum through the Swiss Re Advisory Panel, and was further pursued by the Swiss Re Centre for Global Dialogue, Swiss Re’s premier platform for exchanging and debating expert views with a broader audience. This publication is intended to support and promote these efforts. I hope it will foster an active stakeholder dialogue in a topic that will be critical for the future of all of us.

Peter Forstmoser, Chairman, Board of Directors, Swiss Re
Introduction

Energy security and the global economy are closely related to each other in historical terms. The cartelisation of the oil industry in the 1970s provided the catalyst for a decade of high inflation coupled with poor growth in developed economies. While the link is far from causal, the impressive global growth of the 1990s came on the back of a glut of oil on the global markets, and low energy prices. Recent years have seen energy markets become much tighter. Current oil prices are running at more than double their value at the beginning of the decade. Yet global inflation remains low, while growth is relatively strong, as economist Geoffrey Bell elucidates in an interview. Although the effects of current oil price levels have been benign, growing concerns at the sustainability of future energy resources, as described by senior energy analyst Laura Cozzi from the International Energy Agency, have contributed to market volatility. She believes that the global energy system is not running out of natural resources or money; it is running out of time. To meet the world’s growing need for energy requires massive investments in energy-supply infrastructures. Experts estimate USD 20 trillion between 2005 and 2030.

Strategies to mitigate market price volatility are key to successful asset management, as Swiss Re’s Chief Investment Officer, Benjamin Meuli, reports. Not only must the financial markets be prepared for future oil spikes, as Swiss Re economist Kurt Karl relates, global business and economic leaders must also anticipate the possibility of further increases in oil prices and prepare for it. Swiss Re advocates Country Risk Officers who could act as a coordinating network for global energy and emission policies, as for other global risks.

There is a fundamental discrepancy in the global energy market. A considerable geographic distance exists between the major global energy consumers and their suppliers. Securing key energy supplies and supply lines is therefore a critical foreign policy consideration among consumer states, particularly at a time of tight energy markets, and growing global energy demand. Some consumer countries fear that producers may resort to the “energy weapon”. Andreas Wenger and Jeronim Perovic from the Swiss Federal Institute of Technology’s (ETH Zurich) Center for Security Studies argue that such aggressive tactics are rarely used and ineffective; and that the best way to secure energy supplies is to foster greater energy interdependence between supplier and consumer. Tensions between suppliers and consumers contribute to considerable political risks for foreign investors in the energy sector, as Rolf Tanner, Head of Political & Sustainability Risk Management, and Marco Lier, Political Risk Adviser at Swiss Re, explain; risks that can however be insured.

It is not just (geo-)politics that pose a considerable risk to energy supplies. The great roll-out of energy infrastructures, from the sources of supply to the final point of distribution, now dates back several decades. That infrastructure is now moving to the end of its natural life, requiring huge sums for its replacement. However, the nature of that replacement is uncertain: as established energy resources begin to expire, secure supplies and diversification are required, while the climate change agenda forces a reappraisal of current conventional energy use. Wolfgang Kröger from the Swiss Federal Institute of Technology highlights the scale of investment required to replace current infrastructure, and the power failures already occurring as a result of over-reliance on ageing structures. There can be no quick diversification of energy sources, argues Jan Kalicki, co-editor of “Energy & Security: Toward a New Foreign Policy Strategy”, but oil majors are investing at their end of the energy supply chain, and helping to bring on-stream the next generation of energy resources. Christoph Frei, Swiss Federal Technical Institute of Lausanne, believes governments and societies must now start to establish a vision of future energy alternatives, whilst Ulrich Suter, Swiss Federal Institute of
Technology, maintains that alternative energies and energy efficiency can have a major impact on the energy mix.

The potential for losses in the energy sector arises from conflicts, extreme events, human errors, or a combination of all three factors. Recent increases in risk within the energy sector have provided opportunities for the insurance industry. The fourth chapter of this publication provides an insight into risk assessment in the field, and demonstrates how insurance can best manage the risks of the energy industry. The processes that need to be undertaken in making a risk assessment of a rig are complex and labour intensive. As the Head of Risk Engineering Services Property at Swiss Re, Ulrich Straub visits oil platforms regularly. In an interview he describes his fascinating work. Stanley Cochrane, Head of Onshore Property, Energy and Power at Swiss Re, on the other hand explores the overall risks faced by the energy sector, from terrorism to the damage caused by a natural catastrophe, and how a risk bearer can best manage these challenges.

Swiss Re has been discussing these key issues around the energy markets and energy security with a number of experts and stakeholders on different occasions and with different partners over recent months: The Swiss Re Advisory Panel Meeting on Energy Security in November 2006, held at the Swiss Re Centre for Global Dialogue (Rüschlikon); the collaboration with the World Economic Forum in their Global Risk Network, leading to the publication of Global Risk Report, published in January 2007, and the conference Global Perspective on Energy Security in March 2007, held at Rüschlikon and jointly organised between Swiss Re and the Swiss Federal Institute of Technology Zurich.

These brought together leading energy and industry experts, financial services specialists, economists and political scientists. In this publication we have integrated the knowledge gained. Further information can be obtained via the links listed in the appendix.

This publication would not have been possible without the support of a number of people. We would like to extend our thanks to all of them, in particular to the authors and interview partners. Their rich and diverse contributions on energy security made it possible for us to compile this truly interdisciplinary publication, and address the economic, geopolitical and risk perspective of our future energy security.

Esther Baur, Director, Group Communications, Swiss Re
Oliver Schelske, Vice President, Group Communications, Swiss Re
The economic view
Laura Cozzi, senior energy analyst at the International Energy Agency, highlights the findings of the IEA that current global energy consumption trends are not sustainable in the medium term. Alternative scenarios are conceivable, but not without considerable political will and concrete policies enacted soon.

Reference scenario trends

The global energy system is not running out of natural resources or money; it is running out of time. We are creating an unsustainable energy future. Current global energy consumption patterns, if continued for the next 25 years, will become too vulnerable to failure arising from under-investment, increased risk of adverse climate change or sudden supply interruption. The underlying premise of the Reference Scenario in the International Energy Agency (IEA) World Energy Outlook 2006 (WEO) is that fossil-fuel demand and trade flows, together with greenhouse-gas emissions will each follow their current unsustainable paths in the absence of new government action. The Reference Scenario foresees global primary energy demand increasing by 26% between now and 2015 and more than doubling by 2030 (Table 1). Imports of oil and gas into OECD member countries and countries in developing Asia are set to grow even faster than demand. Non-OPEC conventional oil production is expected to peak within a decade. Gas production is set to plateau shortly thereafter in IEA member countries. As a consequence, OECD countries – and developing Asia – will increasingly depend on both oil and gas imports, much of which will have to come from the Middle East. Global energy-related carbon dioxide (CO₂) emissions will rise to 28% above today’s level by 2015 and to 55% above today’s level by 2030. Developing countries will account for more than two-thirds of this growth in world energy use because their economies and populations are expanding the fastest. These trends will make consuming countries even more vulnerable to a severe supply disruption and a resulting price shock. They will also amplify the magnitude of global climate change.
Globally, fossil fuels will remain the dominant source of energy until 2030, accounting for over 80% of the overall increase in energy demand between now and 2030. The share of oil will drop; however, it will remain the largest single fuel in the global energy mix until 2030. Global oil demand will reach 99 million barrels per day (mb/d) in 2015 and 116 mb/d in 2030 – up from 84 mb/d in 2005. The demand increase for coal will be the largest in absolute terms, driven mainly by power generation. China and India will account for almost four-fifths of the incremental demand for coal. Natural gas demand is also expected to rise fast, in both developed and developing countries, as there is rising demand for cleaner power generation. Hydropower’s share of primary energy use will rise slightly, whilst that of nuclear power is expected to fall. The share of biomass will fall marginally, as developing countries increasingly switch to using modern commercial energy. That, in turn, will offset the growing use of biomass as feedstock for biofuels production as well as for power and heat generation. Non-hydro renewables – including wind, solar and geothermal – record the fastest rate of growth, but from a small base. Their share in electricity generation will reach 7% in 2030, from less than 2% today. Biofuel use in road transport will quadruple its share from less than 1% today to 4% in 2030.

Meeting the world’s growing need for energy requires massive investments in energy-supply infrastructure. The Reference Scenario projections call for cumulative investments of over USD 20 trillion during 2005–2030. The power sector alone is expected to require more than half of that total investment. China alone needs to invest about USD 4 trillion – almost one-fifth of the world total.

On current energy trends, global energy-related CO₂ emissions will reach 40 gigatonnes (Gt) in 2030, that is 14 Gt above the current level. Power generation accounts for half of the increase in global emissions during the projection period. China alone is responsible for around 40% of the rise in global emissions. China’s emissions will more than double between now and 2030, driven by strong economic growth and heavy reliance on coal in industry and power generation. China overtook the United States as the largest CO₂ emitter in the world in 2007. The US also contributes heavily to increased global emissions. The per-capita emissions of non-OECD countries nonetheless remain well below those of the OECD.

**Alternative policy scenario trends**

In an Alternative Policy Scenario, the WEO demonstrates that a package of currently discussed policies and measures aimed at enhancing energy security and mitigating CO₂ emissions would, if implemented, significantly reduce the rate of increase in energy demand and emissions. These policies and measures include efforts to (i) improve efficiency in energy production and use, (ii) increase indigenous output of fossil fuels in importing countries, nuclear power and renewable energy sources and (iii) encourage the development and deployment of other clean and more efficient energy-related technologies. Implementing these measures would require a mixture of economic instruments. They include (i) taxes and cap-and-trade mechanisms, (ii) regulatory measures such as standards to address information barriers and consumers relatively insensitive to price and (iii) increased research and development.
If all currently considered measures were to be implemented, world primary energy demand in 2030 could be reduced by about the equivalent of China’s entire current energy consumption compared to the Reference Scenario. The largest energy savings in both absolute and percentage terms come from coal. Should carbon capture and storage become commercially available before 2030, the use of coal would decline significantly less.

Lower overall energy demand would sharply reduce consuming countries’ need to import oil. In stark contrast to the Reference Scenario, the oil imports by OECD member countries would start to level off by around 2015 and then begin to fall. Global oil demand would only reach 95 mb/d in 2015 in the Alternative Policy Scenario – 5 mb/d less than in the Reference Scenario. Measures in the transport sector would produce close to 60% of all the oil savings. Of that, more than two thirds would come from more efficient new vehicles, notably hybrid cars. Increased biofuels supply, especially in Brazil, Europe and the United States, would also help reduce oil needs. Globally, demand for gas and reliance on gas imports would also be sharply reduced compared to the Reference Scenario.

Energy-related CO₂ emissions would be cut by 1.7 Gt, or 5%, in 2015 compared to the Reference Scenario (see Figure 1). Policies encouraging more efficient production methods and use of energy would contribute over 80% of the foregone CO₂ emissions. The remainder would come from switching to low- or zero-carbon fuels. A more efficient use of fuels, mainly through more efficient cars and trucks, would account for more than one third of the saved emissions. Overall the actions taken in the Alternative Policy Scenario would cause emissions in OECD member countries to stabilise by 2015. Globally, emissions would be 16% lower in comparison with the Reference Scenario in 2030. The policies most effective in reducing emissions also yield the largest reductions in oil and gas imports.

Figure 1: Contribution of different policies to global CO₂ emissions reductions

<table>
<thead>
<tr>
<th>CO₂, Gt</th>
<th>2004</th>
<th>2030</th>
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<tbody>
<tr>
<td>42</td>
<td></td>
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<tr>
<td>34</td>
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<td>26</td>
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- Increased nuclear
- Increased renewables in power generation and biofuels
- Improved efficiency and fuel switching in the power sector

Source: IEA
The policies countries around the world are currently considering will have a major impact on bringing the energy system onto a more sustainable path. They could additionally yield important economic benefits. The economic benefits from producing and using energy more efficiently would more than outweigh the economic costs. Every additional dollar invested in more efficient electrical equipment and appliances mitigates paying more than two additional dollars in investment in power generation, transmission and distribution lines. A similar ratio applies to investment in more efficient cars and savings in oil import bills.

In conclusion, the financial savings generated by the new policies and measures would far exceed the initial extra investment cost for consumers – a key result of the Alternative Policy Scenario. In it, cumulative investment between 2005 and 2030 along the energy chain – from the producer to the consumer – would be USD 560 billion lower than in the Reference Scenario. Investment in end-use equipment and buildings would be USD 2.4 trillion higher; however this would be more than outweighed by the USD 3 trillion of necessary investment avoided on the supply side. Over the same period, the cost of the fuel saved by consumers amounts to USD 8.1 trillion, more than offsetting the extra demand-side investments required to generate these savings. The payback periods of the additional demand-side investments range from one to eight years. They are the shortest in developing countries and for all those policies introduced before 2015.

Strong political support is ultimately required to develop and deploy the cleaner technologies to implement the Alternative Policy Scenario. In particular, stronger economic incentive and support towards renewables, carbon capture and storage and second generation biofuels could help achieving an even more sustainable path that the one described above, as those technologies will be key in helping decarbonise the power generation sector and lower the transport sector’s oil dependence. Without a clear regulatory framework and right market incentives, such technologies may take too long to be widely deployed. The faster we act, the better for everyone.

Dr. Laura Cozzi is a senior energy analyst at the International Energy Agency IEA.
A major supply side shock could cause a jump in oil prices, and a potential subsequent global recession, explains Swiss Re’s chief US economist, Kurt Karl. This risk can be mitigated by reducing global dependency on oil through a variety of methods: Eliminating subsidies and raising taxes on petrol and diesel; increasing strategic oil reserves; and investing more in energy-efficient and alternative technologies, thereby also reducing carbon dioxide emissions. The coordination of these policy issues – energy efficiency and carbon dioxide emissions – would be greatly facilitated by establishing a global network of Country Risk Officers.

The consequences of an oil price shock

Experts agree that a severe oil price shock could plunge the global economy into recession, causing a loss of world income of USD 250 billion to USD 1 trillion.\(^1\) With an estimated global income of USD 45 trillion\(^2\), this would reduce global income by 0.6\% to 2.2\%, resulting in mild to severe recessions in oil-importing nations. Moreover, the likelihood of such a supply shock is fairly high – there is, in fact, a 10\% to 20\% chance of it happening, according to the World Economic Forum (WEF). However it is not all bad news. Improved energy efficiencies – particularly in Europe, the US and Japan – have reduced the impact of these types of shocks. In the past, large oil price increases have led to more severe recessions than are likely to be experienced today.

