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Oxford ENERGY FORUM

A QUARTERLY JOURNAL FOR DEBATING ENERGY ISSUES AND POLICIES

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Since the election of Barack Obama to the presidency of the United States, energy and climate change policies have moved from the back to the front stage of federal government political actions. Under the previous administration there was more rhetoric than effective legislative activity. The most remarkable statement was President Bush's desire 'to cure Americans addiction to oil'. But, how? This was never said in a realistic and effective way. To be sure, California and other states introduced innovative energy policies, but the writ of a state does not extend outside its border although its actions may encourage other states to introduce similar measures.

The Obama initiatives are significant considering the increasing public concerns with climate change and the need for the USA to play a leading role in international negotiations on this critical issue; until recently it was seen as an obstacle rather than a force for good in the international climate change field. For these reasons we invited distinguished authors to present their views on the new US policies and initiatives.

Joseph Stanislaw, with characteristic optimism, sees the set of measures and statements by the Obama administration as defining a transformation that 'is a vital necessity', 'an opportunity of a lifetime for America and the world'. Stanislaw is however aware of the problems and challenges faced by the USA in implementing ambitious programmes of clean energy at home and reaching an international agreement involving China on the country allocation of future CO_2 emissions. And is it possible to create a win/win situation with energy efficiency measures, demand reduction, conservation of resources without adverse effects on economic growth?

More sceptical views are expressed by Richard Matzke, the distinguished oilman. The new US energy plan, which is 'bold, aggressive, challenging, controversial, expensive and long overdue' essentially aims at reducing climate changing emissions. It does not meet the energy needs of industry and consumers. The bill – American Clean Energy and Security Act (ACESA) – passed in the House of Representatives by a tiny majority and with many significant abstentions, reflects both the climate objective and the neglect of energy issues. Stanislaw had noted that in the Bill,

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a text longer than a thousand pages, natural gas is mentioned but one time; and Matzke spells the point in greater detail stating that the Act does not address the 'sources, quantity or cost of the energy required to fuel the US economy'.

At the heart of the US climate change policy is the problem of coal. David Robinson addresses the coal issue in detail in his important article. Pressures by the powerful coal lobby, and from Senators of coal states, have led to compromises that weaken the 'environmental integrity' of ACESA. Robinson emphasises the need to reduce emissions from existing coal-fuelled power plants. And this is where vested interests come into play. There is opposition despite provisions in the Act for incentives to promote carbon capture and storage. And the opposition is likely to be greater when the Act goes to the Senate. Backing out of coal has adverse implications for the security of energy supplies, an issue that worries US governments so much, and for the competitiveness of industry because of increases in the price of electricity. There are also implications for the regional distribution of income and wealth.

As there is much talk about new sources of renewable energy, deemed necessary for the dual objectives of climate change and supply security, we have begun to address the topic with two articles on wind energy. Malcolm Keay focuses first on the paradoxes involved in the development of wind power. It is construed as new energy whereas it is very old. Wind energy is secure but unreliable; environmentally friendly but objectionable; economic but subsidised. He then examines in some detail the case of wind power in the UK, a country with the best wind resource in Europe but where development has been slow. To meet EU targets on the renewable share in electricity generation the UK needs 'a complete makeover of the country's electricity system', a task that involves a set of difficult policies.

Another article on wind by Constable and Aoyama is a statistical analysis of the load factor in UK onshore wind farms, which yields interesting policy conclusions. The reader deterred by the statistical exercise should move to the second part of the article where inferences are made. The import of the analysis is that a sub-optimal choice of sites results in higher subsidies and costs.

Two separate articles, one by Segal and the other by Fattouh, complete this issue of *Forum.* Segal addresses the distributional problem of oil revenues and shows how they can be used to alleviate world poverty. This is an exciting subject. The issue has a clear economic solution, but as too often alas, the implementation is defeated by a lack of political will. Fattouh analyses a problem that has become topical since the rise of oil prices to more than $140 per barrel and their subsequent rapid fall to below $40 per barrel. This volatility, better understood as a significant price swing is bothering OECD governments with good reasons. Very unusually, it has led President Sarkozy and Prime Minister Brown to write a joint article deploring this type of volatility and calling for ideas on international co-operative action. One idea is to set a band within which oil prices would be allowed to fluctuate. Fattouh examines with insights the problems posed by volatility and the remedy of a price band.

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Obama's Energy Policy

Joseph A. Stanislaw discusses how far Obama's energy policy is a transformative moment

In just six months, the Obama administration has made Washington the epicentre of a veritable revolution in American energy and environmental policy. After decades of lethargy, during which California and over thirty other states were the centre of innovation, hardly a week now passes without a landmark measure announced on the Hill or in the White House.

Among the highlights have been the passage of a stimulus bill in February that included over $60 billion for clean-energy initiatives; the appointment to the post of energy secretary of a Nobel Prize-winning Cassandra of global warming; the elevation of energy and environmental issues in the White House hierarchy; the creation in spring of a network of Energy Frontier Research Centres; the increase in May, for the first time in a decade, of fuel economy standards for cars; the launch of an historic energy-efficiency initiative in June; and a stream of ambitious rhetoric on a post-Kyoto climate pact. This was capped, of course, by the House's passage of the Waxman-Markey climate change legislation in late June. The complex, 1200-page bill would require the United States to reduce carbon dioxide and other greenhouse gas emissions by 17 percent from 2005 levels by 2020 and by 83 percent by midcentury.

All this marks a transformation for America that will echo worldwide. Obama has reordered the country's energy priorities, focusing first on the energy we should not be wasting – through efficiency initiatives, conservation, and demand reduction, all without sacrificing economic growth – and then emphasising new and renewables. Oil and gas come in a distant third – natural gas was mentioned *but one time* in the 1200 pages of the Waxman bill. Nuclear energy, meanwhile, remains a question mark. Thus shakes out the new energy playing field in America.

Yet what might have been the single most revealing moment occurred not in Washington, but halfway around the world – in China. Not Brussels, not Dubai, not Moscow, nor Berlin or London. Beijing.

It was there in mid-July that Energy Secretary Chu and Commerce Secretary Locke – notably, two Americans of Chinese descent – convened with their Chinese counterparts to discuss both energy and climate change (also of note: their visit was advanced by two months from its original date). Secretary of State Clinton followed shortly afterwards, and President Obama will travel to China in November for a summit with President Hu Jintao.

The headlines from the visit focused on US–China cooperation in negotiating a new climate treaty next December in Copenhagen. After all, beyond their combined political weight, the USA and China are the world's two largest carbon emitters. But there was an even more important agenda: 'seeking common interests between China and the United States in developing clean energy,' as the Department of Energy gently put it in a statement.

This is because, despite all the American *rhetoric* on clean energy this year, much of the *action* is taking place abroad. In fact, the USA could well develop the innovations to be *one* of the leaders in the field – but even then it is likely that the bulk of the manufacturing will take place abroad. This is why the House voted overwhelmingly on 10 June against any climate change treaty that could weaken the intellectual property rights of American green technology.

President Obama has been adamant about America's clean-energy future. 'The American people know that the nation that leads in building a 21st century clean-energy economy is the nation that will lead in creating a 21st century global economy – I want America to be that nation,' Obama said on 26 June, the day the US House of Representatives passed the American Clean Energy and Security Act.