Figure 1: Risk within next 10 years

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<td>Pandemics</td>
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<td>Interstate and civil wars</td>
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<td>Oil price shock</td>
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<td>Transnational crime and corruption</td>
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<td>Middle East instability</td>
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<td>Fall in $</td>
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<td>Climate Change</td>
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<td>Liability regimes</td>
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<td>Developing world disease</td>
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<td>Loss of freshwater services</td>
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<td>Nanotechnology</td>
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<td>Failed and failing states</td>
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<td>Proliferation of WMD</td>
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**Likelihood**

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<th>Below 1%</th>
<th>1–5%</th>
<th>5–10%</th>
<th>10–20%</th>
<th>Above 20%</th>
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**Source:** WEF

Oil supply shock triggers

There are many possible scenarios that can produce an oil supply shock. One specific scenario reviewed by the WEF Global Risk Network is that the Organization of Petroleum Exporting Countries (OPEC) reduces output substantially to firm up oil prices. Concurrently, a major supply disruption occurs in one or more of the following countries: Iraq, Saudi Arabia, Nigeria, Iran or Venezuela. This would immediately lift oil prices between 50% to 100%, with no hope of a near-term recovery. As mentioned above, the result would be a mild global recession and contraction of global GDP, depending on how severe the shock is. Under this scenario oil-importing states, such as the US, large parts of Europe and Japan, would be most affected. Meanwhile, the oil price increase would boost incomes in oil-exporting nations.

Figure 2: Price of West Texas Intermediate

![Graph showing the price of West Texas Intermediate oil from 1962 to 2006.](image)

Sources: Federal Bank of St. Louis, FRED; shaded areas are US recessions

Mitigating an oil supply shock

The good news is that some long-term planning by the oil-importing nations can reduce the impact of an oil supply shock. One simple measure is to stockpile oil reserves and use them to smooth a potential spike in oil prices. Other strategies require long-term investments and planning, such as investing in energy-efficient products and clean energy sources and encouraging subsidies or government spending on energy-efficient technologies. A further policy initiative is to promote common standards for energy transit and eliminate energy-price subsidies. Governments can raise taxes on energy products and services. More nuclear energy and coal-fired electric utility plants can be developed (while being mindful of the risks and the environment). Finally, states can invest more in refinery capacity and Liquid Natural Gas plants (including their off-loading and processing terminals).
How insurance can cushion oil shocks

The insurance industry helps mitigate supply-side shocks in at least three ways. First, insurance in energy infrastructure allows the sector to survive natural catastrophes such as Hurricane Katrina. Despite major loss events, such as the US hurricane season of 2005, the insurance industry continues to provide protection – even increasing insurance capacity with catastrophe bonds. Second, insurers with specialized skills provide protection to oil and gas exploration in extreme locations with new, sophisticated technologies. Finally, the insurance industry also offers protection for new energy-efficient technologies, even though the risks of these technologies are yet to be fully understood. For this risk bearing to function efficiently, governments must enact policies and a legal framework that are stable and viable in the long term.

Oil dependency and climate change

Climate change and energy usage are inexorably connected. Oil and coal combustion releases carbon dioxide (CO₂) into the atmosphere. Reducing CO₂ and other greenhouse gas (GHG) emissions kills two birds with one stone: it makes an oil-importing country less dependent and helps prevent global warming. However, a holistic approach is needed, so that the bid for greater oil independence does not increase CO₂ emissions. This could occur, for example, if coal-fired electric utility plants were promoted without sufficient account taken of their CO₂ emissions.

Climate change and energy prices are also influenced by extreme weather events. Climate change is widely believed to be a driving force behind the observed increase in the frequency and severity of tropical storms. These storms frequently disrupt oil and gas supplies, particularly in the Gulf of Mexico.

Bringing policy issues together

The creation of a new senior-level, government post – the Country Risk Officer (CRO) – could help integrate energy-efficiency and GHG policies. Analogous to a Chief Risk Officer in a corporation, a CRO could improve, extend and integrate existing mitigation efforts. First, he/she would balance and prioritize the risks a country faces in order to mitigate a supply shock. Currently, there is a great deal of compartmentalizing when it comes to understanding potential energy risks and much ‘silo-thinking’. Second, the CRO would better prepare his/her country for natural catastrophes resulting from climate change. Third, he/she could strengthen public-private partnerships to help transfer risks and finance economic losses. Finally, the CRO could coordinate global efforts to mitigate the risk of supply shocks.
Rising oil prices could bring deflation, not inflation

Geoffrey Bell, founder of the Group of Thirty, a consultative group on international economic and monetary affairs, and member of the Swiss Re Advisory Panel, discusses why rising oil prices over recent years have not had the inflationary effects seen during the last sustained global price hike of the 1970s.

Mr Bell, we discussed energy security, efficiency and, above all, prices at the Advisory Panel meeting on energy security. Interestingly, energy prices received the most attention. Over recent years, resource prices have steadily increased, especially for oil. Why has this disrupted neither the merchandise nor the financial markets?

Over the past five years, we have had the longest period of rapid world economic growth, certainly since the 1960s, with an average global GDP growth of about 5%. From 2002 to the present, oil prices have increased two-and-a-half fold. Yet it has not affected the world economy. Let me try to explain.

For one, oil intensity, the ratio of oil consumption to GDP, has dropped dramatically over the past 20 years. There is no question that a barrel of oil is used more efficiently today. There is one exception to this, the US. Although oil intensity has diminished, the US still has the largest oil consumption by far. By and large, particularly in Europe, and across the world, people are using less oil energy relative to GDP. That has been extremely important.

You are talking about oil consumption. But what has changed in terms of the resilience of the financial system? Have financial markets become more stable?

The question one has to ask is why we did not have more inflation despite the oil price rising from USD 30 a barrel to USD 80 a barrel. My view is very much that during this period central banks have made a big effort to keep inflation low. People now believe that, in sharp contrast to the 1970s, this will continue going forward. Central banks have become more independent and, therefore, devoted to keeping inflation low. This is extremely important. Second, it is easy to underestimate the impact of globalisation in keeping manufacturing costs down. In my view, a very important point has been that goods from China and services from India and all around the world, have kept global prices down. In other words, if you want to raise prices in an industrialised world, you will lose your markets. That has been a very big force.

It is worth mentioning that this is very similar to the last quarter of the nineteenth century, a period called the Great Depression, when agricultural prices fell by an average of 1.5% per annum for 25 years. This was because North and South America increased their agricultural production and subsequently shipped their goods in newly invented refrigerated ships across the world. That kept agricultural prices down. This now is happening in manufacturing. To summarise, you have had the combination of central banks and a changing world economy that kept inflation low. What does this mean for oil? Unlike in the 1970s, when rising oil prices led people to demand higher wages and governments allowed them to rise in an inflationary spiral, that is not happening today. Central banks know that if oil prices go up, you pay more for oil but you will not rush to spend on something else. I think that has been absolutely critical because we live in a low-inflation environment.
However, we can safely say that the dependence on oil imports has hugely impacted our current account balances. What does that mean and could it impact exchange rates?

I agree with you entirely. The worst offender regarding that issue is the US. While it has become less dependent, it is still by far the industrialised country with the highest dependency on energy. At the end of the day it needs to reduce that further. Therefore, when oil prices go up and the US imports a great deal of oil, the price of imports rises and worsens its balance of payments deficit. Last year, the US balance of payments deficit approached USD 900 billion. Now, it has been extremely lucky because the Chinese in particular, but other countries too, chose to finance that deficit by buying more and more Treasury bills. Normally, that would have caused the dollar to fall sharply. However, as these countries continue to buy US Treasury bills and help finance the US deficit, this is keeping the dollar's fall very gentle. Nevertheless, I agree that under normal circumstances an increase in the price of oil worsens the balance of payments and leads to a sharp fall in the exchange rate. But that just has not happened this time around.

What do you predict – how stable is this situation going forward? What do you expect in the short- and long term?

In the short term, the world economy is doing well and oil production is more or less flat. Remember, from the mid-1980s until 2003, real oil prices actually fell. They did not start to rise until four years ago. As a consequence, during the period up to 2003, people were not willing to invest large amounts into new production. Plus, environmental concerns made it harder to build new oil refineries due to the “not in my backyard” attitude. Moreover, during the past five years or more, we have seen an explosion in growth in South East Asia that helped to push up all emerging markets by raising commodity prices across the board, including oil. Personally I do not expect that to change much over the next few years. Consequently, I see the price of oil remaining somewhere around USD 60 a barrel or, put differently, between a low of USD 55 and a high of USD 70. Of course, the oil price remains subject to shocks and closures of oil fields because of the possibility, for example, of terrorist attacks. I cannot see oil prices dropping to USD 40 or USD 30 a barrel.

When you say 'shocks' – do you think that the nature of shocks is changing? Will they be different, longer or more volatile? You are painting a picture of relatively stable oil prices going forward, within a pretty narrow range.

Let me move on from the very short-term to a more long-term time scale. I am strongly convinced that we are not going to see inflation resurge, even if the price of oil should climb to USD 100 a barrel. In other words, if the price of oil continues to rise, central banks will remain vigilant and not allow oil prices to influence overall price levels. As mentioned previously, we will not relive the 1970s, when higher oil prices led to rising wage demands and a subsequent increase in the underlying inflation rate. That will not happen. Instead, I would expect deflation, i.e. the opposite of what we saw in the 1970s, if oil prices rose from USD 70 to USD 100 a barrel – following, for example, a shock such as the disruption of oil supplies from the Middle East. In other words, you would pay more and more money for oil and then have less money to spend on restaurants and travel. My feeling is that, in today's world, rising oil prices would be much more deflationary than they used to be.
If I may address the next 10 or 20 years, we have a situation whereby China, India and even South America will be doing very well. Therefore, I see the demand for oil continuing to rise and, subject to terrorist attacks and disruptions in the Middle East, the underlying price of oil rising gradually alongside. As long as this happens gradually, the world can adjust. But let me make another important point. The US remains the largest consumer of oil and most of that is consumed as gasoline because people drive a great deal here. Given that the price of gasoline is approximately half of that in Europe – a gallon in the US costs around USD 3 – the US will have to allow prices to rise. And that should ultimately discourage people from having very large cars. Also, I expect the Administration to exert some pressure to lower oil consumption. That will make a big difference in the potential increase in oil prices. Like most things in economics, you can deal with them unless there are spikes. And I do not see that happening unless there are shocks in the Middle East.

Geoffrey Bell is the President of the economic advisory group Geoffrey Bell & Company, as well as being the Executive Secretary of the Group of Thirty. He is also a member of the Swiss Re Advisory Panel.
Swiss Re's Chief Investment Officer, Benjamin Meuli, argues that strategies to mitigate market price volatility are key to successful asset management.

Mr Meuli, an oil price shock is considered by many experts to be one of the largest risks to the world economy. At the same time, rising oil prices in recent years have shown that the economy has become more resilient to oil price increases. To what extent is an oil price shock a risk for financial markets and Swiss Re in particular?

The global economy has become much more resilient to an oil price shock. The chance of collective action by producers and others in response to some form of disruption, for example to a terrorist attack, is in our assessment quite high. The effect of such an impact, compared to the 1970s, is very much reduced today, also in large part due to the fact that the amount of oil required to produce one unit of GDP is significantly smaller today. Societies are also increasingly focused on alternative energy sources and are taking steps to ensure greater security in terms of supply. As far as developed economies are concerned, an oil shock is much less of an issue then it was, although one that cannot be ignored completely.

If we look at the potential impact on Swiss Re’s investment portfolio, one has to remember that there are two sides to Swiss Re’s balance sheet. We are not just looking at the assets in isolation, but we are also looking at how the assets perform in relation to the liabilities of the firm. In that context we have to consider oil prices from different perspectives and take into account correlations.

For example, for the foreseeable future the oil price is going to be highly correlated with the economic development in the Asian economies. With the swift pace of growth in India, China and other parts of the world, the demand for oil in those parts of the world is increasing rapidly, together with accompanying external costs of pollution and carbon emissions. These emerging economies are generally more dependent on oil and are far more energy-intensive. If growth in these economies is going to continue at a similar pace, the demand for oil will subsequently increase. The price for oil will remain elevated. We therefore see an investment in oil as a proxy for an investment in Asia.

You emphasize the importance of asset-liability management for an insurer. One example to illustrate this is how Swiss Re has hedged hurricane exposures with oil and gas financial instruments. Can you explain how this works?

Yes, this is another area in which oil is relevant in the investment portfolio. We have been looking at oil and oil-related products as hedges for natural catastrophes exposures, in particular our exposure to a large hurricane moving through the Gulf region of the United States. We have seen enough evidence, given the refining concentration in that area, the capacity of the oil rigs and so on, that if a major hurricane were to move through this region, it would significantly reduce capacity for refining and production in the USA. What kind of investment would perform should such an event occur? We have looked at using both natural gas and unleaded petrol futures and options as a way to hedge our exposure. One can have a situation where a sharp increase in the price of oil, particular the refined products on which oil is ultimately based, would correlate inversely with losses in our property natural catastrophes book. We have already implemented this strategy, albeit on a small scale.
What has been the experience?

Last year we first undertook the hedge, but there were no major hurricanes. Unfortunately the only way we can judge if this strategy is successful is if there is a major hurricane event. We will continue with that strategy until such time we proved to ourselves that it definitively works or doesn’t work.

We also discussed the risk of higher inflation associated with high oil prices at the Advisory Panel meeting. While it is considered a lower risk than in the past, it could have an impact on both the assets and the liability side of the balance sheet. How do you mitigate the inflation risk?

Inflation is a risk that we have to deal with in the investment portfolio. Inflation is also a factor in our liabilities, but rather difficult to model and quantify precisely. The inflation exposure we have is often not the same as general retail price inflation. For example, in terms of some of the long-term payouts we make within workers compensation policies, the inflation link can be to medical expenses and other things that tend to inflate much faster than general inflation. We attempt to hedge the inflation risk in a variety of methods, either by using inflation-linked securities within the bond market, or occasional inflation swaps. We also believe that our exposure to equities is a reasonable hedge against inflation, and clearly our exposure to commodities including oil also provides some inflation protection.