The United States, however, needs to peer vigilantly through its rear-view mirror – and through the windshield – to keep tabs on the competition. A quick survey of the scene shows why.

Asian nations in particular are investing vast resources in renewable energy research and technology development, while setting ambitious targets for clean energy use. For example, South Korea has committed to investing 2 percent of GDP each year in clean energy, for a total of $80 billion over five years. China is aiming to generate 20 gigawatts of solar power by 2020, a tenfold increase from today, and is offering its industry the world's most generous subsidy to help meet that goal. Beijing also is investing heavily in wind, battery, and other technologies. Already, the USA lags in key industries. Only one-fourth of the world's top renewable-energy companies are American-owned. And only one US company, General Electric, is among the world's top ten wind turbine makers; American solar companies do not fare much better.

Obama is aware of the deficit. 'It is China that has launched the largest effort in history to make its economy energy efficient,' he said recently. 'We invented solar technology, but we've fallen behind countries like Germany and Japan in producing it. New plug-in hybrids roll off our assembly lines, but they will run on batteries made in Korea.' House Majority Leader Steny Hoyer put it even more pointedly: 'In the years to come, I hope that America will be selling clean technology to China and India and not the other way around.'

So no longer is the energy debate dominated by talk of peak oil, Russian gas cut-offs, or the machinations of OPEC. Increasingly, the 'market and might' of China, India, and the other new-energy tigers – with their more centralised economies, their vast R&D budgets, and their sway in the climate debate – are compelling the Obama administration to try to lean as forward as possible in its energy policies.

All American energy companies face enormous challenges on the world stage, as the dynamic of global industry fundamentally changes. Chinese and Indian oil and gas companies can do things in the world today that a German or US company cannot. They combine the power of both the private and public sectors. If a Chinese company wants a stake in a Nigerian oil field, Beijing can contribute a few billion in foreign aid to sweeten the pot. Washington cannot. China has the domestic market, the foreign reach, and the currency reserves to be a formidable enabler for its energy industry.

In this context, the Obama administration has done as well as could be expected – though perhaps not as well as the biggest optimists hoped, which the Waxman bill underscored.

In the first six months of his administration, President Obama achieved what eluded his predecessors. He has put energy and environment policy at the heart of plans for America's future. By arguing for a Green New Deal as the way to combat climate change and lead us out of the economic morass, the President seeks to transform a moment of profound crisis into one of generational opportunity. If he succeeds in marrying reform with recovery, the effort could fulfill an extraordinary triptych of goals:

- Build the foundation for a twenty first-century economy,
- Assert America's global leadership, and
- Sharply increase the country's national security.

But the President's work has only just begun. In his first six months, he laid out an ambitious vision of *where* we need to go. In the next six months, however, he must overcome political interests to prevail on precisely *how* we will get there.

To a significant degree, he can disarm opposition to his plans by underscoring that he will not play favourites on the new energy playing field – and that instead his goal is to set clear, transparent targets and allow all players to compete in meeting them. At its most basic level, his task is to set a price for carbon and then allow the market – not the government – to decide how to get there. And while he must be prepared to compromise, he should be unyielding in hewing to his guiding principle – using reform and recovery together for the future.

Within a month of taking office, and without even passing an energy bill, Obama had demonstrated his conviction. He did it through symbolism, by making fuel efficiency the subject of a presidential directive during his first week. He did it through staffing, by appointing ardent advocates of the environmental and climate change agenda to senior jobs. And he did it through spending. The more than $70 billion allocated to energy and environment projects in the February economic stimulus bill made it 'the biggest energy bill the country's ever seen,' as White House energy and climate czar Carol Browner said.

Obama put it simply: 'It is time for America to lead again,' he said in his address to Congress, referring specifically to energy and climate change policy.

Together with Obama's 2010 budget, released shortly thereafter, the stimulus bill set out an ambitious series of energy goals. Specifically:

- Create five million green jobs by investing $150 billion in renewable energy efforts over the next ten years (Congress authorised the development of 130 clean energy technologies)
- Double alternative energy production, to cover 10 percent of electricity needs, by 2012, and to 25 percent by 2025
- Implement a carbon-trading system that will reduce greenhouse gas emissions by 2050, while also generating $685 billion in 'carbon revenues' in the next decade alone
- Update and expand the nation's energy infrastructure, focusing specifically on building an electricity grid that can better integrate renewable energy
- Promote energy efficiency by, among other measures, retrofitting buildings so they sip rather than chug energy, and upgrading public transport systems
- Invest heavily in energy R&D, with $8.8 billion in the stimulus bill alone, including $800 for clean coal, $1.5 billion for industrial carbon capture, $800 million for biomass, and $400 for geothermal

Already, this is a huge list – but the President could add two more critical items to his agenda.

First, he will need to engage the American oil and gas industries. Until now, the administration has treated them almost like second-class citizens (or worse), invoking them only in the context of increasing their taxes and reducing their subsidies. Yet the USA cannot cross the bridge to a low-carbon future without mobilising the American oil and gas industries. To accelerate this process, all energy forms, including fossil fuels, should be allowed to compete within a framework set by the government. Also, the oil and gas industries generate hundreds of thousands of highly skilled, high paying jobs – jobs that America must keep at home. These are skills and positions that, once lost, are unlikely to return.

Second, and in a similar vein, the President must show his cards on nuclear energy, the proven carbon-free energy source that produces 21 percent of America's electricity. How does it figure in his vision of America's energy future? He cannot keep this industry, which must make investments with a 50-year or longer horizon, in limbo for much longer.

Another immediate priority of the next six months is for the administration to use all its political and diplomatic powers to ensure that the global climate change negotiations scheduled for December in Copenhagen succeed. The auguries thus far are

not good. The meltdown during the G8 Summit in Italy in July – when developing countries refused to sign onto the West's ambitious goal of having them reduce emission 50 percent by 2050 (the West would cut by 80 percent) – is emblematic of the impasse that exists.

If the USA shows up in Copenhagen with signed legislation on a domestic carbon bill, this would be an excellent bargaining chip. The Waxman bill was a good start, but now the Senate must be brought along. Short of this, the administration will have to show determined leadership in designing a framework of ideas and principles on carbon that can attract the support of, especially, China and Canada. This is what the Chu–Locke visit to Beijing was partly about.

"the USA cannot cross the bridge to a low-carbon future without mobilising the American oil and gas industries"

American industry needs clarity on carbon. In the absence of federal legislation, industry does not know where to make investments. The business community, resigned to the fact that a price for carbon will be set, is now clamouring for finality. Says Browner: 'Even in this down economy, it's better for us to know what's going to be expected in terms of how we use energy, in terms of greenhouse gas emissions, so as we come through the recovery we can plan for all that. Give us our marching orders.'

The Waxman bill offered a certain degree of clarity, although it delivered significantly less than the home run for which optimists had hoped. In order to secure a razor-thin, 7-vote margin, the bill's sponsors had to make concessions to Congressional representatives from energy-producing (primarily coal) states. Thus cap-and-trade was watered down, among other measures. But this logrolling – natural in American politics, though perhaps disappointing in a European context – produced a historical bill.