High oil prices of recent years have also spurred new investment opportunities. How do you see these and what has Swiss Re’s approach been in trying to capture them?

We have extended the investments we have in commodities. A few years ago, we had no exposure at all and relatively little capability internally ourselves to invest in commodities. Consequently, we made a decision with our strategic partner Horizon 21 to sponsor a fund of investments in commodities where we gain access to the 30 best investment managers within this asset class. We have increased our exposure quite significantly in the past two years and are extremely pleased with the performance.

Oil is the kind of commodity that in some situations can assume the investment properties of gold. In the old days, when there was a major geopolitical disruption, investors used to flee to gold. Nowadays, if the barometer of geopolitical tension rises, then the price of oil starts to rise. Given that Swiss Re is the type of company that will be adversely affected by a large terrorism or other global events, I would strongly argue in favour of having a larger exposure to commodities, particular to oil, because it is likely to perform well in times of stress where we may be facing losses elsewhere on our balance sheet.

What is your view on renewable energies? Where do you see the greatest potential and what is Swiss Re’s strategy?

This is another current theme within our investment portfolio. We have significantly increased our volume of sustainable investments in recent years. In 2004 we invested around CHF 100 million, and increased our participation so that it currently stands at CHF 500 million. Included within that figure is a very significant allotment of investments devoted to alternative and renewable energy products. These investments are likely to form an increasingly significant part of our overall investment portfolio.
In April this year, we successfully launched the EUR 329 million European Clean Energy Fund, which invests solely in clean energy projects and is one of the largest funds of its type in Europe. The Fund provides capital to European clean energy projects, which are environmentally beneficial, including wind, solar, hydro-electric, geothermal and waste-to-energy projects, and generates carbon credits or tradable renewable energy certificates. Swiss Re is the anchor investor in the Fund and acts as carbon advisor for the selected projects. The Fund was placed in Europe by Swiss Re’s affiliate, Conning Research and Consulting. The United Nations Economic Commission for Europe awarded the Fund a mandate under the Energy Efficiency 21 Project. This qualifies the Fund as an accredited investment vehicle within the UN system, which allows the Fund to participate in special project financing initiatives and to receive UN grant money for Kyoto Protocol and climate change related projects.

How do you take into account the fact that rising energy prices affect various industries in different ways?
We take that into account mostly within our equity portfolio, where we move our money very actively from sector to sector, depending on how we value different underlying macro themes. We have been fairly overweight in energy and materials as ‘sectors’, anticipating both increasing oil and commodity prices. However, it is very difficult to generalize, and you almost have to study individual companies as to whether or not they face margin pressures due to oil price increases. Energy price spikes that directly drive companies into default are rare. Industries that could potentially be impacted include the airline and automobile industries. They would not be able to sufficiently pass increased fuel cost to consumers. The automobile industry could be hit in terms of unit sales of high margin products such as SUVs and pick-ups. At the end of the day, any price increases would in most cases be passed on to customers.

Overall, do you see the recent developments in the energy markets and the discussion around energy security more as a risk or as an opportunity for the insurance industry or Swiss Re in particular?
It has to be an opportunity. There can be no question about that. When major events happen, such as climate change, and we all agree that they are happening, even if we don’t know exactly how fast or what the specific impacts will be, that has to boost insurance demand, so that ordinary people can go about their daily business secure in the knowledge that they are protected. It must be an opportunity for Swiss Re to develop new products and solutions for our clients as well as on the investment side. At the same time, there are of course major challenges. Uncertainty is still uncertain.

Benjamin Meuli is Chief Investment Officer and Member of Swiss Re’s Executive Board.
The geopolitical perspective
Jeronim Perovic and Andreas Wenger, both from the Center for Security Studies at the Swiss Federal Institute of Technology (ETH Zurich), discuss the dependency of energy consumer from few major oil and gas suppliers; and that greater interdependency between consumer and producer states may actually improve energy security.

The mix of high oil prices, continuing instability in the Middle East, Russia’s unpredictability as an energy supplier, and growing concern about global climate change are factors that have recently thrown OECD economies into a state of political confusion. The question that continues to be of concern to observers – and for which no one has a ready answer yet – is how to find a quick way out of a policy dilemma: To make industrialized nations less dependent on imported fossil fuels; to ensure their continued economic growth; and to manage the effects of greenhouse gases.

Ambitious targets versus current needs

With its March 2007 decision, the EU sent a clear signal to commit its 27 member states to reduce overall European greenhouse gas emissions by 20 per cent. At the same time, members were told to increase the share of renewable energy sources to one-fifth of energy consumption by 2020. Likewise, in his 2007 State of the Union address, US President George Bush announced plans to reduce gasoline usage by 20 per cent over the next decade. In December 2005, the Swedish government announced an ambitious plan: Sweden intends to end its oil consumption altogether by the year 2020, and to become, in the words of the former Minister for Sustainable Development Mona Sahlin, “the first country in the world to break the dependence on fossil energy.”

However bold these decisions may be, developed economies need to acknowledge that oil will most likely remain their most important source of energy for the next 25–30 years. Even if proactive new energy policies are put in place, and even if some individual countries manage to become significantly less dependent on fossil fuels, it will still take time for these measures to substantially affect overall energy requirements. This outlook is disturbing in itself, aside from the lack of progress in diversifying energy supplies in order to reduce future greenhouse emissions. Consumers in developed economies must accustom themselves to two trends: First, because of the expected global increase of oil demand, competition for oil and gas will intensify; second, because of the declining oil production in the OECD, known fossil reserves will be further concentrated in other regions. Are these two issues reason for serious concern?

To co-operate or compete?

Competition is unlikely to result in a “resource war” between the great powers. Because they depend so strongly on oil, major consumers such as the US, Japan, and the EU, but increasingly China and India too, rely on the world energy markets to be as stable as possible. Any factor that threatens this stability drives up prices, and hampers investments as well as production increases.
At the same time, it would be just as unrealistic to assume that consumer states will cooperate more closely on energy matters in the future. While the EU members recently decided to impose binding measures on greenhouse gas emissions, each country still sets its own policy with regard to its foreign energy relations. On one end of the spectrum, Poland, which depends on Russian energy and feels vulnerable to Russian pressure, has taken a hard-line stance against Russia. In autumn 2006, it refused to start renegotiating the Partnership and Cooperation Agreement between the EU and Russia, set to expire at the end of 2007. At the other end of the European spectrum is Germany, which is seeking a new treaty that will strengthen the bonds between Europe and Russia. Germany envisions an energy partnership with Russia, a free trade zone, and closer relations in research, education, and culture. Additionally, Germany plans to build a pipeline through the Baltic Sea that links Russia to Germany while avoiding transit countries, a move that Poland sees as violating its interests.

On the global level, China’s current policies exemplify some of the problems resulting from energy cooperation: In order to sustain current economic growth, Chinese state-controlled energy companies are making large-scale investments throughout the world. By doing so, the Beijing government is exhibiting little compunction about negotiating with regimes criticized by western governments. For example, China recently signed energy contracts worth billions of US dollars with Iran. Such Chinese-Iranian agreements not only subvert US efforts to impose economic sanctions on Iran, but also prove that Tehran has long ceased to depend on developed economies as its only trading partners. China and India represent genuine export alternatives for Iran as well as other Middle Eastern countries.

Unstable suppliers

Nevertheless, there is considerable potential for energy conflicts at a state or regional level. The situation in the oil- and gas-rich states of the Middle East or the former Soviet Union shows that resource wealth can hamper democratization processes and the evolution of a free society, as well as innovation and social reforms. The huge profits from trading in natural resources often disappear into the pockets of powerful elites. Besides this social injustice, which could potentially trigger domestic conflicts, many energy-rich states (such as Russia and Venezuela) use oil revenues to expand their security organizations and armed forces, which may disrupt regional balances of power.

The growing awareness that oil resources are limited has sparked fears in developed economies about delivery shortages. This situation will come to a head once oil production passes a point of maximum global production, a situation referred to as “peak oil”. Regardless of whether this situation will be reached in 15, 20, or 30 years, it is certain that production will eventually be unable to meet rising global demand – a demand largely driven in recent years by China. In 2005, China imported 45 per cent of its oil, but it is expected to import 82 per cent in 2030. By that time – and just to meet China’s needs alone – the world will require additional output equivalent to current extraction levels of Saudi Arabia.
Whether it is due to a lack of investment, as economists argue, or the depletion of resources, as geologists claim (or a combination of both), it is a fact that in some areas outside of OPEC and the former Soviet Union – such as the US and the North Sea – oil extraction has already peaked. Known global reserves are increasingly concentrated in the so-called “strategic crescent” stretching from the Middle East across the Caspian Sea to Western Siberia (Russia). Currently, some 70 per cent of conventional oil reserves and global gas are concentrated in this area – and that concentration will increase. It is true that concentration matters less if other fossil energy sources, such as non-conventional oil (for example, the tar sands of Canada) or coal (the biggest reserves of which are located in the US), are taken into account. However, while these sources will provide a welcome addition, they will not constitute a real alternative over the next 25–30 years.

Growing dependencies

In other words: The oil market will become tighter and dependency on the Middle East and Eurasia will increase. Since oil is the engine of industrialized economies and cannot be easily replaced – especially in the transportation sector, where in the US case it accounts for 97 per cent of consumption –, even very high oil prices will not allow a rapid shift to other resources. As a result, the degree to which the industrialized nations can diversify away from the Middle East and Eurasia is limited.

For many decades, the US and European consumer countries have worked with autocratic or authoritarian regimes. However, changing political conditions and perceptions make them feel uneasy about the notion of excessive dependency. Spurred by public fears of terrorism and rising dependency on Middle East oil, Senator John McCain warned of US reliance on foreign oil in a speech to the Center for Strategic and International Studies in Washington on 23 April 2007: “Al-Qaida must revel in the irony that America is effectively helping to fund both sides of the war they caused. As we sacrifice blood and treasure, some of our gas dollars flow to the fanatics who build the bombs, hatch the plots, and carry out attacks on our soldiers and citizens.”

One can easily see the flaws in this argument. Terrorist groups are also frequently the cause of domestic tension in supplier countries; moreover terrorists can operate effectively without large sums of Western petrodollars. Finally, petrodollars are not money “lost” to the Western consumer since part of it flows back into the global economy as investment. The bulk of the money, however, benefits the regional economy creating new jobs and investment opportunities – including for US and European companies.

However controversial McCain’s argument may be, what matters is the message that the US, and other major consumer economies, wish to become less dependent on energy from the Middle East. This is not only because oil money supports corrupt regimes (although interestingly, this argument alone does not carry particular weight, given that relations between the US/EU and such supplier states have existed for decades), but also because it feeds transnational terrorism and regional instability.

In Europe, it is the reference to the “energy weapon” – especially with regard to Russia – rather than the connection between terrorism and oil that can galvanize people to change their consumption habits. The risks stemming from Europe’s dependence on Russian gas were seen in January 2006, when Moscow suspended natural gas deliveries to Ukraine in
order to achieve higher prices. This action, which resulted in shortages of gas supplies in a number of European countries, caused concern in Western Europe and beyond. It was claimed in some quarters that the Kremlin’s real motive was to demonstrate that it could use the “energy weapon” against Europe if it wanted to.

Again, this is only one side of the story. From an economic point of view, Gazprom has no interest in cutting off gas supplies to Europe, which remains its most important market for gas exports outside the former Soviet Union – and a very lucrative one, too. Apart from instances where Russia used energy cuts in its price disputes with neighbouring states, the energy weapon as such is very rarely used. No major energy producer has used energy as a weapon directly against a developed economy since the OPEC nations stopped their oil supplies to the US in 1973. If the past shows anything, it is that petroleum has generally proven to be resilient to political upheavals; even after the 1979 revolution and its hard-line anti-Western rhetoric, Iran remained a reliable supplier of energy to the OECD members. The Soviet Union supplied energy to Western Europe even during the last frosty phase of the Cold War. Venezuela, despite its radical about-face from its previous US-centred foreign policy, remains one of the US’s key energy partners.

**Market interdependencies**

The problem is not dependency as such, but how we perceive it and how we cope with it. A realistic assessment of the West’s energy situation will help us to work towards a more economically sustainable and ecologically sound energy policy by developing renewables and increasing energy efficiency. This goal, however, should not primarily be used as an argument to diversify away from the Middle East and Russia. On the contrary, it is as important to foster interdependencies and mutual trust between oil and gas producers and consumers.

In this respect, author and energy expert Daniel Yergin’s definition of energy security as “the availability of sufficient supplies at affordable prices” needs to be extended to include the interests of producing countries as well. The higher the stakes for producing countries — ranging from production, transportation, and refining to distribution across the entire supply chain — the more stable the whole chain. In this respect, Gazprom’s acquisitions of European energy assets — a development often portrayed negatively in European media — facilitates mutual interdependencies. Western European states certainly should insist on reciprocity: If Russian energy companies are allowed into the EU energy market, then EU companies should be allowed to enter the Russian market. Ultimately however, the common goal should be to become more interdependent and thereby raise the stakes for both sides.

As wealth transfers from developed economies to the Middle East and other energy regions, it actually supports undesirable regimes. That remains a big dilemma, with no quick and easy solution. However instead of creating new threats (for short-term political purposes) that may alienate energy producers, Western governments should at least be honest about the real problems associated with their dependency.

Andreas Wenger is Professor of International and Swiss Security Policy and Director of the Center for Security Studies (CSS) as the Swiss Federal Institute of Technology (ETH Zurich). Dr. Jeronim Perovic is a senior researcher at the CSS.

Our energy future: An economic, geopolitical and risk perspective
Energy security, political risk and the insurance industry: Past and future

Rolf Tanner and Marco Lier, Swiss Re’s political risk experts, talk about the varieties of political risk and potential risk solutions facing the energy industry. Political risk insurance penetration is currently relatively low, but may grow with a concentration of energy supplies from politically fragile regions.

“Prediction is very difficult, especially about the future”, said Niels Bohr, the Danish physicist and Nobel Price winner. Bohr's statement reminds us that the countless projections regarding future energy demand should be treated with healthy scepticism. Past forecasts about future energy demand have proven notoriously imprecise. Yet, for all the uncertainty, one prediction is clear: Demand will rise. A second scenario is also highly likely: Traditional hydrocarbon sources such as oil, gas and coal will continue to constitute the bulk of additional supplies, at least in the next two decades.