However, the Waxman bill is only half the picture; the Senate must now come on board. The administration can hardly be happy that the House barely passed a climate bill (219–212) even after weakening it with billions in handouts. The Senate fight is even tougher. The president will need to ensure the bill drives down emissions while spurring investments in clean technology that all nations can build on. Politically, the linchpin will be for the White House to continue to tie the climate bill to national security – and freeing America from dependence on the unreliable, or even dangerous, countries that now supply us with fossil fuels. Obama joined the Senate battle just days after Waxman passed. 'My call to every senator, as well as to every American, is this: We cannot be afraid of the future. And we must not be prisoners of the past,' he said. 'Don't believe the misinformation out there that suggests there is somehow a contradiction between investing in clean energy and economic growth. It's just not true.'

The administration could use its willingness to promote carbon legislation, as well as a national renewable portfolio standard, to forge a climate consensus with China. President Obama's summit in Beijing in the fall could be high noon in this regard. One key to this will be to send a clear signal to the developing world that the United States will lead in efforts to both develop and transfer clean energy technologies – including in legacy energy fields, especially coal (which is fundamental to China's future).

Come September, the President's efforts to enact his energy vision could be playing out on three legislative fronts, with a bill on carbon, another on renewal portfolio standards, and a third wide-ranging energy bill. As the administration plans for the inevitable autumn horse-trading, it must develop a strategy to protect its highest priorities, including:

- Carbon legislation, as discussed earlier
- An ambitious, national renewable portfolio standard
- The funding of basic and advanced research, and the training of college students in fields related to clean and renewable energy; the establishment of the Advanced Research Energy Agency with stimulus funds was an innovative move that should be built upon
- A 'Clean Energy Bank' that can overcome the mind-boggling bureaucratic hurdles that have prevented *available* funds from being distributed by the government either as loan guarantees or subsidies to help develop clean energy and efficiency technologies
- A prominent role for the legacy fossil fuel industries – oil, gas, and coal – with an emphasis on developing cleaner forms of these fuels
- The creation of a White House task force that can determine how best to create a new green energy 'culture' in America, starting with education at the primary level.

Above all, the administration should be guided by a fundamental three-part vision to:

- Create a set of goals with respect to carbon emissions;
- Establish clear and transparent rules of engagement; and then to
- Allow any and all players, including oil and gas, coal and nuclear, to compete for market share and funding.

This is an opportunity of a lifetime for America and for the world. But more than an opportunity, this transformation is a vital necessity. There will probably be more money spent in the energy sector in a broad sense in the next fifty years than has been invested in the past 100 years, if not in the history of mankind. We will have a complete transformation of our system in a fifty-year period. In doing so, we must aim to go from mutual misunderstanding – which dominates the world today – to mutual interdependence.

Richard Matzke argues that the energy plan is in reality a climate change plan

The US administration's energy plan has attracted global attention not because it meets the energy needs of US industry and US consumers but rather, because it is a plan that will result in the reduction of climate changing CO_2 industrial emissions in the use of fuel to create energy. The plan is bold, aggressive, challenging, controversial, expensive, and long overdue. Its legislative version is greater than 1000 pages and should be referred to in its original form for those seeking a better understanding than can be presented in this brief article.

In the months preceding the November 2008 US presidential elections, the Obama website described what was then called the 'New Energy for America Plan'. Reportedly its primary goal was twofold: one, to reduce the quantity of energy being consumed by Americans, and two, to reduce the carbon content of the fuels used to create energy for Americans. A closer reading of this plan also reveals that it may have been designed to address both budget problems at the federal level and financial problems at the personal level. The initial idea of selling CO_2 emission permits (carbon credits) to those who produced CO_2 emissions or could not meet mandated CO_2 emission reductions was largely designed to generate funds to reduce the anticipated enormous federal budget deficit. At the personal level a windfall profits tax coupled with removal of all production incentives on the conventional oil and gas business was supposed to provide funding for a $500 per person energy rebate as promised by Mr. Obama if elected. The latter of these has been characterised as a questionable effort to acquire votes at the expense of an industry that is often at odds with elements of the federal government.

The original plan consisted of the following proposals, all more or less designed to contribute to achieving the two primary goals referred to above:

1 Reduce industrial greenhouse gas emissions 80 percent from 2005 levels by 2050.
2 Increase gasoline fuelled new auto/truck mileage to 35 mpg by 2016.
3 Increase biofuel consumption to 60 billion gallons by 2030.
4 Establish a low carbon fuel standard which will reduce the carbon in fuel by 10 percent in 2020.
5 Require 25 percent of electricity to come from renewable fuel sources by 2025.
6 Require that all new buildings be carbon neutral by 2030.
7 Require that all new vehicles have flexible fuel capacity by 2013.
8 Invest $150 billion over ten years to create 5 million new jobs.
9 Eliminate all oil and gas tax incentives originally provided to increase domestic oil and gas production.

During the past six months, the Obama administration has aggressively pursued the popular acceptance and legislative implementation of many of these goals and has met with the normal and expected resistance. Geopolitics, recession, job losses, energy price changes, special interest and a global environmental meeting planned toward year end have all contributed to establishing priorities, the need for compromise, and substantial modification of many of the original goals. Based on the magnitude of reaction, it appears that industrial CO_2 emission, automobile fuel efficiency, and the elimination of oil and gas industry production incentives have attracted the greatest level of concern and interest.

As time passes and activity progresses it becomes ever more difficult to describe what is happening as the creation of an energy plan for the USA in a conventional sense. What is presently being debated is how US citizens can reduce CO_2 emissions as they consume fuel to create various forms of energy. The issues being actively promoted today are about how to reduce the carbon footprint in the creation of energy not how to meet the energy needs and expectations of US consumers. And, as the cost of alternative approaches becomes well documented and more widely understood by elected officials, the financial consequences begin to measurably impact the goals and objectives of the original plan.

On June 26, 2009 the US House of Representatives passed historic legislation which very clearly addressed the threat of climate change. The bill passed by the House is titled the 'American Clean Energy and Security Act' and it mandated the creation of clean energy but did not address the sources, quantity or cost of the energy required to fuel the US economy or to meet the life styles desired of its citizens. The bill passed by the House of Representatives is what the Obama 'New Energy for America Plan' has morphed into or possibly it is a clarification of what the original authors of the Plan intended it to be.

"As time passes … it becomes ever more difficult to describe what is happening as the creation of an energy plan for the USA in a conventional sense"

The primary component of the bill passed by the House is the description of the process by which the incentives to reduce CO_2 emissions will be administered, or alternatively, the penalties that will be applied if mandated CO_2 emission levels are not achieved. The goal of an 80 percent reduction of CO_2 emissions by 2050 from levels of 2005 is consistent with the original plan, but in the House passed version 85 percent of the required CO_2 emission permits will be given away free rather than sold. This obviously diminishes the revenue generating potential originally intended and creates tremendous industry anxiety as to how and to what industries the free CO_2 emission permits will be distributed. The bill also appears to allow for

the creation of a secondary market in tradable emission permits or carbon credits. This possibility has generated considerable concern as to how the market will be regulated in order to avoid financial disasters such as those recently experienced in other derivative markets in which non-principals were permitted to speculate.

The historic significance of the 'American Clean Energy and Security Act' results from the fact that it is the first time either branch of the US Congress has approved legislation designed to reduce, what are believed by many to be, climate changing CO_2 emissions. The vote count in the House of Representatives, 219 'yes' votes to 212 'no' votes including 44 'no' votes by Democrats and only 8 'yes' votes by Republicans, foretells considerable and aggressive future debate, difficult compromise, and probably lengthy delays in implementation.

In the near future the bill will move to the US Senate where its cost to US consumers and the resulting decline in US industrial competitiveness will be thoroughly debated. Both of these potentially fatal issues are addressed in the House bill but the mitigation analysis involves many unknowns and the uncertainty of the predicted results remains great, thus credibility is substantially lacking.

There are many knowledgeable people associated with the affected segments of US industry who are highly sceptical of the process by which the plan mandates CO_2 emission reduction. One seems worth quoting: Keith Rattie, CEO of Questar Corporation, said in a speech in Utah on April 2 2009: 'If you do the math for the entire country, 80% by 2050 would require a reduction in America's carbon footprint from about 20 tons per person today to less than 2 tons per person in 2050. America's carbon footprint of 2 tons per person per year has not occurred since the Pilgrims arrived at Plymouth Rock in 1620.'

When the administration's planning process began there existed something that resembled a viable US automobile industry. For years the industry's spokespeople argued effectively against higher mandated mileage requirements in spite of what non US auto manufacturers were able to achieve and what US consumers desired. With the advancing economic downturn the US auto industry became an early recipient of billions of dollars of taxpayer bailout funds which had only a marginal effect on the economy of the industry but did seem to salvage the industry from disappearing completely. In its present condition of near government ownership and monumental debt to the government the US auto industry has no choice but to support and achieve the mandated 2016 standards of 39 mpg for new cars and 30 mpg for new small trucks versus today's standards of 27.5 mpg for cars and 23 mpg for small trucks. Accomplishing these mileage standards will be difficult but if achieved it will ultimately make a very significant contribution to realising the two goals of the Obama plan. Although significant improvements do not happen fast it is interesting to consider that if the average mileage of all autos and small trucks in the USA were doubled it would reduce US consumption by almost as much as all the oil currently produced in the country.

"The conventional US oil and gas industry … was essentially left unmentioned in the House passed 'American Clean Energy and Security Act'"

The conventional US oil and gas industry received considerable unwanted attention in the original 'New Energy for America Plan' but was essentially left unmentioned in the House passed 'American Clean Energy and Security Act'. Most observers believe this does not bode well for the industry and expect a series of substantial reductions of the existing incentives to find and produce domestic oil and gas. It is also anticipated that when legislation affecting the domestic industry is finally passed it will contain numerous elements not previously discussed that will have a measurably negative impact on the financial health of the industry and will result in an accelerated decline in domestic oil and gas production. When considering the direction one would like to see taken by the domestic oil and gas industry it is significant to note that the combined effort of hundreds of small US companies investing and operating with the benefit of risk reducing incentives have found sufficient new onshore natural gas in the USA in the past few years to fuel the US economy at today's rate of consumption for over 100 years. Natural gas is an abundant and clean fuel that presently generates almost 25 percent of the electricity in the USA and if desired, can be converted by existing technology to a nearly pollution free liquid transportation fuel. 'Drill, baby, drill'.

The original plan called for the following punitive actions to be taken for the purpose of raising government revenue and discouraging the production and consumption of domestic oil and gas. Not all are of equal importance to every company but collectively they are the incentives that have made the US industry the most productive and efficient in the world. The proposed actions are:

1 Reduction of foreign tax credits
2 Repeal of manufacturing tax credits
3 Repeal of percentage depletion
4 New excise tax on Gulf of Mexico production
5 Repeal of tax credit for marginal fields and enhanced oil recovery
6 Repeal of intangible drilling cost deduction

Other actions now anticipated are:

1 Raise the royalty rate of onshore production to 50 percent
2 Reduce terms of federal leases from ten years to five years
3 End royalty-in-kind program

The negative consequences to the US oil and gas industry would be immeasurable if all these proposals were to be implemented. Many industry leaders have given their opinions and there is little doubt of a pending reduction

in domestic oil and gas production and a horrendous loss of jobs if the listed actions are enacted.

Coal which generates 50 percent of US electricity and nuclear which generates 20 percent of US electricity seemed only to be acknowledged as high risk fuels but received no particular role in either the original or the House passed plan. The USA contains possibly 30 percent of all the coal reserves in the world and it is the least expensive to produce of all energy sources today. A successful effort to solve the CO_2 problems associated with coal production and its combustion, which is not part of either plan, would make the USA much less dependent on foreign sources for fuel of any kind and would create an abundance of new US businesses and jobs.

The author acknowledges assistance from PFC Energy, Washington DC

David Robinson assesses the crucial role of coal in the US climate legislation

Introduction

If a bomb was ticking and could explode at any moment, you would do everything possible to defuse it right away. The problem of climate change resembles a ticking bomb. Yet the global response to this bomb has been slow and inadequate. There are many reasons, including the absence of global leadership, the difficulties of collective action in the international system, the uncertainty about when and where the bomb will explode, and the preference to let others do the heavy lifting.

One other reason for the slow response is that protecting or compensating the potential losers often weakens the environmental integrity of the legislation. This matters less where a small country is concerned. However, weak climate legislation in the USA will undermine global efforts to fight climate change.

This article examines some of the pressures that have weakened the environmental integrity of the American Clean Energy and Security Act (ACESA), which recently passed through the House of Representatives. Producers and consumers of coal and of coal-based electricity (i.e. the 'coal lobby', including companies, workers and consumers of different sizes in these sectors and more generally citizens in the regions where the companies operate) are the main losers from climate legislation; compensating them and helping them to prepare for the future has come at a price.

This article has four sections. First, it summarises the challenges of climate change and the importance of cutting coal emissions from existing coal-fired power plants, especially in the USA and China. Second, it discusses some of the reasons why ACESA is coming up short. Third, it illustrates how this draft US legislation has been weakened in order to obtain support from affected parties, especially those relying on coal and coal-based electricity. And, finally, it draws some conclusions.

The reader should take away two messages. First, the pressure to weaken the environmental integrity of ACESA in the US Senate will be intense; it is important for the Administration to resist that pressure. Second, there is no credible way to stabilise greenhouse gas emissions without cutting emissions from existing coal plants. US legislation should focus on cutting emissions from existing (not just new) coal plants and providing economic incentives for this to happen as soon as possible in the USA and China.

1 The Problem – and the beginning of the solution

The latest evidence from MIT, published recently in the American Meteorological Society's *Journal of Climate*, indicates a median probability of surface warming of 5.2 degrees Celsius by 2100, with a 90 percent probability range of 3.5 to 7.4 degrees. This can be compared to a median projected increase in the 2003 study by MIT of just 2.4 degrees. The conclusions of the MIT study are presented on a large roulette wheel, which reminds us that we are gambling with the world's future!

To avoid dangerous interference in the world's climate, the world's governments have already committed to limit temperature increases to 2 degrees Celsius this century. To achieve that, the industrialised countries must start by cutting emissions by 25–40 percent by 2020, using 1990 as a base year. Global emissions should also begin to decline between 2015 and 2020. On current performance, the world is unlikely to meet these targets. Meanwhile, the bomb is ticking.

"The USA and China currently account for over 40 percent of the world's anthropogenic greenhouse gases (GHGs) and over 50 percent of coal use"

The consequences of failure to meet the targets would impact hundreds of millions of people. The hardest hit will be in developing countries, with growing problems of health, access to food and water, loss of homes to floods, drought and radical weather events, and more frequent wars over access to resources. The governments of the wealthiest countries also recognise that this could undermine global political, economic and military stability, and that climate change will create serious problems for their citizens.