Producing these supplies will require enormous investments (up to USD 20 trillion, according to the International Energy Agency), both to replace existing production and transportation facilities as well as to develop new ones. Such investments will need to be protected against a multiplicity of risks, offering enormous business opportunities for the insurance industry as a professional risk taker. Many of the energy-producing and refining assets are already insured in OECD countries. However insurance penetration for these assets remains relatively low in many emerging market countries, both because general insurance penetration is low; and because energy production is often part of the public sector, which rarely seeks private insurance protection. Energy is thus destined to be a growth focus for the international insurance industry. With growth, however, exposure to energy-related risks will also rise.

Energy issues have always been highly politicised. Political risk and energy policy are permanent companions. Yet political risk remains a vague term that bundles together very different events and trends. In this article, we shall take a close look at three sets of political risks relating to energy security, both from a general and from an insurance point of view: terrorism risk in the international oil and gas market; expropriation risk in the oil sector; and potential political risk associated with the future of nuclear energy.

Terrorism risk in the international oil and gas market

Oil and gas are produced and consumed in different geographies. This requires long transportation routes vulnerable to man-made disruption, including terrorist attacks. A large part of today’s global oil output travels through bottlenecks such as the Straits of Hormuz (21.2% of world oil demand) or the Straits of Malacca (15.8% of world oil demand). Moreover, proven oil and, to a lesser extent, proven gas reserves are concentrated in regions fraught with political conflict (Middle East, Africa, the Caspian basin, Latin America).

1 For a debate on the notion of political risk, see “Political risk and insurance: challenges and opportunities in a globalised world”. insights (Swiss Re), March 2007, pp. 5.

In 2002, al-Qaida attacked the French tanker Limburg off the coast of Yemen. One year later, al-Qaida-affiliated fighters began to launch a series of attacks on oil compounds and installations in Saudi Arabia. In Iraq, pipelines were blown up regularly. Financial markets react nervously whenever terrorism risks loom over the oil markets.

Yet physical interruptions or limitations of oil and gas supplies due to terrorist events have occurred only on a small scale to date. Thus far, terrorists appear to lack the military capabilities to really disrupt major supplies over the long term. Pipelines are exposed to attack; but can be relatively quickly shut down, and the damaged components easily replaced. Large-scale fixed installations (oil wells, loading terminals, gas liquefaction and re-gasification facilities, or refineries), on the other hand, are usually well protected. Moreover, such installations have built-in systemic redundancies that make it hard to inflict lasting damage. Many guerrillas and terrorists may also be intrinsically reluctant to attack oil installations. Unlike al-Qaida, which follows a global agenda and focuses on its confrontation with the US, local guerrilla and terrorist groups aim at taking power in their respective country of operation. They may thus hesitate before destroying assets that could benefit them once they are in power.

When looking back on armed internal conflicts in major oil-producing areas over the last two decades, it is striking how little these conflicts actually disrupted oil production and oil supply, both onshore as well as offshore.

<table>
<thead>
<tr>
<th>Country/Conflict</th>
<th>Fatalities</th>
<th>Oil production (b/d) at outset of conflict</th>
<th>Oil production (b/d) at end of conflict or figure today</th>
<th>Increase/decrease over conflict period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azerbaijan 1991–92</td>
<td>22 000</td>
<td>238 000</td>
<td>226 000</td>
<td>−5%</td>
</tr>
<tr>
<td>Angola 1992–2002</td>
<td>30 000</td>
<td>550 000</td>
<td>905 000</td>
<td>+64%</td>
</tr>
<tr>
<td>Algeria 1992–2005</td>
<td>200 000</td>
<td>1323 000</td>
<td>2015 000</td>
<td>+52%</td>
</tr>
<tr>
<td>Russia/Chechnya 1999–</td>
<td>18 000</td>
<td>30 000* (2003)</td>
<td>2015 000</td>
<td>+52%</td>
</tr>
<tr>
<td>Iraq 2003–</td>
<td>56 000</td>
<td>1339 000</td>
<td>1820 000</td>
<td>+36%</td>
</tr>
<tr>
<td>Sudan (Darfur) 2003–</td>
<td>200 000</td>
<td>255 000</td>
<td>379 000</td>
<td>+49%</td>
</tr>
</tbody>
</table>

* 0.6% of Russia’s total production. Chechnya mostly serves as an oil transit region.

Sources: IISS, Armed Conflict Database; BP Statistics

Though there have been spectacular attacks on shipping and oil installations, the relatively low number of such incidents has kept insurance losses minimal. This may change, though, as international energy companies re-entering the upstream sector in the Middle East and other oil producing countries purchase insurance for these commercial ventures. Equally, it can be expected that in future the national oil companies (NOC) which hold the vast majority of proven oil reserves will also buy more insurance in the international market for their operations. Last but not least, the number of oceanic tanker fleets is expected to triple by 2030 along with the increasing need to transport oil and liquefied gas. International insurance companies will underwrite many of these tankers at an average value per vessel of USD 150 million. Thus, while the risk of terrorism significantly disrupting the international oil and gas flow appears to be contained, terrorism may grow as a threat to insurers as they increase their penetration of oil producing areas.
Expropriation and confiscation risks in the international energy market

Resource nationalism has returned to centre stage, with confiscations and expropriations in the oil sectors of Latin America and Russia capturing media headlines. Confiscations are only the tip of the iceberg; many foreign energy companies have been forced to renegotiate their contracts with the governments of oil and gas producing countries in recent years. Tax regimes have been adapted as well, not only in emerging markets, but also in OECD countries. According to “The Economist”, changes in the British tax regime have actually cost the international oil industry more than the confiscations in Venezuela post 2001.  

Confiscation, expropriation and nationalisation of foreign corporate assets in emerging markets and developing countries are not new. It occurred most notoriously after decolonisation, when many of the newly independent countries adopted socialist-inspired policies and a wave of expropriations – often without any compensation – swept across Asia, Africa and Latin America. According to one estimate, there were 2,000 expropriations between the 1960s and the 1980s. Commodities were regarded by governments of newly independent countries as national property that could not be left in the hands of profit-seeking foreigners. Instead, the thinking went, such commodities should be brought to the ‘use and benefit of the people.’ This was particularly so with oil, regarded as a key strategic asset, as well as with other extractive industries, particularly mining.

Table 2: Recent confiscations in the oil and gas industry in emerging markets

<table>
<thead>
<tr>
<th>Country</th>
<th>Companies</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venezuela</td>
<td>Shell, BP, Chevron, Repsol YPF</td>
<td>Forced joint venture with PdVSA (Petróleos de Venezuela) as majority stakeholder</td>
</tr>
<tr>
<td></td>
<td>Total, ENI</td>
<td>Oil fields seized by government because companies refused to convert operations into joint ventures with PdVSA</td>
</tr>
<tr>
<td></td>
<td>Chevron, ExxonMobile</td>
<td>Forced increase of PdVSA’s share in joint ventures</td>
</tr>
<tr>
<td></td>
<td>Perenco, Teikoku Oil, Harvest Resources</td>
<td>Levied back taxes by government</td>
</tr>
<tr>
<td></td>
<td>ConocoPhillips</td>
<td>Left the country</td>
</tr>
<tr>
<td>Bolivia</td>
<td>Petrobras, Repsol YPF, BP, Total, British Gas</td>
<td>Occupied premises and forced negotiations with government on granting greater control to state gas company YPFB</td>
</tr>
<tr>
<td>Chad</td>
<td>Chevron, Petronas</td>
<td>Left country after having failed to pay back taxes</td>
</tr>
<tr>
<td>Russia</td>
<td>Shell, Mitsubishi, Mitsui</td>
<td>Gazprom received share in Sakhalin II project after government pressure</td>
</tr>
<tr>
<td></td>
<td>BP/TNK</td>
<td>Gazprom gained control over Kovykta gas field after BP/TNK licence was revoked</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Occidental, Petrobras</td>
<td>Government revoked licences after claiming that they were obtained illegally</td>
</tr>
</tbody>
</table>

Sources: Various media, situation as of August 2007

Yet the track record of public sector oil companies has been mixed at best in most countries. A reversal began to take root in the 1980s and 1990s, when oil prices were low and international investment was needed. Increasingly, previously nationalised oil and gas sectors were re-opened and foreigners were invited back to participate in, and fund, oil and gas operations, either directly or through joint ventures. When communism collapsed, the former Soviet Union was added to the landscape of newly privatised oil and gas companies, with some new private (or at least semi-private) and public energy giants, such as Gazprom or LukOil. Meanwhile international oil and gas companies gained access to promising production blocks in the Caspian basin, in Siberia and the Russian Far East. Now the pendulum has once again swung back as international oil companies are being expropriated in Ecuador, Venezuela, Bolivia and harassed in Russia.

The first wave of expropriations in the 1960s and 1970s led affected companies to claim insurance protection against these type of events. The existing government-affiliated export credit agencies (ECAs) could not offer satisfactory products. As an alternative, Lloyd's syndicates and a few composite multi-line insurance companies began to market expropriation risk covers. This gave birth to a new set of insurance products, offering protection against political risk events. Cover includes confiscation and expropriation, currency inconvertibility, contract frustration and political violence, among others, with expropriation and confiscation risks remaining the “classics”. In the 1990s, when governments no longer confiscated as openly as in the past, the focus shifted towards “creeping expropriation”. In these cases local emerging market authorities harassed international asset owners to the point where they abandoned their property or sold it below price to local competitors.

Loss statistics on confiscations and expropriations are difficult to obtain, as they are obfuscated by recoveries. In contrast to other insurance lines, recoveries are an integral part of the political risk underwriting market. For example expropriations may be reversed once a new government comes into power, or the former owner is fairly compensated retroactively, e.g. after arbitration or an international trade dispute settlement. Whether the current wave of confiscations seen in Latin America and Russia will lead to a spike in insurance losses remains to be seen. Underwriters insist that they have been extremely conservative in recent times when it comes to medium- to long-term risks in the oil and gas sector.

The political risk insurance market has remained a niche market compared to the overall insurance market. Foreign direct investment in emerging markets has skyrocketed since the early 1990s, whilst the share covered by public or private political risk insurance has remained small. In fact, the share of trade and investment transactions covered by political risk insurance was even declining until 2000, when it reached its nadir, but has since picked up again. Many private investors and manufacturers still regard insurance as unnecessary or simply too expensive. It remains to be seen whether demand for political risk insurance will grow once international companies return to the Middle East and other areas with oil and gas reserves.

5 Some ECAs began to expand their product range in the 1970s and 1980s to cover some types of expropriation risks. Other countries that did not have an ECA before the 1970s now established such agencies.

The potential for political risks with nuclear energy

The political risks connected to nuclear energy are different altogether. Only time will tell whether these potential risks will ever materialise into real ones. For the insurance industry this means that it is still totally unclear whether the nuclear issue will bring financial and reputational losses, or a combination of the two.

Concern over the proliferation of nuclear weapons has arguably become the most important issue in international politics. This is partly due to fears of nuclear terrorism after 9/11. Moreover, in the unipolar world of today regimes opposed to the US see nuclear weapons as their best defence against alleged American regime change plans. Since 1998, the number of openly known nuclear weapon powers has increased from six to nine, after staying flat for 25 years.

Civilian nuclear power is meanwhile making a strong comeback. The accidents of Three Mile Island (1979) and particularly of Chernobyl (1986) all but halted the development of nuclear power in the OECD countries. Nuclear power, however, is now back on the agenda, being discussed as a future option to contain CO₂ emissions. Moreover, existing nuclear power plants in Western Europe and North America have reached the second half of their lifespan and need to be replaced soon. Yet, even under a scenario of forced expansion, the overall share of nuclear power will remain limited (and significantly below that of coal and gas when it comes to the generation of electricity).

Figure 1: Nuclear Power Capacity 2006

<table>
<thead>
<tr>
<th>1000 Mwh</th>
<th>Europe</th>
<th>North America</th>
<th>South America</th>
<th>Asia</th>
<th>Africa &amp; Middle East</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>100</td>
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<tr>
<td>150</td>
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<tr>
<td>200</td>
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<td>250</td>
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<tr>
<td>300</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: SIPRI Year Book 2006, p. 690
“Operating” = Reactor connected to grid; “Under construction” = First concrete for reactor poured, or major refurbishment under way, “Planned” = Approvals and funding in place, or construction well advanced but suspended indefinitely; “Proposed” = Clear intention but still without funding and/or approvals.
The revival of nuclear power is likely to revitalise the dormant, but still polarised political debate about its safety and the related problem of long-term waste storage. Anti-nuclear activists flatly dismiss climate change as a justification to promote nuclear energy. Moreover, they argue that nuclear power – whether for civilian or military use – increases the danger of nuclear terrorism.

In energy-hungry emerging markets, debates about the civilian nuclear option are still largely absent. This situation may change; nuclear power has in the past served to galvanise grass roots political movements. Political feeling towards the considerable ecological problems of some emerging markets could be catalysed by the nuclear issue.

The insurance industry has a long history of underwriting nuclear risks through pools or other public-private partnerships. New nuclear power plants may offer new business opportunities. Yet controversies around nuclear power could eventually embroil the insurance industry – even against its will – in a debate about the true external cost of nuclear energy. Anti-nuclear activists like to argue that the nuclear industry is heavily subsidised as it does not have to pay the correct insurance premiums to cover potential losses from severe accidents. Such a scenario seems unlikely, but it cannot completely be ruled out.

**Conclusion**

New developments in the energy security landscape offer both opportunities and threats to the insurance industry. Demand for insurance protection in traditional and non-traditional forms will increase. Equally, as energy security and energy markets are highly politicised, the insurance industry will also be confronted with more political issues and risks. As experience and actuarial data on political risk insurance and terrorism insurance are scarce compared to other lines of business, mispricing risks may remain. The insurance industry may have to become more politically active itself and make its voice heard on these energy-related issues. This could be in areas such as insurance legislation or establishing new market mechanisms and public-private partnerships to manage certain types of political risks in the energy sector.

Dr. Rolf Tanner is the Head of Political & Sustainability Risk Management, and Marco Lier is a Political Risk Adviser, both working at Swiss Re.
Investment challenges
Energy security and critical energy infrastructure protection: A lack of scrutiny

Wolfgang Kröger from the Swiss Federal Institute of Technology (ETH Zurich) highlights the crucial strategic importance of electricity supplies, and the level of investment required both to encourage diversification of electricity supplies, and to ensure reliable power distribution.