It is widely accepted that there is no silver bullet and that a wide range of methods for cutting emissions will be needed. Yet, one crucial part of the answer is to cut emissions from coal, which currently account for almost 40 percent of world (energy based) CO_2

emissions and could reach 50 percent by 2050.

The USA and China currently account for over 40 percent of the world's anthropogenic greenhouse gases (GHGs) and over 50 percent of coal use. Both countries rely heavily on coal for electricity. Over the past five years, China has brought on stream coal-based capacity approximately equal to the entire US capacity of coal-based plants; China also plans significant additions. Once built, these coal-based plants will almost certainly run due to their low variable costs.

To sum up, there is no realistic way that the world can address climate change adequately if China and the USA do not reduce the emissions from their existing coal-based generation plants.

2 US Draft Climate Legislation

On June 26, 2009, the US House of Representatives approved the American Clean Energy and Security Act (ACESA), by a narrow margin of 219 to 212. It must now be debated in committee and passed by the Senate, before eventually going to the President to be signed into law, assuming it makes it that far. It is possible that a version of ACESA will become law before climate change negotiations in Copenhagen in December this year.

First, the good news; ACESA is the first major climate bill to be passed by either chamber of Congress in the USA. Among its most important and positive features are a minimum national standard for renewable energy, a nation-wide cap and trade program to reduce greenhouse gas emissions in the USA (83 percent below 2005 levels by 2050), as well as significant investment and incentives to promote energy efficiency measures and carbon capture and storage (CCS). The draft also avoids the problem of windfall profits that beset the EU emissions trade scheme, and may be able to get at least some of the CO_2 price signals through to customers.

Second, the bad news; the passage of the legislation in the House has come at a cost in terms of its environmental integrity, partly in response to the concerns of the coal lobby. The pressure to weaken ACESA will be even greater in the Senate, as explained below.

3 Key Trade-offs Related to Coal

Coal is generally considered to be 'bad' because of its effect on the environment, but backing coal out of the US energy supply creates a number of problems for (a) national security, (b) the cost of electricity, (c) the regional and social distribution of wealth, and (d) the global competitiveness of US industry. Simply put, there are trade-offs between the environmental benefits of reducing coal emissions and the economic and political benefits of relying on coal. Below, we examine each of the key trade-offs and then explain how this is likely to influence voting behaviour in the Senate.

National and Energy Security. The USA has the world's largest coal reserves. Estimates of the remaining life of those reserves vary, but in all cases are sufficient to be considered of strategic importance. Currently, one of the few energy objectives that enjoy cross-party support is the reduction of US dependence on imported oil, especially from the Middle East and Venezuela. Looking forward, coal will become of even greater strategic importance in the transport sector as electricity replaces oil as a transport 'fuel'.

Cost of Electricity. Coal's high share (50 percent) of US electricity generation reflects the economics of the industry prior to the introduction of a price for CO_2 emissions. Domestic coal is relatively inexpensive to mine. The resulting low variable costs of coal compensate for the relatively high fixed costs of large-scale coal plants. When CO_2 emission costs are ignored, the levelised cost of new conventional coal-based generation has generally been lower than the cost of alternatives. The economics change when CO_2 emission costs are internalised, but conventional coal plants continue to be competitive until CO_2 emission costs rise substantially. CO_2 prices have to reach quite high levels before it is uneconomic to run these plants, once they have been built. One of the central objectives of the coal industry is to keep CO_2 emission prices as low as possible until the technology to capture and store CO_2 is commercially available.

Regional and Social Distribution of Wealth. The benefits of the coal industry are shared unevenly. Typically, the beneficiaries of coal live or operate in the coal mining areas of the east (West Virginia, Pennsylvania) and the Rockies (Wyoming, Montana) and the coal-based electricity areas of the Midwest. Introducing a CO_2 price will negatively affect the economies, companies and generally the people of these regions. Naturally, political representatives will resist climate legislation that adversely affects their constituents.

Competitiveness of US Industry. Some industries, for instance cement and iron and steel, point to the risk of leakage (i.e., that business will move to other parts of the world where emissions are not controlled adequately). Although these industries now accept the inevitability of federal climate legislation, they have lobbied for mechanisms that will effectively protect them from cost increases and from foreign competitors.

The trade-offs described above add up to strong and organised political support for weakening climate change legislation, compensating the losers and helping the coal and related power industry to make a transition to a low carbon future. The fight is, to a large extent, between those regions and interests that benefit from low cost coal now, and those that do not. This fight will now be waged in the Senate, which will soon be considering ACESA. There are three features of the Senate negotiations that could lead to an even weaker bill from the environmental perspective.

First, the Senate is more sensitive than the House of Representatives to regional political interests. Support for aggressive climate legislation comes mainly from Senators in the states that rely least on coal, in particular the Pacific West and the North East. The states that rely heavily on coal

are more concerned about the introduction of climate legislation. This was already evident in the House of Representatives, whose representation is based on popular vote (i.e., population), but will be even more clear-cut in the Senate, where each state has the same voting weight.

Second, a significant proportion of the Senators from the states with coal interests are Democrats. Thus, while the Democrats now have sixty Senators and could pass legislation without the support of Republican Senators, there are many Democratic Senators who will press for further concessions, for instance an easier emissions cap.

Third, the states that rely most on coal are demographically the poorer states, both in terms of income per capita and unemployment. It is difficult for the current administration to pass legislation without ensuring that these groups are protected. In the current economic climate, the prospect of creating additional unemployment in these regions is especially unpalatable.

4 Coal and ACESA

ACESA is about 1400 pages long and includes numerous mechanisms to address the concerns of the coal and related power industry, their customers and other interests who would be threatened by more environmentally aggressive legislation. Some of the measures do not have a significant impact on the environmental integrity of ACESA or on international negotiations, for instance rebates to small customers whose electricity prices would otherwise rise significantly as a result of climate legislation. Other concessions to the coal lobby are positive for the environment, for instance incentives to invest in carbon capture and storage. However, some concessions weaken the environmental integrity of ACESA and are potentially problematic for global climate negotiations. I will focus on three of these.

First, the legislation postpones significant emission reductions. For large domestic sources of emissions (e.g. power stations) the cap and trade part of the legislation requires a 17 percent reduction in CO_2 emissions by 2020, and an 83 percent reduction by 2050, in both cases using 2005 as the base year. The early target is not ambitious by international standards. If the 17 percent were measured by reference to 1990 as the base year, it would amount to approximately no reduction at all by 2020. For similar sources of emission, EU legislation requires a 20 percent reduction compared to 1990 levels, with the potential to rise to a 30 percent reduction in the event of an international agreement. Even though the 2020 US target is not ambitious by comparison to EU targets, there will be a strong effort in the Senate to weaken it further. For instance, the mining industry argues that a 6 percent reduction (instead of 17 percent) would be required to maintain coal demand at current levels until carbon capture technology becomes more widely available.

"Support for aggressive climate legislation comes mainly from Senators in the states that rely least on coal"

Second, domestic cuts may be replaced by international offsets, reducing the 'domestic effort'. ACESA has two other main programs (as well as others) to cut emissions beyond the 17 percent that apply to large domestic sources: one to reduce tropical deforestation and a separate program for domestic and international offsets. The coal lobby supports international offset projects because they are expected to lower the cost of CO_2 emission permits in the USA. However, offsets reduce the incentive and the requirement to cut emissions at home. Furthermore, it is difficult to know whether these international offsets will deliver real CO_2 reductions abroad. Even if all the additional reductions were achieved, the overall US targets would still be below EU targets for 2020 and even further below the IPCC recommended reduction of 25–40 percent by 2020. Nevertheless, we anticipate that the coal lobby will press either for an increase in the volume of international offsets, or some other means to keep the price of domestic emission permits as low as possible.

Third, ACESA is a source of trade friction, especially with China and India. An indication of what is to come is in the early part of ACESA.

> The Administrator, in consultation with the Department of State and the United States Trade Representative, shall annually prepare and certify a report to the Congress regarding whether China and India have adopted greenhouse gas emissions standards at least as strict as those standards required under this Act. If the Administrator determines that China and India have not adopted greenhouse gas emissions standards at least as stringent as those set forth in this Act, the Administrator shall notify each Member of Congress of his determination, and shall release his determination to the media. (Section 3, International Participation, page 11 of ACESA.)

Later, ACESA imposes emission allowance requirements on importers of products in protected sectors from countries that have not passed climate legislation that is as demanding as ACESA. ACESA is clearly designed to support industries that are significant consumers of coal and coal-based electricity, including the iron and steel industry. Whether this legislation contravenes US obligations under the WTO is debatable; what is not in question is that it is provocative and will further heighten tensions with Beijing and New Delhi.

5 Implications: Good News, Bad News and Next Steps

Compared to previous US 'efforts' to combat climate change, ACESA is a step forward. No one doubts that the USA will engage in serious negotiations about the follow up to the Kyoto Protocol. ACESA will establish clearly the US position and will set the tone for the negotiations.

However, as currently drafted, ACESA is not ambitious enough, especially

in the period up to 2020. It does not respond adequately to internationally agreed targets, nor does it meet the tougher test of climate science. If it were to be weakened further as it goes through the Senate, this will undermine US credibility in climate negotiations. It is hard to believe that China and India will accept binding obligations to reduce emissions in response to this combination of unambitious US emission targets along with protectionist threats. If they do, they will be right to demand even greater transfers of financial and other resources from the USA and other developed countries to get the job done.

So what is to be done? To begin, the President needs to intervene more forcefully in the coming months to avoid further weakening of ACESA's environmental credibility as the legislation goes through the Senate. In particular, it is important to strip out or weaken protectionist measures, and to at least maintain the emission reduction targets.

Second, there is no credible path to stabilising global GHG emissions without reducing CO_2 emissions from existing power stations in the USA and China – the main source of emissions from the world's power sector. Both countries are likely to continue to rely on coal for electricity and it should therefore be a policy priority to create incentives to cut emissions from these plants. There are many ways to reduce emissions from coal plants, including retrofits to improve efficiency, biomass co-firing and carbon capture and storage (CCS). ACESA has already created incentives to develop and install CCS at new power stations in the USA. A central objective of ACESA and international agreements should be to provide the incentives to drive down the costs of CCS and other abatement technologies so that they will be adopted for existing stations in the US and more importantly in China, where most of the world's coal-based generation will be based. If ACESA were able to set that train in motion, the USA will have made a major contribution to defusing the climate change bomb.

How Resource Revenues can Halve Global Poverty

Paul Segal

'The meek shall inherit the Earth, but not its mineral rights'
J. Paul Getty

Who benefits from oil revenues? The bitter struggles for oil nationalisation through the twentieth century bear witness to the sensitivity of this question. Now that the principle of national sovereignty over natural resources has been established, the debate has moved on from which *countries* should benefit from resource revenues, to who *within* the resource-exporting countries will benefit. Political upheavals in Venezuela and Bolivia are two dramatic examples of what can happen when a majority feel that they are not getting their fair share of their national patrimony. This question became all the more pressing during a decade of rising commodity prices, leading to record oil prices, which the global financial crisis appears to have slowed only temporarily.

But while the years leading up to the current economic crisis were a period of almost unprecedented global growth, the World Bank has reminded us that well over a billion people still live in extreme poverty, below the World Bank's '$1-a-day' poverty line (now updated to $1.25 per day at 2005 prices and measured in purchasing power parity international dollars). In 2000 the United Nations pledged to achieve a set of Millennium Development Goals by 2015, the first of which is to halve the proportion of people living in poverty from its 1990 level. I have been considering whether resource revenues might lend a hand in achieving this Goal.

In doing so I have been analysing the potential impact of the simplest policy imaginable: that each citizen within a country receive his or her per capita share of their country's resource revenues, without conditions or qualifications. Since the payment would be uniform across all citizens within a country the relative impact on incomes would be greatest for the poorest, and the impact on poverty is potentially large.

This idea, which I call the *Resource Dividend* (RD), has been gaining traction recently in discussions of major hydrocarbon producers: the policy has been suggested for Iraq, Nigeria, Bolivia, and for energy exporters more generally. The Alaskan Permanent Fund, which receives 25 percent of state hydrocarbon revenues and passes them on as a Dividend to the citizens of the state, is an existing, though partial, version of the policy. But the originator of the idea that all citizens should receive some direct share of their national patrimony was Thomas Paine, in his 1795 pamphlet *Agrarian Justice*. Writing on the land enclosures in England, Paine started from the premise that 'the earth, in its natural, cultivated state was, and ever would have continued to be, *the common property of the human race***.** In that state every man would have been born to property' (emphasis in original). From this he argues that privatisation of resources may be desirable from the point of view of efficiency, but that all citizens should receive indemnification for their loss of 'common property'.

The idea that all citizens have an equal right to the natural endowment of his or her country thus has a long history, and is intuitively appealing. This does not imply that international oil companies, service companies, and other individuals and organisations involved in the process of making natural resources marketable should not receive fair payment for their services. But once these services have been paid for, the remaining revenues are pure *rents*: they are attributable to the bounty of the earth, and not to the efforts of any individual. As such, no individual has any special claim to them. In international law, codified in the International Covenant on Civil and Political Rights, the International Covenant on Economic, Social, and Cultural Rights, and other treaties, the world has agreed that resources belong to *the people* of the country in which they are found. The RD is a natural way to ensure that *the people* receive their fair share of their resources.

The Calculations

The Resource Dividend is a national policy, but the hope is that many countries would implement it. To estimate its potential impact on global poverty one therefore needs two global datasets: estimates of resource rents in all countries, and estimates of the distribution of income in all countries. Both are available from (different parts of) the World Bank and details of data sources and estimation methods can be found in my 2009 paper referred to below. Following the Alaskan Permanent Fund I assume that the RD is paid out as the 5-year average of resource rents, which allows some smoothing of incomes.

After re-estimating the number of people living below the World Bank's $1-a-day poverty line, I perform two exercises. First, I simply add the RD to everyone's income and count the number of people falling below the poverty line. However, if a government is already taxing resource rents then the expectation will be that other taxes will be raised to compensate for the lost resource revenues. The first calculation therefore assumes that all extra taxes are levied on those who were above the poverty line before the policy was implemented. Since the very poorest rarely pay any taxes this is not an entirely unreasonable assumption. But as a robustness test I also perform a calculation where each person is assumed to pay taxes proportional to their post-RD incomes, at a rate equal to the share of rents in GDP. So if rents are 4 percent of GDP and this implies a RD of $10 per month, then in this second calculation I add $10 to each person's income and subtract 4 percent from the total. The results are presented in Table 1.