Energy security is now a key international issue...

...with the supply chain offering multifaceted challenges.

Energy security is gaining in importance as a key factor in maintaining economic growth, national welfare and global stability. This concerns both energy supply and infrastructure. Having been high on national and international agendas for a long time, it is now also a key factor in corporate decision making, when taking socio-political, environmental (carbon dioxide (CO₂) emissions) and technological constraints into account.

However the debate has been hobbled by narrow national or business interests, which have lacked realism and an honest cost appraisal. A considerable amount of uncertainty is involved, which underlines the need for a comprehensive international approach. This should include all major stakeholders – politics, business, consumers, interest groups and academia – in tackling the multifaceted challenges and vulnerabilities which encompass the whole energy supply chain, thereby increasing the level of protection. Those key elements of the supply chain include the provision of resources/fuels; transportation of resources/fuels from producer to consumer states, either land- or sea-based; and the infrastructure to ensure energy distribution (such as electricity) in consuming states.

Energy needs and supply options

Global energy demand is rising...

...whilst supplies are becoming more concentrated...

Despite savings and efficiency measures, energy demand is expected to rise continuously worldwide. The IEA World Energy Outlook foresees total world energy consumption in 2030 to be almost 60% higher than it was in 2002.¹ This is expected to be mainly fossil fuel based, with oil and gas accounting for around one third each of the increase. The share of fossil fuels in the energy mix will remain unchanged or slightly increase to almost 80%. The dependence on imports of major consuming countries is expected to continue to grow, with, for example, import requirements for the EU’s 25 members rising from around half today to 65% in 2030.²

The huge geographical distance between energy producing and consuming countries, particularly regarding oil and natural gas, needs to be bridged by land-based or maritime transport infrastructure. Around 60% of global energy deliverables are transported by ship and 40% by pipeline. Vast quantities of oil must pass through choke points. By 2030, for example, as much as 28% of the world’s oil and 4% of gas supply could flow through the Straits of Hormuz (see Figure 1): “Temporary blockage or destruction of land-based port facilities would have a catastrophic impact on global energy markets”.³

Liquified natural gas (LNG) is important because it allows producers to access new and distant markets. For consuming economies, in particular the US, it is an instrument of diversification of primary energy. “Terrorism is a particularly important concern to the global LNG industry. One single incident where a super-tanker, hijacked by a group of terrorists, were rammed into a port facility would set this industry back not unlike the impact that Chernobyl or Three Mile Island had on the global nuclear industry”.  

Pipelines are large, cumbersome, and often exposed to natural hazards, such as earthquakes or extreme weather conditions, and are subject to human intervention. Some operate at or near full capacity and are poorly maintained. In Europe these systems are often stand-alone, independent, and disconnected from any major grid.

The technological quantum leap required to significantly decarbonise or diversify our energy supply systems will not be commercially available on a large-scale within the next 10 to 15 years. CO₂ regulations, which will grow more stringent in the future, will have to be mastered by evolutionary developments in today’s technology.

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4 Figure reproduced from original source.
6 Predicted to increase in frequency and severity due to effects of global climate change.
Continuous growth in energy demand, in particular electricity, and replacement of production facilities within the next 10–15 years will lead to new installed capacities of 95–125 GW per year, or about two large plants over the period per week worldwide.

Huge investments are needed, totalling about USD 20.2 trillion (in USD 2005) or around USD 800 billion a year, in the energy-supply infrastructure worldwide through 2030 (see Table 1). The electricity sector alone will need to spend almost USD 11.5 trillion, with 51% of the investment to replace existing capacity. Almost half of the total energy investment will take place in developing countries; EUR 900 billion is expected to be the necessary investment requirement in EU-27 over the next 25 years for electricity generation alone.7

| Table 1: Investments in the energy-supply infrastructure needed by 2030 |
|-------------------------------------------------|------------------|-------------|------------------|
| in USD trillion                               | in % (overall)   | in % (as of category) |
| Oil                                           | 4.3              | 21           | 73               |
| Exploration and development                    | 3.1              |              | 73               |
| Refining                                      | 0.8              |              | 18               |
| Other                                         | 0.4              |              | 9                |
| Gas                                           | 3.9              | 19           |                  |
| Exploration and development                    | 2.2              |              | 56               |
| LNG Chain                                     | 0.3              |              | 7                |
| Transmission and distribution                  | 1.4              |              | 37               |
| Coal                                          | 0.6              | 3            |                  |
| Mining                                        | 0.5              |              | 89               |
| Shipping and Ports                            | 0.1              |              | 11               |
| Electricity                                   | 11.3             | 56           |                  |
| Power generation                              | 5.2              |              | 46               |
| Shipping and Ports                            | 6.1              |              | 54               |
| Sum                                           | 20.2             | 100          |                  |


Energy supply infrastructure in industrialized countries

Assuming that primary energy resources are available to consuming countries, technical facilities are necessary for treatment, storage and transportation; to convert primary energy into its final form, such as electricity; and where appropriate, to transport it over longer distances and distribute it locally. For electric power supply a complex system of generators using different technologies, transformers, switching yards and control stations, high voltage transmission lines and local distribution networks are required. These systems must be tightly integrated; and are mostly operated, managed, and controlled by digitalized systems.

Electricity is perceived as common good; interruption of service may cause inconveniences or even harm to society and the economy. Therefore the electric power supply system is one of the most critical infrastructures.

For Europe the stability of operation of the Union for the Co-ordination of Transmission of Electricity (UCTE) grid is essential. This synchronized network came into being through the integration of smaller national systems into a larger continental system serving 450 million people and providing 2400 TWh/a, out of which about 10% is exchanged cross-border. It is subdivided into control blocks; very often large discrepancies can be realized between contractually agreed exchange programs and physical flows (see Figure 2).

Figure 2: Schematic view of the UCTE grid, control blocks, and electricity flows on 04.11.2006, 10.09 p.m. – exchange programs (black) and physical flows (blue)

This system now appears to be at risk; it has been developed over the last 50 years and is currently being operated beyond its original design parameters, mainly due to market liberalization and related side-effects, such as reduced reserves and redundancies due to economic pressure. Intermittent electricity generators such as wind power units will have to be integrated into the network.

Recent major blackouts highlight the question of whether the high degree of reliability experienced in the past can be maintained without significant changes in technology and policy (see Table 2).

An analysis of interruption data shows that cascading failures in the North American electricity grid have been more common than one might expect. Forty-six of the events between 1984 and 2000, or nearly three per year, involved losses of over 1000 MW. The probability of smaller power losses follows an exponential curve, while the probability for losses over 500 MW follows a pattern (“power law”) typical for self-organized systems. European investigations tend to support this alarming result.

### Table 2: Recent major blackouts of electric power supply systems

<table>
<thead>
<tr>
<th>Blackout</th>
<th>Loss of load [GW]</th>
<th>Duration [h]</th>
<th>People affected</th>
<th>Main causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 14, 2003 Great Lakes, NY</td>
<td>~ 60</td>
<td>~ 16</td>
<td>50 mio</td>
<td>Inadequate right-of-way maintenance, EMS failure, poor coordination among neighboring TSOs</td>
</tr>
<tr>
<td>Aug. 28, 2003 London</td>
<td>0,72</td>
<td>1</td>
<td>500000</td>
<td>Incorrect line protection device setting</td>
</tr>
<tr>
<td>Sept. 23, 2003 Denmark/Sweden</td>
<td>6,4</td>
<td>~ 7</td>
<td>4,2 mio</td>
<td>Two independent component failures (not covered by N-1 rule)</td>
</tr>
<tr>
<td>Sept. 28, 2003 Italy</td>
<td>~ 30</td>
<td>up to 18</td>
<td>56 mio</td>
<td>High load flow CH–IT, line flashovers, poor coordination among neighboring TSOs</td>
</tr>
<tr>
<td>July 12, 2004 Athens</td>
<td>~ 9</td>
<td>~ 3</td>
<td>5 mio</td>
<td>Voltage collapse</td>
</tr>
<tr>
<td>May 25, 2005 Moscow</td>
<td>2,5</td>
<td>~ 4</td>
<td>4 mio</td>
<td>Transformer fire, high demand leading to overload conditions</td>
</tr>
<tr>
<td>June 22, 2005 Switzerland (railway supply)</td>
<td>0,2</td>
<td>~ 3</td>
<td>200000 passengers</td>
<td>Non-fulfillment of the N-1 rule, wrong documentation of line protection settings, inadequate alarm processing</td>
</tr>
<tr>
<td>Aug. 14, 2006 Tokyo</td>
<td>~ 2</td>
<td>~ 5</td>
<td>0,8 mio</td>
<td>Damage of a main line due construction work</td>
</tr>
<tr>
<td>Nov. 4, 2006 Western Europe (UCTE)</td>
<td>~ 14</td>
<td>~ 2</td>
<td>15 mio households</td>
<td>High load flow DE–NL, violation of the N-1 rule, poor inter TSO-coordination</td>
</tr>
</tbody>
</table>


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Obviously our electrical supply system with long transmission distances is overburdened and minor events, such as ‘flashover’ resulting from inadequate tree cutting programmes, may cascade into massive failure. Malfunction of critical equipment and the reaction of protective systems has complicated matters, while system automation proved insufficient.

Case studies show cyber attacks are also critical to energy security. For example, in 1982, software developed by the CIA and transferred to the Soviet Union caused malfunctions and reset pump speeds and valve settings in a pipeline, resulting in an enormous explosion, equivalent to 3,000 tons of TNT (this was comparable to the 14–20 kilotons produced by the U.S. bomb dropped on Hiroshima near the close of the Second World War).  

Options to enhance infrastructure protection and energy security

The options to enhance energy production and security are numerous, including:
- Technological developments to increase efficiency and reduce dependence on imports (cleaner coal, affordable renewables, innovative fuels, etc.)
- Diversifying primary energy resource utilization (by notice or under constraints of sustainability), properly integrating new technologies (wind, etc.)
- Building strategic reserves  
- Facing challenges of disruption of supply/services
- Ensuring necessary investments in all parts of the energy sector
- Creating sufficient redundancies in systems, increasing interconnectedness of grids/pipeline networks where appropriate
- Making security of energy supply and high degree of reliability of related infrastructures an overarching (political) principle
- Building new producer-customer-partnerships and defining responsibilities
- Making systems less vulnerable/more robust/better protected based on improved analytical (modelling) capabilities

The safe and continuous operation of infrastructure is one essential part of energy security. Full understanding of these systems and modelling and simulation capabilities are prerequisites to analyze risks and vulnerabilities and to develop new strategies to reduce them.

Wolfgang Kröger is Professor of Safety Technology and Director of the Laboratory for Safety Analysis at the Swiss Federal Institute of Technology (ETH Zurich). He is also the Founding Rector of the International Risk Governance Council.


12 Strategic reserves peaked in 1980 at around 150 days, since then have fallen steadily.
How the private and public sector can contribute to energy security: Five fundamentals for a new producer-consumer framework

Jan H. Kalicki, co-editor of “Energy & Security: Toward a New Foreign Policy”, discusses how the global economy will remain dependent on fossil fuels into coming decades; but through a combination of investments by the major oil companies, forward thinking government policies, and a fostering of interdependence amongst suppliers and consumers, the risks associated with this dependence can be reduced.

Mr. Kalicki, numerous programmes are being developed and implemented to reduce our dependency on fossil resources. What is your opinion: how much will the future energy mix differ from what it is today? We need to be realistic: at least until mid-century the world will continue to depend on fossil fuels for most of its energy. During our own lifetimes over 80 percent of the world’s energy supplies will come from oil, gas and coal. Natural gas is the cleanest of the fossil fuels, but they all require greater progress in carbon sequestration. Beyond these primary sources, other energy will come from nuclear, geothermal, hydro, biomass, solar, wind and ultimately other sources such as hydrogen. It is important to promote all of these in an environmentally responsible way, as it is equally important to promote energy efficiency and conservation.

The conference “Global perspectives on energy security” also discussed cooperation as a resource for energy security. What opportunities for cooperation do you see? The EU, the US and other countries have key opportunities to cooperate regionally as well as globally. We can do this through upstream and downstream development. We can make energy security a priority in our trans-Atlantic dialogue. We can work more closely with the rapidly developing nations of Asia, particularly India and China – the latter is beginning to lead the way in vehicle fuel standards. And as members of the International Energy Agency (IEA), we can build our strategic reserves and work to globalize the IEA and its cooperative mechanisms for responding to supply disruptions.

When people in the western hemisphere talk about energy security, they sooner or later express their fear about disruptions in the major supply countries. What do you think of those fears? On the one hand it's remarkable to what extent we have succeeded in maintaining reliable energy supplies. On the other hand that's no reason for complacency, because threats to these supplies continue to face us around the world. Energy markets have faced numerous challenges in recent years, and a tight demand/supply market is particularly vulnerable to political confrontation and conflicts. The growing tendency of some countries to use energy for coercive purposes is causing particular concern and danger. Moreover, as we saw with Hurricanes Katrina, Rita and Wilma in 2005, natural disasters can have devastating impacts not only on the energy industry, but also on the social and economic development of the communities in which they occur – including the poorest amongst us.

How can we better develop the resources we currently have – and how do high oil prices and the Middle East figure in this picture? As oil prices have crossed successive thresholds, it has become more and more clear that we are facing a new energy equation. In all our strategies, we need to focus on initiatives which will increase future energy supply and use energy more wisely and efficiently.
Oil and gas demand are high and growing, so much so that the world consumes twice as much oil as is currently being discovered. Moreover, well over half of those finds will come from the Middle East for a simple geologic reason: that is where most of the resources are. For the past quarter century, the Middle East has actually provided a reliable supply of oil and gas to global markets. Saudi Arabia has steadily provided over 8.5 million barrels of oil per day – in fact, the Kingdom produced over 10 million barrels per day during supply disruptions in recent years – and its policy of maintaining over 1.5 million barrels of spare capacity has established it firmly as the “central banker” of oil. Now the Kingdom is undertaking a major investment program to increase that supply to 12.5 million barrels per day. Similarly, Qatar is a major gas supplier to the world – exporting over 20 million tons per year, a number that is expected to rise to over 60 million tons annually by the end of this decade.