Table 1: Number of people living below $1-a-day poverty line in 2005, millions

Current	1,327	(25.6%)
With RD	600	(11.6%)
With RD and tax	741	(14.3%)

Source: Author's calculations.

The number of people living below the poverty line in 2005 is estimated at 1.3 billion, or 25.6 percent of the population of the developing world. With the RD on its own, this drops to 600 million, a decline of 55 percent. With a RD that is paid for out of taxes proportional to income the number is 741 million, a decline of 44 percent. Global extreme poverty is therefore approximately halved by the policy, and the first Millennium Development Goal achieved at a stroke.

While the RD has been on the agenda for hydrocarbon exporters for some years, what is striking about these calculations is that the great decline in poverty is due primarily to countries that are not particularly rich in natural resources. Nine countries reduce poverty by more than 10 million people with the RD (Brazil, China, India, Indonesia, Nigeria, Pakistan, South Africa, Uzbekistan and Vietnam). Of these, five have resource rents comprising less than 6 percent of GDP. These five – Brazil, China, India, Pakistan and South Africa – account for 54 percent of the total population of all developing countries and 67 percent of the poverty reduction due to the RD. Poverty reduction due to the RD is therefore not primarily due to resource-rich countries. And while the impact of the RD on poverty is dramatic, 6 percent of GDP does not, by global standards, amount to a dramatic redistribution – European countries spend 6.6 percent of GDP on redistributive cash benefits, excluding pensions (and much more including pensions).

In India, for example, natural resource rents comprise 4.2 percent of GDP, most of it due to oil, gas and coal. But the RD reduces extreme poverty in India from 42 percent of the population, or 455 million people, to 20 percent, or 223 million people (24 percent or 267 million with proportional income taxes). What accounts for this surprising result? While the RD in India amounts to only $2.60 per person per month in cash terms, in terms of real purchasing power (using purchasing power parity, or PPP, exchange rates) this is worth more like $6.60 in urban areas of India, and $10 in rural areas – a reflection of the well-known fact that most everyday consumption goods such as food are relatively cheap in poor countries compared to rich countries. In 2005 prices, using PPP$, the World Bank's poverty line is PPP$38 per month. In rural areas India's RD is thus more than a quarter of the income of anyone below the poverty line. In China the RD is larger at $7.50, equivalent in PPP terms to PPP$20.50 in rural areas and PPP$15 in urban areas. Chinese extreme poverty is 16 percent or 211 million people; this drops to a mere 1 percent of the population with the RD, with or without a compensating tax.

Policy Challenges

For many developing countries the Resource Dividend would have a dramatic impact on poverty. But implementing such a policy may seem a huge challenge. It would have to overcome both political constraints and administrative constraints.

The political constraint is the simple fact that if governments are currently enjoying the flow of resource revenues to their coffers, then they are likely to be reluctant to give them up. While the proposal is that they recoup their lost revenues through general taxation, raising taxes is hard work and governments may prefer an easy source of revenues to the struggle of persuading citizens and businesses to hand over their money for government spending. On the other hand, the policy is in the direct interest of a majority of citizens. One might therefore expect it to be politically feasible only in a democracy where, for instance, an opposition party might decide that the RD is a vote winner, and that being in government with no source of easy money is better than being out of government.

The administrative constraint is that many developing countries with large informal economies have limited administrative reach across their territories, and getting cash payments out to citizens in distant or cut-off areas would be a challenge. But with modern technologies it would not be insuperable, and perhaps the most important technological advance in this area is the rise of cheap mobile phones, which enable people to manage bank accounts in remote areas in a number of developing countries. Beyond this minimal mobile phone infrastructure all that is needed is an electoral

roll to determine who is a citizen. As an unconditional and untargeted transfer, the RD is easier to implement than any other form of social benefit. The RD therefore requires no great administrative leap and would be feasible for all but the very weakest states.

Further Benefits

The political and administrative challenges are not insuperable. Moreover, they point towards further benefits associated with the RD. For governments of resource-rich countries that rely on resource revenues to fund the government, giving up these revenues and having to raise taxes from citizens and businesses in society may even ameliorate the *resource curse,* the finding that resource-rich countries tend to grow more slowly than resource-poor countries. One explanation for this negative effect is through the impact of resource revenues on government institutions. The argument is that it is only through the process of raising taxes that governments develop administrative capacity and the institutions of conflict resolution that define good government. When revenues can be extracted out of the ground, or through negotiations with mining companies alone, then the government is likely to pay little attention to fostering the rest of the economy and society. Losing resource revenues and having to raise taxes on the rest of the economy may therefore force a government to become both more effective and more accountable.

Moreover, the RD gives citizens a strong incentive to register with the fiscal system in order to receive their share. By reducing informality in the economy this would help to increase government administrative capabilities, and facilitate reforms of the fiscal system more generally – which are typically sorely needed in developing countries.

A final benefit of the RD is that its great simplicity would reduce the ease with which resource revenues can be skimmed off by corrupt individuals. This is for two reasons. First, the RD should be administered by an independent government institution that receives resource revenues and disburses them to individuals. By keeping these revenues separate from the government budget they are automatically insulated from standard forms of corruption such as overbidding for government contracts. Second, the RD is the easiest policy to make transparent. The administering institution would publish the quantity of revenue and the number of citizens, and each citizen will then know how much he or she is due. When people know what they are due it is much harder to keep it from them.

Conclusion

The impact of the Resource Dividend is potentially dramatic and it could reduce global poverty by half. But its greatest impact is in countries for which resource rents comprise less than 6 percent of GDP – and 6 percent of GDP is not, by global standards, a major redistribution. The policy is not as difficult to implement in administratively-weak developing countries as one might assume, and the implementation may indeed reinforce a government's administrative capacity by providing an incentive to workers in the informal economy to register with the fiscal system. Beyond these practical benefits, the RD is also legally and morally the most defensible use of resource revenues: since the natural resources in a country belong to all its people, the people should receive their fair share.

This article is based on Paul Segal (2009), 'Resource Rents, Redistribution and Halving Global Poverty: The Resource Dividend', Oxford Institute for Energy Studies Special Paper 22, www.oxfordenergy.org/pdfs/SP22.pdf.

Will a Crude Oil Price Band Stabilise the Market?

Bassam Fattouh

Introduction

The proposal for a crude oil price band, revived by the Indian delegation during the Jeddah Meeting in July 2008, seems to be gathering support. The French president Nicolas Sarkozy and the UK Prime Minister Gordon Brown urged 'oil producers to agree a target price range, based on a clearer understanding of the long-term fundamentals'. In a joint article in the *Wall Street Journal* (8 July 2009), the two leaders gave an indication of what the upper and lower band should reflect, arguing that 'the world's economy is still reliant on secure supplies at prices *that are not so high as to destroy the prospects of economic growth but not so low as to lead to a slump in investment*, as happened in the 1990s'. The proposal for a band for oil prices has also received support from a few oil exporters such as Venezuela.