But we also need to develop new resources...
Without a doubt – as we maximize current energy resources, we must also do much more to develop the next generation: from clean coal to wind, from ethanol to hydrogen – these are all big commitments for industry and governments around the world.

You have been advising Chevron Corporation as its Counsellor for International Strategy. What do you think the private sector can contribute in order to strengthen energy security?

International energy companies are making significant investments which will help respond effectively to the tight global energy market. For example, Chevron is developing new gas fields offshore from Australia and Bangladesh. It is also developing new oil fields in West Africa – notably Angola and Nigeria –, the Caspian, in Kazakhstan as well as Azerbaijan. Chevron and other companies are also bringing vast new, non-conventional resources online – notably the oil sands of Canada and the heavy oils of Venezuela – and creating new energy pipelines, from the West African Gas Pipeline to the CPC oil pipeline from Kazakhstan across Russia to the Black Sea. In addition to production and transportation, we must also do much more to increase refinery capacity, which is currently almost entirely accounted for by growing demand worldwide. Chevron is expanding refinery capacity in the US and investing in new refineries abroad, for example in Korea and India. Another of our major partners, Saudi Arabia, deserves great credit for its refinery investment initiatives, as does China. In the US, much more can be done to increase access to energy resources from the offshore continental shelf. The US government needs to reduce the regulatory requirements which have prevented a single new refinery from being built for the last 30 years – and which has even slowed down the expansion of existing refineries.

What kind of support should the regulator give?
If governments can shift their own priorities, I believe industry can and will do more. Major energy companies do not need subsidies or other incentives – what they need is a moratorium on the disincentives to increase capacity and production. Such disincentives range from access limitations and new source reviews to calls in the US to alter accounting methods and repeal foreign tax credits. Allowing market signals to prevail will do more than a raft of well-intended but counterproductive regulations getting in the way of developing energy resources.
What opportunities do you see for the public and private sector to work together? Could you give some regional examples?

Let me start with the example of California. Under AB 32 – the California Global Warming Solutions Act – the state seeks to restore 1990 Greenhouse Gas levels by 2020. All the implementation issues lie ahead, and it will be essential to work with the Governor, the legislature and the California Air Resources Board to ensure that the system is phased, flexible, and does not jeopardize investment or jobs in the state. Starting well before this legislation, Chevron and California have been working to generate fuels with radically higher ethanol content; and Chevron has launched with the US Department of Energy a demonstration project for hydrogen-based vehicles.

The common denominator here is transportation, which is key to future demand. In the face of high gasoline prices, consumers are pressing for higher fuel efficiency, and industry is responding through hybrid cars and cleaner, more efficient fuels, not just in the US and Europe, but in China and Japan. However, we must widen the spectrum of energy efficiency to include buildings, industrial facilities, and other large energy users.

What could be done on a more global level?
As we pursue global energy security, the key must be energy interdependence – not energy independence. Energy consumers and producers, government and industry, national and international oil companies, should work together in partnership to achieve the energy security goal: reliable, affordable supplies for future growth and well-being. I believe we should adopt a new producer-consumer framework – based on the fact that the security of supply is so important to consumers and the security of demand is so important to producers.

What do you see as the main elements of such a global framework for energy security?
I think a global energy security framework should be defined through five fundamentals. First, open markets. We should promote transparency and the free flow of energy trade and investment on a level playing field. By removing market barriers, we could increase production significantly and moderate the price volatility we face today. Transparency – from reserves and supply/demand data and forecasts to cash flows – will promote market-based developments. An excellent example is the Extractive Industries Transparency Initiative (EITI) which should be implemented by both private and public sectors globally.

Second, sound policies to promote stable and predictable fiscal and regulatory regimes, contract sanctity and the rule of law. The better established these are, the greater the investment, development, and security of energy for all countries. It is exactly these policies that are under assault in a new wave of petro-politics from the Orinoco to Sakhalin – but in all honesty they are also facing difficult times in some of our own legislatures.

Third, robust technology to conserve and optimize the resources we have now, to develop a full range of new energy sources, and to continue mitigating environmental impacts – all embedded in an effective energy security action plan. In the public sector, this entails replacing an approach driven by special interests with one propelled by the most cost-effective opportunities identified by the marketplace.
Fourth, broader energy efficiency – in effect, the biggest and cheapest form of new energy we have at our disposal. Efficiency deserves a concerted drive by all of us – starting with recognition that transportation is key to future demand. Consumers are pressing for higher fuel efficiency, industry is responding, and governments should recognize and reinforce these signals from the marketplace.

Fifth is the need for responsible development. We should see energy – both its production and its use – as a platform for broader economic growth and social well-being, in an environmentally sound fashion. This should apply everywhere – in developing, transitional and developed countries. We need to make sure that the economic benefits of energy reach all stakeholders – including the poor and the vulnerable. Only a proactive national and international leadership that is fully supported by industry can achieve this.

This new producer-consumer framework would entail energy security based on interdependence. We must expect the industry to demonstrate accountable leadership – but we must also expect it of policy-makers and society.

**What do you think are the prospects for adopting this framework?**

I think the prospects are good – provided producers and consumers can join together on a concerted basis. We can build on some encouraging steps by the G-8 as well as in the EU and the US over the past year. Ultimately this requires responsible leadership by government and industry alike. Leadership for energy security must be rooted in realism and action, not just politically attractive – yet ultimately empty – catchphrases. We need to work hard to make the energy market less volatile and reach a more positive balance based on growth and development. Finally, leadership should be rooted in partnership, not nationalism or isolation. Narrow, parochial concepts of energy security have failed us over the last 30 years, and it is now time to shift the debate.

That is the opportunity for Europe, the US, and the world of energy producers and consumers – that is, the world of all of us. I believe we are up to the challenge if we get our own houses in order and demonstrate our shared capacity for global leadership.

Jan Kalicki is co-editor of “Energy & Security: Toward a New Foreign Policy Strategy.” He is a Senior Scholar at the Woodrow Wilson International Center for Scholars in Washington, DC, a former Counsellor to the US Department of Commerce and Counsellor for International Strategy at Chevron Corporation.
Innovative technologies and alternative energy sources: Regulation by price is too slow

Ulrich Suter from the Swiss Federal Institute of Technology (ETH Zurich) suggests that politicians and scientists need to engage in a more intensive dialogue in order to accurately develop the most promising future energy sources. Key to any successful energy policy will also be the more efficient use of energy; potential efficiency gains are such, believes Professor Suter, that future economic growth need not necessarily lead to higher energy use.

Professor Suter, you have suggested that energy planning suffers from ‘tunnel vision’. What do you mean by that?
Tunnel vision refers to the perceived correlation between energy demand and GDP growth. With each percentage-point increase in GDP, primary energy demand is expected to rise by half a percentage point.

I have described this as tunnel vision because this model does not account for the fact that behavioural changes may dramatically alter energy demand. All the predictions I have seen in recent years are based on this correlation. But there is no solid rationale behind it! It is absolutely feasible that an increase in national GDP may actually result in people consuming less primary energy.

So it is possible to decouple GDP growth from energy consumption?
Absolutely. We could cut our primary energy demand in half without substantially changing our lifestyles. There are a number of measures we can take, such as switching lighting technology or building materials or the way we drive cars. We could not implement all these measures tomorrow but maybe over a 20-year horizon. We could increase our GDP by 20% and actually reduce our energy consumption by 30, 40 or even 50% without changing our lifestyle too much. The above-mentioned correlation has led to what scientists call an error of the second kind: You observe a correlation and you deduce a cause/effect relationship. But my point is that there is no cause/effect relationship here, it is simply a correlation. However, the majority of forecasts I have seen base their energy predictions upon it, right up until 2050!

You talk about cutting energy demand by half. Is that a feasible goal? And what role would alternative energy sources play in overall energy policies?
Alternative energies must be developed whatever happens as sooner or later fossil-fuel-based power plants, whether they are oil, gas or coal-fired, will no longer offer reasonably priced power. Oil will sooner or later become a scarce commodity. Gas can take over for a while. But in the long run we need alternative energies. Coal will be around for a while longer but it requires technological large investments to allow it to be ecologically feasible.

In the long run, alternative energies, and especially renewable energies, are the most rational way forward. Not only should we consume less, but in coming decades we should be able to substitute non-renewable energies. Within 50 years a substantial percentage of our energy use should be from renewables; and within 100 years the bulk of our energy should come from renewable sources.
What I found very interesting with regard to substitution – and the path from non-renewables to renewables – is the energy triangle model. Can you explain it further?

The triangle model comes from the 1998 Joint Report of the World Energy Council and the International Institute for Applied Systems Analysis. From a starting point in 1850 we consumed 80% of our energy in the form of renewables, largely water, with a little biomass in the form of wood, and 20% in the form of coal.

As energy demand grew, people simply used more coal. Later on, oil and gas entered the picture. By around 1920, all additional energy use stemmed entirely from oil and gas, at first mostly oil. In 1970, nuclear energy started to appear.

Now we must ask ourselves what options we have going forward. There are five different scenarios. They range from extreme energy conservation and an emphasis on renewable energy to “business as usual” models. It is important to keep in mind that whatever path we choose, it will take a long time to change our primary energy mix. This is because so much infrastructure is already in place (which cannot be changed overnight) and because demand for energy will continue to increase dramatically in developing nations. That is why conservation is an equally important part of any strategy.

**Figure 1: Energy triangle**

If we talk about renewables and nuclear energy today, we must also talk about the potential of known resources versus projections of future developments. The ETH does a lot of work on future alternative sources that are still at an early stage of research. What kind of projections can you make about future developments?

In the long run, real solar energy will become a very important renewable source. By real solar energy I don’t mean the photovoltaic solar cells most people are familiar with, although these can be important; I am referring to the less broadly-known approach of harnessing solar radiation through thermal and chemical processes. If society is sufficiently focused, in 100 years we could probably generate most electric energy from solar sources and hydropower (largely already in use). However, it would take a long time to build up that capacity.

Biomass energy is also of significance. Brazil is currently leading the way in this much discussed area. US biomass production is less effective as they use less energy-efficient crops. Energy-wise corn is several times less efficient than the chaff from sugar cane, as well as competing with foodstuffs for agricultural land. In Germany there are programmes to use different types of biomass, including grain. You thresh the grain to produce flour. But instead of disposing of the chaff, the leftover husks are fermented into ethanol.

Despite some potential, we must remember that we cannot simply build up biomass production to replace oil within a few decades. We do not want to create a situation, as in parts of Brazil, where rain forests are burned to generate biomass while producing tremendous amounts of carbon dioxide. In 30 years time you may be left with infertile soil and a situation that is barely better than merely pumping oil out of the ground.

Ultimately we must have good regulations in place. Price is a very good regulator but not the only one. Price regulation alone tends to be slow, often too slow for politicians, who tend to make the picture even more complicated.

I agree that regulation may lead to market distortions, but so can subsidies. In Switzerland, we had a situation typical of many developed economies where the thermal use of solar energy attracted few subsidies, whilst photovoltaic solar cell technology was heavily subsidized. The result is that we now have many photovoltaic applications that are able to compete, or come close to competing with commercial electricity. Solar thermal and solar chemical approaches, meanwhile, have had a harder time competing. Now, fortunately, that has changed and solar heat is booming.

Is the dialogue between science and politics good enough to steer us in the right direction? The dialogue between the two is clearly insufficient, not just in the area of energy. I do not want to blame either side. All I can say is that it is difficult to talk to politicians about things that will matter in 10, 20 or 30 years, and a similar situation exists with some CEOs. Their reward cycle is shorter; we cannot expect them to necessarily take decisions that are good for all of us several decades down the line but bad for them now.
That said, which of the companies offering alternative energy solutions do you expect to succeed? For example, how do you expect photovoltaic companies to fare in the long run?

If you have a house in Zurich, photovoltaics do not make sense because of the infrastructure in place. High-density living is very sustainable to begin with, and you are easily connected to a general power grid, which can be fed very efficiently. Photovoltaics are however very useful for an isolated dwelling. Likewise, photovoltaics are smart to use, for example, for an emergency motorway telephone. But they are not particularly suitable for densely inhabited areas. I think photovoltaics are a good niche technology.

Photovoltaics are therefore not the solution for everything; and there are open questions about other alternative energy technologies. Wind may be the weakest source of them all. Wind turbines come at a considerable social cost for the beauty of the landscape; although in Germany they have solved this by building their largest wind farms just over the sea horizon. Moreover it takes a wind farm of 200 turbines to create the equivalent energy output of a regular power plant.

And wind energy has strong peaks, whilst storage is not that good. Exactly. If the wind is too weak, it does not generate any power at all, but if the wind is too strong, it also does not make any power. There will be some further growth in wind technology, but the future is biomass and real solar energy in terms of renewables.

In terms of the overall energy picture I believe that nuclear fission is also a sensible alternative for the next 50 years; after that we may not have enough nuclear fuel left.

But fission is a problem for some parts of the population. It is an emotional issue. Part of the problem has to do with storage of the spent fuel and other radioactive waste. The Finns seem to have found one solution; they put their nuclear waste in a big tunnel from which the radioactive material can be relatively easily transported, if necessary, and moved to a more suitable location.

But do we have enough uranium? Not forever, but at least for the next 50 years. Nuclear fission is a very reasonable thing to do and the reactors have become supposedly much safer. The experts I have talked to on the subject all confirm this. Moreover the advantage of near-zero green-house-gas emissions is attractive.

Energy efficiency takes a central role in the ETH vision of a 2000-Watt society. Could you give us a few examples of energy efficient products and solutions that have been discussed or developed at ETH? Efficient combustion engines for automotives have been a research topic at the ETH for a long time. In the early 1990s, the ETH developed a hybrid car in collaboration with Volkswagen. The programme was later stopped, as the market was not quite ready. At the moment the ETH holds the record in energy efficiency in moving a human being at the speed of 60 kilometres per hour with a hydrogen powered vehicle that consumes the equivalent of one litre of gasoline per 5,385 kilometres. This is a very important research field for us and one where we can contribute significantly.
Another ‘hot’ topic is so-called low temperature heat. Several people in our Departments of Architecture and Civil Engineering create buildings or clusters of buildings to reduce, for instance, wind cooling and wind drag between them. This can reduce heating requirements by 10%–20%. The programme also includes exchanging heat for fresh and used air, better insulation or using windows with a fitted metal layer to prevent infra-red radiation entering or leaving the room, making heating and cooling easier.

The new Eawag/Empa building 1 in Duebendorf, Switzerland, is a fascinating example. Right, it is a near-zero energy building. The amazing thing is that you do not notice it when you are in there. So much can be done without changing our lifestyle, comfort or quality of life.

We must become more ascetic if we want to reduce our carbon footprint. How can businesses and societies survive and still earn money in such a world? This is an important but difficult undertaking. There are some models for this; asceticism must be made attractive. I believe that it is possible to reduce the grey energy (the energy used to create a product) consumed and increase the energy efficiency of the consumer with products that cost more because they deliver more function in a much smaller, elegant, largely virtualized product. Marketing is a very powerful tool, take only the transformation of watches through the last decades as an example. Simplicity and austerity could be selling. We need to change the reasons why we buy something.

Your examples describe our western society, a very mature economy where status symbols and prestige actually play a significant role. What about all the other societies that still need to and want to grow and which feel that this new ascetism would cripple them? I truly hope that one can move our and their goals into another direction. An important remnant of the era of colonisation – where we could still have an impact – is in music and films. If we changed our goals and desires as consumers, maybe we could still impact world behaviour through our cultural products. It is not impossible.

Ulrich W. Suter is Professor of Polymer Materials at the Department of Materials of the Swiss Federal Institute of Technology Zurich (ETH). He is also a member of the Swiss Re Advisory Panel.

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1 Eawag and Empa are both ETH institutions. Eawag is the Swiss Federal Institute of Aquatic Science and Technology and Empa is a research institute in material sciences.
Supply uncertainties were reported at the top of the agenda of energy industry CEOs in one of the recent surveys of the World Economic Forum (see Figure 2 at the end of this article). These uncertainties include political tensions in the Middle East and elsewhere, through to concerns about an ageing energy infrastructure, as Christoph W. Frel from the Swiss Federal Technical Institute of Lausanne, explains. Global warming has been coupled as a policy concern alongside the supply of energy, particularly in terms of carbon emission legislation. A combination of global warming and energy supply challenges has lead to debate on alternative energy sources: The carbon sequestration of coal; other non-renewable sources, such as gas and nuclear; and renewables, such as solar, wind and biomass. Finally there is the less reported factor of sufficiently qualified personnel to roll out either infrastructure replacements or new technologies.

The politics of energy security

Some prominent oilmen insist that the USD 60–80 per barrel price merely shows oil history is repeating itself. The high oil prices of the last four years have many parallels with the 1973–74 oil shock. Whilst the Watergate scandal kept the US government occupied, Saudi Arabia’s King Faisal used the “oil weapon” to support the Arab side in the Yom Kippur war. In the resulting high price environment the geopolitical situation was tense, with all eyes on Saudi Arabia – much as they are on Russia today. As a result of the political uncertainty the power balance shifted from international oil companies (IOCs) to national oil companies (NOCs) which we are seeing, albeit to a lesser degree, today. As in the 1970s, the IOCs decreed that “Diversification, diversification, diversification!” was – and is – the medicine to cure national energy policies. Eventually prices came down.

The crisis of the 1970s demonstrated that there are two sides to the energy coin; security of revenues and security of supply. The former is the main concern of hydrocarbon producing countries, whilst the latter troubles energy consuming countries. Whilst one led to the foundation of the Organization of the Petroleum Exporting Countries (OPEC), the other provided the motivation behind the creation of International Energy Agency (IEA). Both organizations were the products of their age, embodying the concerns that then absorbed their founders.

Moving on from past crises

However, the world is clearly very different from that of 1960 and 1973–74, the founding years of OPEC and IEA, respectively. The key changes between the high prices of the 1970s and today can be grouped around five core pillars: Supply side concentration; demand side growth; multi-polar political world; energy protectionism; and the rise of climate change on the global agenda.

On the supply side, the current landscape is marked by increasing concentration. In 1970, roughly half of global oil reserves were located in the Middle East, whilst in 2006 it is over two thirds (despite the fact that many Middle Eastern fields have matured). The emergence of natural gas in the wake of the 1970s only increased this concentration.
Today roughly half of natural gas resources are concentrated in three countries: Russia, Iran and Qatar. The emergence of Russia has offered little diversification potential; it increasingly influences OPEC and plays a powerful role on the gas market.

Demand side growth is mainly characterized by new key players: China and India. Neither of them is a member of IEA. Overall demand has grown steadily whilst the energy intensity has increased: The use of oil was around four times more efficient in 2005 than in 1970. Despite the more efficient energy use, total demand for oil has increased by 50%. Natural gas demand has grown by 150% over the period, bringing it firmly into the energy mainstream. Today it is hard to believe that it was a disappointment when Qatar discovered natural gas instead of the expected oil in the 1980s. “It took us 20 years to understand the value of this resource”, stated Abdullah Bin Hamad Al-Attiyah, Second Deputy Prime Minister and Minister of Energy, Industry, Electricity and Water of Qatar.

In the 1970s geopolitics was dominated by the Cold War. Today, alongside the hegemony of the US, China is emerging as a major power, whilst there are new nuclear threats from Iran and North Korea, further aggravated by an international atmosphere poisoned by fanaticism and terrorism. Over the past three decades, we have moved from a bipolar Cold War to a world with multiple poles and ideologies. Within many nations, power has become dispersed and vertical command and control structures are eroding. It is increasingly difficult for multilateral organizations to orchestrate powerful collective action.

International relations in the 1970s were in thrall to energy power politics (in sharp contrast to the late 1990s when some experts wrote that energy was off the geopolitical agenda). Nevertheless, the nature of energy politics has changed. In the 1970s, concerned consumer countries were dominated by the Middle Eastern-dominated OPEC, and with a focus on oil. Today, particularly since the Ukraine crisis in January 2006, Europe's concerns are focused on Russia and natural gas.

Energy markets: Between protection and liberalization

Energy markets have seen waves of liberalization and globalization since the 1970s. They have consequently become more intertwined whilst comfortable reserve margins have dried out. There are hardly any spare production and refining capacities in the oil sector (as observed during hurricanes Katrina, Rita and Wilma in 2005) and the US and Europe have experienced numerous power blackouts (particularly in the summer of 2003, but also in 2006) in recent years. Oil prices in particular and energy prices in general have reached their highest levels since the 1970s oil shocks, and have been further aggravated by painful levels of volatility. Such uncertainties and high prices have rekindled economic nationalism and protectionism. Producing countries have started to re-nationalize or take closer state control of their oil and gas sectors: examples include Russia (2005: Yukos); Venezuela (2005); and Bolivia (2006). In resource-rich countries, tight markets strengthen the negotiating power of their state-owned companies, in turn shifting market power away from the IOCs, which are traditionally built on strong project management skills and technological know-how, to the NOCs. Consuming countries, meanwhile, have tended to start protecting their domestic energy companies in line with concerns regarding their own energy security. This has been particularly visible in the US (2005: Unocal-CNOOC/Chevron) and in Europe (2006–07: Endesa-E.On/Gas Natural/Enel, GdF-Enel/Suez, Centrica-Gazprom). This drift away from efficient and competitive markets is accentuated by mergers, which further concentrate power in the hands of a few giant...
such market actors.

Climate change: A public good

Climate change is a key issue across the globe that will not be solved by the expiration of oil. There is sufficient coal and non-conventional hydrocarbons that could more than replace an eventual decline in oil production. Politicians and industry leaders must therefore confront the question: How does human society adjust its energy consumption in order to mitigate greenhouse gas emissions?

Energy security and a healthy climate are both public goods. They are universally desired; there are numerous actors involved; and markets alone cannot deliver as there is opportunity for windfalls and free riding. Welfare economic theory contends that the state should intervene to provide public goods whenever potential benefits or costs to society are deemed sufficient. A global framework in which these public goods could be delivered is key to any future vision of a low carbon economy.

Currently there are too few incentives to invest in a global low-carbon infrastructure and energy security still outranks climate change on most national policy agendas. The political weight of an issue differs considerably depending on whether the issue is environment, economics, or security. Climate change has moved from a strictly environmental agenda (in the 1990s) to the economic agenda (at least in Europe, where carbon trading markets were initiated in 2005). It would be equally justified to look at climate change as a security issue and ask how homeland security is prepared to deal with issues such as accelerated migration or more frequent environmental disasters. The principle of precaution forces global society to invest in preventing climate change from occurring. We must therefore establish a framework to deliver the necessary energy infrastructure investments.

Window of opportunity

Never before – and certainly not after the Kyoto agreement – has global business looked so favourably on such a framework. Both sides of the Atlantic have recently seen headlines such as, “Ninety international companies call for action on climate change” or, “Business leaders launch climate change initiative”. Much of that enthusiasm comes from companies such as utilities and technology companies which will deliver or operate the infrastructure to secure our energy future. The number of companies in denial of greenhouse politics is falling, whilst a growing number understand that they are exposed to regulatory uncertainty.

Any post 2012 carbon framework will affect long-term investments related to greenhouse gas. Hence any uncertainty over the framework hampers the required investments in energy infrastructure. It is in business interests to see such a framework developed quickly. Business needs predictability to prevent stranded investments. It wants a level playing field to maintain the competitive landscape and consistency to ensure that the same rules are applied across the globe.

Envisaging a low-carbon future

“Keep all options open” is a pragmatic political statement; but it cannot replace a real vision. A vision is not necessarily something which can be instantly implemented in policy. There is a plurality of stakeholder visions as to where and how energy policy should develop. Addressing climate change must take this multiplicity of views into account.

In its 2006 World Energy Outlook the IEA estimated that around USD 20 trillion need to be globally invested in energy infrastructure by 2030 to deliver the world’s energy requirements. Much of this money will flow into massive long-term infrastructure distribution projects to supply electricity and fuel mobility. Pipelines, hydro dams, or nuclear power plants cost billions of US dollars and are built to last for more than half a century. Current investments therefore have very real long-term implications. The fundamental issue regarding electricity is whether it will be produced in a centralized or decentralized manner. The corresponding question concerning mobility is whether predominantly liquid fuels infrastructure is utilized or whether it should be replaced with a very different infrastructure to distribute hydrogen. In Table 1, the energy visions Clean Coal Society, the Nuclear Society, Energy 2.0, and Bio Society, are described.

Key stakeholders within any future energy vision include:
– governments who define national energy policies;
– energy companies who own the critical infrastructure;
– NGOs, such as Greenpeace or WWF, as benchmarks of public opinion on issues including nuclear or renewable energies;
– consumers choosing to buy hybrid cars; or high fuel requirement cars; or to take public transport;
– venture capitalists, capable of driving innovation and potentially transforming an entire sector as we remember;
– cities becoming increasingly important in the “shifting power equation” and for implementing energy efficiency policies; cities are currently home to around 50% of the global population and the trend is rapidly increasing.

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Bio fuels: The path of least resistance

Figure 1 illustrates respective visions and stakeholder positions. The Bio Society is the least controversial amongst stakeholders. It benefits from an existing infrastructure and technology. Politicians have already identified this as the path of least resistance. There have subsequently been ambitious policies and aggressive targets to introduce biofuels that bring us closer to this vision. Many of these targets go beyond what countries can produce by themselves – and that should help to erode today’s bio-trade barriers. For some developing countries biofuels carry great opportunities but considerable risk: rapid growth in traded biofuels may lead to relative price changes in basic commodities that ensure food security; it may also cause ecological damage if current agricultural land use is displaced towards ecologically valued environments. Proponents of the biofuels cause will have to avoid headlines such as “unleaded, but 100% rain forests” or “his meal in my tank” from becoming reality. Sufficient regulation is required to ensure that “good biofuels” find their way onto local markets and into international trade in particular. Finally, the promotion of R&D projects to produce second generation biofuels from cellulose biomass and waste is crucial for the future of this vision.

Carbon sequestration: The key to clean coal

The largest unknown with the Clean Coal Society is the extensive use of CCS. Demonstration projects for underground geological sequestration are underway and the result sharing needs to be continued and fostered. However, research alone is not enough to make this vision viable. Moreover CCS technologies need to be dispersed for mobile technologies; that is carbon capture from transport, notably cars.
Figure 1: Energy vision ideal types and stakeholder support.

Source: Author. A large stakeholder is symbol for support, a small stakeholder less, an upside-down stakeholder resistance.

**Nuclear: Back on the agenda?**

The centralized Nuclear/Hydrogen Society faces an infrastructure challenge. Providing hydrogen as dominant fuel for mobility requires a full hydrogen distribution chain. We have some distribution experience with natural gas; however hydrogen is a smaller molecule than methane, which makes it more difficult to keep in the pipe. This challenge can be mitigated if energy is distributed as electricity rather than hydrogen and hydrogen is produced locally via electrolysis. In terms of overall energy efficiency this is far from ideal, but if nuclear energy is abundant and cheap, it may be a suitable trade-off. In countries with strong civic movements, the larger challenge is to overcome NGOs’ concerns regarding nuclear waste, proliferation and accidents. Progress has been made on these issues. If fourth-generation nuclear fission can bring a true breakthrough in transmutation and incineration, there would be less concern regarding waste and proliferation. More nuclear capacity will however inevitably engender greater risk, and will challenge the level of global risk acceptability. Allied to this risk is a legitimacy issue; the potential dangers of nuclear technology has resulted in only a limited number of nuclear players. Great hopes and considerable sums have been invested in nuclear fusion. In order to build trust, it is key to maintain the dialogue with civil society and NGOs and include them in the monitoring of nuclear energy. Finally, as long as there is unequal international access to nuclear technology, this vision lacks global legitimacy.

Nuclear accidents are fading from memory.
Energy 2.0: Personalized energy

Even though this vision is particularly difficult to summarize, it may be supported by a (rather surprising) alliance of city dwellers, NGOs and venture capitalists. Disruptive technological change will play the key role in the Energy 2.0 Society. The history of another sector, IT, is also one of disruptive change. It occurred at the transition from computers to personal computers. The web exploded into life when personal e-mail addresses became available. Web 2.0 is characterized by the personalization of products available on the web. Such personalization exists within micro-finance. At first, large financing institutions were not interested; but micro-finance has grown into a multi-billion dollar business. It remains to be seen whether energy technology can be equally personalized. In Germany individual wind farms, even if only one turbine, have legal access to the grid. There may be other personal forms of energy generation, or some form of incentive system to encourage less energy consumption.

Energy efficiency: The cheapest option

Energy efficiency is widely discussed; but it has no co-ordinated support or lobbying group. This could potentially change if energy-slimness became fashionable and “slim city rankings” rewarded the best local energy policies. Numerous technologies exist or are being developed; many of them are profitable, if not in the short-term, at least in the mid-term. It is crucial to create a constituency for energy efficiency. Depending on which energy vision is pursued, efficiency will play a different role. Should nuclear energy prove abundant there seems to be little need or incentive for efficiency unless energy prices are high. The Clean Coal Society will invest a lot of energy in carbon capture and storage. In the Bio Society it will be food competition that will keep us highly aware of the resource’s value, in turn driving efficiency. Last but not least, the efficient use of locally available resources is a pillar of the Energy 2.0 Society. In the end, a mixture of these visions rather than one ideal type is likely to evolve. If we care about our climate we need low-carbon visions and must implement them quickly. If we really want something to change, we must understand the different energy visions. Each vision has its challenges and not one is without its costs.

How to Read the Issue Map

Key issues are positioned according to three parameters:
- The horizontal axis indicates how large an impact the issue is expected to have on the energy sector.
- The vertical axis indicates the degree of uncertainty surrounding an issue.
- The size of the bubble indicates distance in time to when the issue becomes pressing. Immediate concerns are shown by larger bubbles, while small bubbles indicate issues that will become important only in the longer term.

From the Map to an Agenda
- High impact/low uncertainty issues require immediate action – by industry associations, political decision-makers, etc.
- High impact/high uncertainty issues would benefit from multi-stakeholder dialogue.
- Low impact issues are either considered unimportant or they have not yet registered on CEOs’ radar screens. The latter is most likely where the survey reveals sharp differences over the impact of an issue. In that case the World Economic Forum may seek to raise awareness.
- Setting the Agenda: Issues that lay on the upper right corner of the Issue Map define the Forum’s Energy Agenda. The Forum seeks to balance short-term and long-term issues.
Energy Geopolitical Focus

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Energy Market Focus

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Energy Vision

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The insurance sector's perspective
Risk assessment as a pre-requisite for underwriting: From Siberia to the Mexican Gulf

Swiss Re's Head of Risk Engineering Services Property, Ulrich Straub, visits oil platforms on a regular basis. He knows the problems and risks of the industry first hand and gives us an insight into his work.

Mr Straub, you work in the area of risk assessment with a special focus on the oil exploration and production industry. Could you describe a typical day in the field?

I work for exploration, production and refining – both the upstream and downstream parts of this industry. If we are visiting a rig, we normally begin the day by receiving a safety briefing, before boarding the helicopter and flying out to the platform. We usually have meetings with the operation, maintenance, inspection, engineering and safety departments. During these meetings, we try to extract information to understand how they operate and run these facilities.

When the meetings are over – which normally takes, depending on the size of the facility, between one and two days – we take a walk around the platform and examine its condition. How is the housekeeping? Is the equipment well-maintained? We're only looking at the physical aspect of a platform.

At the end of the visit, we have a final meeting to tell the management what we think of their operations – what we saw, what we liked, what we did not like. Then we provide the recommendations which we believe are necessary to improve the overall operation.

Do you come back a year or half a year later to check if they have implemented the recommendations?

Not in that frequency usually. What we receive, depending on the client, is a regular update on the recommendations. The larger companies have databases where every recommendation is tracked. We receive updates by email. Normally, we revisit such an installation on a two- or three-year cycle, the period needed to approve and implement a capital investment.

However, a lot of our recommendations are related to management systems and processes. This is much less expensive and can be done quickly. It is only in case of very serious deficiencies that we quickly return to double-check whether the problems were corrected. But this is very rare.

What are the areas in the world where you work?

Everywhere. From Siberia to the Mexican Gulf. From Africa to Asia.

Because of your experience, people must ask for your advice in the area of risk management quite frequently. Could you give some examples?

It is actually not risk management; but more a kind of risk engineering. We receive such requests very often. The last two we had were from one of the largest Brazilian petrochemical companies. They are planning to rebuild their central control room. A central control room should be blast-proof. If there is an explosion in the plant, the control room should survive because that is the only way you can still control an incident. If you have a control room which is not blast-resistant or blast-proof, it can be wiped out. Then the whole incident gets out of hand.

Currently, they have one of these control rooms which is not blast-proof, but they intend to build a blast-proof one. There are now two options. You build it bunker style or you
build it so far away that even if there is an explosion, the explosion does not reach the operations at that location. So they sent us the map. Nowadays it is no problem to build a control room remotely. With fibre optics and new technology it is easy – from a purely technical standpoint – to locate the control room far away.

But there are disadvantages. The field operator cannot communicate face to face with the panel operator. In the remote one, communication is mostly done by radio. Radio communication is normally not as effective as face-to-face communication, especially if you have to discuss problems. In that case we ended up recommending to build it remotely because the whole plant was already completed so it would have been problematic to build it inside. We still have to see how they maintain communication.

For example, last month, a company had a major accident. The corporate manager was very concerned and said, ‘The things I do not know keep me awake at night. The accident means that our safety management auditing system has not worked as designed. The question is, how do we have to improve the safety auditing system so that we do not have these shocks in the future?’

We were invited to take part in that taskforce. In workshops, we discussed what could be improved. By the end we practically had a new, comprehensive safety management auditing protocol. We hope to prevent such events in the future. Risk is never zero but one has to strive to get there.

Could you describe the general components of a risk engineering system?

Normally you have to have personal safety, environmental and process safety measures in place. We do not place our emphasis on personal safety – such as an employee tripping or banging their head – because this area is already largely regulated by the state or by the government. If we see something regarding personal safety during our visit, we mention it as a matter of professionalism and good ethics. However, it is definitely not our emphasis. Our emphasis is on process safety, risks which jeopardise the running of the entirety of an operation. If a shock goes as far as to consume an entire operation, this can cause really large losses with multiple injuries or multiple victims. Through risk engineering we seek to avoid this systemic risk.

What are the most typical safety risks?

They are usually deficiencies. Very strict protocols must be followed to ensure that the right work is performed on the right equipment and that everybody involved has signed off on the changes. Similarly, when a process gets changed, the new process – maybe it’s just a pipe that’s added or moved, maybe more – needs to be reviewed in the context of the entire plant to determine whether it poses a risk to another process. This is called change management and may require a complete risk assessment. Change management is also required when personnel leave the company. That potential loss of knowledge and experience has to be assessed and addressed. That question also has to be asked in downsizing exercises. Does the facility retain enough experience to safely run the plant? Most deficiencies that can lead to process risk are in management. Hardware can be fixed quickly… but management systems? There we often see a lot of room for improvement. The final part of our process risk assessment is fire protection. There must be adequate fire protection measures in place. If fire protection is required, it means all your other systems have already failed – so that is already a bad sign.
If you talk to your industry contacts, is energy security an issue?
The energy business is the motor of our world economy and therefore potentially an attractive terrorist target. In general, refineries and petrochemical plants have a very tight security system in place. After September 11, these measures were stepped up. As the motor of the world economy, the energy industry needs to function in a reliable, smooth manner. This economy is ever more energy-hungry and requires secure supplies. Currently, that can only be provided by oil and gas. Alternative energies remain relatively marginal. It would be nice if we had alternative sources that could provide energy as cheaply and easily. It is necessary to protect the climate from changing, but we also need to make sure that the energy engine is running. The insurance industry provides recommendations for ensuring efficient and effective risk management systems and thus contributes towards mitigating business interruption risks. If a loss occurs, insurance payments facilitate a rapid recovery.

Ulrich Straub is the Head of Risk Engineering Services Property at Swiss Re.
Growing energy insecurity and high oil prices: Challenges for the (re-)insurance industry.

Tight oil markets driving oil prices upwards, combined with higher exploration and extraction costs, and greater concern at natural catastrophe risk have all increased insurance demand from the energy sector, explains Stanley Cochrane, Head Onshore Property, Energy & Power at Swiss Re. Insurers and reinsurers cannot cover all the risks that the energy market would like to pass on; but where they cannot provide coverage, (re)insurers have begun to collateralise that risk and disperse it within the capital markets.

Tight markets

The current energy market can be easily summarised: Supply is tight, whilst demand keeps rising. As Americans grudgingly pay over USD 3 a gallon at the pump and leading investment banks predict a barrel of oil to cost USD 95 by year-end, the message is slowly sinking in: Energy security, as we know it, is a concept of the past. Tellingly, the report by the US National Petroleum Council published in July 2007 was headlined, “Facing the Hard Truths about Energy.” The report concludes that, “the world is not running out of energy resources, but there are accumulating risks to continuing expansion of oil and natural gas production from the conventional sources relied upon historically.” These risks, the report states, create significant challenges in meeting growing global energy demand.

One of the industries most directly affected by these challenges is the (re-)insurance industry. Growing energy insecurity coupled with persistently high prices poses both a challenge and a risk to the energy value chain. On the supply side, the low-hanging fruit of easily accessible oil fields are gone, whilst demand rises inexorably.

Insurance in the energy sector covers the entire value chain from its upstream production and exploration of oil and gas, the midstream pipeline and tankage companies to the downstream sectors of refining, marketing and petrochemicals.

Rising costs

Declining stocks and growing demand has forced the oil majors to search for oil and gas in ever more extreme locations. Whilst the territories that are their traditional base for exploration, such as the North Sea, the shallow waters of the Gulf of Mexico and continental US, see their crude supplies diminishing, most of the countries where oil is plentiful are now off limits to foreign corporations. This combination has limited the oil majors to exploring in areas to which they have access. In these areas, exploration and extraction is frequently technically challenging or environmentally sensitive; areas such as in the deep waters of the Gulf of Mexico or the Arctic. The costs of operating in such difficult areas can call into question the entire investment case. Such investments will eventually further increase prices because they must employ more costly and cutting-edge technology to explore in deeper water or extreme climates, hire an ever larger pool of increasingly scarce and expensive engineers and specialist contractors and pay more for construction materials such as steel.

Organisation of Petroleum Exporting Countries (OPEC) members often find further exploration politically and logistically difficult, whether it be because of political strife in the case of Iraq or the Niger Delta or, as in the case of Venezuela, with the decision to keep the industry in national hands. Yet resource nationalism has tended to come and go in cycles and the phenomenon is not necessarily here to stay. Countries that have spurned the oil majors over a long period may suddenly decide to revive foreign investment.

Along with rising costs, climate change and resulting extreme weather, events like Hurricanes Katrina, Rita and Wilma have caused more risk awareness among the large oil and gas companies particularly in the Gulf of Mexico, where a large part of the US oil reserves are concentrated. For insurance companies hurricanes and the accumulation risk pose a huge threat; yet they also present opportunities.

On the downstream side, oil refiners are under pressure to push output at existing facilities to profit as much as possible from rising product prices. US refineries, by global standards, are already relatively aged; and no new refineries have been built over 30 years. High oil prices pose a further disincentive for companies to adhere to legally required overhauls or rest periods for their facilities.

High oil prices have a direct impact on insurers. It is a standard feature of “all risks” insurance policies to reimburse oil companies for interruption to their business. Given persistently high oil prices, such a clause can become extremely costly for the (re-)insurance industry. Proper risk calculation in such cases is critical for the industry. If a storm hits a platform, it can potentially be damaged or out of production for around twelve months. The same conditions apply to oil refineries, where escalating refining margins can produce very large loss estimates in the case of a major explosion or similar scale incident.

Where there is a geographic density of production and refining facilities, accumulation risk further aggravates potential high-loss scenarios. For example, in addition to rigs, over half of the US refining capacity is located in the Gulf of Mexico, and exposed to significant storm risk.

2 Such trends have forced the industry to put upper limits on what it is prepared to indemnify. Oil (or refinery margin) price caps, where the industry will pay, for example, up to a ceiling of USD 60 a barrel for the loss of production have become increasingly common. With the embedding of high prices in recent years, this provides more security to the insurer and serves as a loss sharing mechanism between the insurer and the insured.

Price caps are still hard to sell in the market, especially where a programme is split between dozens of insurers. Furthermore, the competition from start-up companies, who may be more focused on earning premium rather than avoiding losses, makes it harder to negotiate price caps.

2 For further information on the energy construction boom and business interruption insurance, see Swiss Re’s focus report: Energy construction boom – A paradigm shift for insurers, Swiss Re 2007.
Some risks are of much less significance to insurers than widely believed. The threat of terrorism remains largely benign for insurers because of the low penetration of cover. Following September 11, (re-)insurers have all but ceased to offer terrorism cover in "all risks" policies except in very specific cases. Whenever they are forced to provide terrorism cover under government-sponsored schemes, such as the US Terrorism Risk Insurance Act (TRIA) or the UK's Pool Re scheme, the insured amount remains relatively small. Expropriation is a similar issue: It is a niche market. Overall risk remains relatively small for (re-)insurers because it is rarely insured. It had previously been more common, but once the loss potential was realised, few insurers provided such coverage. Some specialist insurers such as Lloyd’s may insure expropriation.

**Limits of traditional coverage**

The cash-rich oil majors are well aware that insurers generally do not insure expropriation and terrorism. They treat these factors as a calculated risk they must take on their own balance sheets. It falls on the oil majors to conduct significant research before moving into a country. These companies would be very pleased to see their political risk underwritten; but few insurers are willing to offer coverage.

Renewable energy sources have started to alter the energy insurance landscape. The exploration of alternative energy sources requires a relatively small investment compared to oil exploration costs, whilst and the operation of, for example, a wind farm does not pose huge insurable risks.

However growing energy insecurity and higher prices pose more of a challenge to the industry. As seen post-hurricane season in the Gulf of Mexico in 2005, they also offer a considerable opportunity for insurers with specialized skills and expertise in financial markets. Hurricanes Katrina, Rita and Wilma – the biggest insurance events in history with the overall loss estimated at USD 15–20 billion – significantly increased demand for insurance cover. The demand for catastrophe cover in the energy sector however often exceeds the appetite of the insurance market, and there is growing interest in transferring risks to the capital market through catastrophe bonds. Players with specialized skills and deep financial market expertise are well placed to grab a growing piece of the insurance pie.

Stanley Cochrane is the Head Onshore Property, Energy & Power at Swiss Re.
Further information

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Esther Baur, Fritz Gutbrod, Oliver Schelske (project manager)

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