These new calls for a price band represent an underlying change in governments' views about the process of price formation in oil markets. The sharp rise in oil prices in 2008 has raised concerns about the role of non-fundamental factors (mainly speculative activity in the futures markets) in the determination of the oil price. They have also raised the issue of whether importing and exporting countries have a role in reducing volatility in oil markets. An underlying theme is that oil price volatility is undesirable since it increases uncertainty, which hampers economic growth and undermines investment in the oil sector. Also by increasing uncertainty, volatility in oil prices could derail investment in alternative energy sources. Finally, there are fears that speculative activity can cause oil prices to overshoot and may choke off economic recovery.

Volatility and Oil Price Cycles

Since the main objective of a price band is to dampen volatility and prevent sharp swings in oil prices, it is important to make a few general observations about the nature of volatility. This will set a framework for this discussion about the price band and clarify some of the misconceptions in the current debate.

The first concerns the definition of volatility. It is important from the outset to distinguish between small price changes such as intra-day volatility, inter-day volatility, inter-week volatility, implicit volatility on the one hand and swings in oil price movements on the other hand. The latter are both sharper and of longer duration. From the various announcements, it seems that the proposal for a price band is not concerned with volatility *per se* but rather with preventing sharp swings. The two concepts are different. For instance, one could keep the oil price within a certain band but within this band, the oil price could exhibit high inter-day or intra-day volatility.

The second issue relates to the causes of day-to-day oil price volatility and those of sharp swings in oil prices. Fundamental factors that cannot fully explain short-term volatility may play an important role in explaining price swings.

The third issue relates to the various impacts of volatility. For instance, do oil companies give any consideration to intra-day or inter-day price volatility when making their decision on whether to invest, or not, in an oil or an alternative energy project? Do current episodes of price volatility affect OPEC's decision to invest in new capacity, or is demand uncertainty a much more relevant determinant of their investment decisions?

The fourth issue is whether the focus should be on price volatility at the near end of the futures curve or volatility of prices at the back end of the curve (i.e. further in the future). This distinction is important as argued below. It raises in turn a number of issues about the existence of transmission mechanisms of volatility between the front end and the back of the forward curve and whether the underlying causes of volatility are different in various points of the forward curve.

The final issue concerns the role of transparency and better dissemination of data and information. There is a perception that improvements in the quality, reliability and accessibility of the relevant information can reduce volatility. This may not be the case. Higher transparency and more information would increase the stream of news that hit the traders' screens, which may result in higher volatility as traders continuously react to news.

The preceding discussion highlights some of the complexities involved in defining and analysing oil price volatility. It also indicates that governments' main concern is not volatility *per se* but sharp price swings.

The Context

One of the major features that characterised the oil market during the 1980s and the 1990s was the stability of the long-term price for oil. While prices at the front part of the price curve exhibited, in some instances, high volatility reflecting deteriorating geo-political conditions and sharp downward swings, price volatility was rarely transmitted to the back end of the futures curve.

As oil prices rose sharply during the boom years, uncertainty about the existence and the timing of feedbacks from prices to oil supply and demand markedly increased. This affected the way in which expectations were formed – with important implications for oil price determination. In effect, the market entered into a phase of indeterminacy of beliefs, where market participants (including oil companies and oil producers), did not know where to anchor the anticipated oil price that would balance supply and demand in the long run. In effect, prices in the short and long run became jointly determined. The whole futures curve became subject to a series of roughly parallel shifts.

This changed with the current financial crisis, which created a strong feedback in the oil market, especially on the demand side. Whether the decline in global oil demand and the rise in spare capacity will help to re-establish powerful feedbacks into the oil market and stabilise the anticipated longer-term oil price is yet to be seen.

The Implicit Price Band

The idea of a band is, in one sense, trying to reinvent the 'normal' functioning of the oil market. In effect, the current oil market operates within an *implicit* band. The upper and lower bounds are determined by different sets of beliefs which themselves are based on *expected* fundamentals of the oil market. When oil prices rise above a certain 'normal' level, the view that high oil prices would impact on demand and/or induce a slowdown in growth and/or encourage substitution at the margin dominates the market. The rise in price would lead to an expectation that prices would fall in the future. On the other hand, when prices fall below a certain level, the view that such low oil prices will induce an OPEC response and/or slowdown in non-OPEC supply will dominate. Again, this is stabilising and will lead to the anticipation of future price rises.

Within the implicit band, price changes are influenced by a very wide variety of public signals about fundamentals or expectations of fundamentals. But this may not always be true in an environment of high uncertainty. In a market characterised by indeterminacy of beliefs, market participants tend to form their expectations of futures prices on the basis of anticipations of other players' expectations. This captures some of the intuition provided by Keynes's beauty contest metaphor where traders are motivated to guess other traders' guesses to benefit from short-term movements in oil prices.

The above framework offers useful insights that could help us explain the short-term behaviour of oil prices in 2008. One such insight is the importance that public information or publicly observed signals acquire in the context of 'beauty contests'. Since public signals can affect my guess about other players' guesses, they could have a disproportionate impact on the oil price. In a market characterised by indeterminacy of beliefs, participants watch closely public signals and other market participants' reaction to these signals. What will matter in forming investors' expectations is what other investors

think and how other investors are likely to respond to public signals and information. For instance, if I think that other investors will respond to public news about a weak US dollar, then it is profitable that I also react to such news. This is rational even if I think that news about the weak dollar is not relevant for understanding oil market fundamentals.

Rather than guessing the beliefs of other players, agents can decide to mimic the action of others. In fact, in the presence of uncertainty, copying the decision of others may be rational at the individual level. If the shifts in demand for assets are correlated among traders and do not cancel each other out then noise trading is capable of influencing market prices.

The events of the last few years have highlighted three features about the *implicit* bands and behaviour of traders within the bands. First, the band has become very wide as a result of lowering and lifting the upper bound. In the last year, the implicit band ranged between $35 and $140. Currently, the price is oscillating in a much narrower band between $60 and $70. Some investment banks such as Barclay's Capital are predicting that the 'Goldilocks range of prices, which are neither too hot for consumers nor too cold for producers, probably stretches over the interval, from about $75 per barrel all the way up to $100 per barrel'. Second, financial players are not shy in testing the upper and lower bounds, which may result in overshooting or undershooting of prices. The sharp rise in the oil price in the first half of 2008 could be viewed as an attempt by the market to test the upper bound of the range and elicit some sort of supply, demand or policy response. The fall in the oil price in 2009 to less than $40 can be viewed as an attempt by the market to test for the lower bound of the range. Third, short-term and long-term price expectations can operate in parallel as reflected in the recent divorce between the front end and the back end of the forward curve causing some steep movements in the time spreads.

Feedbacks and Expectations of Feedbacks

So the next question is: How could policymakers improve on the already existing implicit band? There are two potential ways. The first is to bring short-term expectations in line with long-term expectations to avoid steep time spreads and their destabilising consequences. The second is to narrow the band within which price oscillates. This requires governments to bring back into the oil market an expectation of the feedbacks if prices move outside the band.

Thus to enforce a band, there is a need to establish certain mechanisms that induce expectations about feedbacks in the market. If such feedbacks are built into the expectations of market participants, then the price could be contained within the band without any adjustment in actual levels of output. Of course, there is always the possibility that the market from time to time would like to test whether these mechanisms are operating in a smooth manner.

In theory, there may be a role for government to play in stabilising long-term expectations. However, it is important to move away from focusing solely on the role of speculation and transparency issues towards a more general framework that also takes into account the way the market functions and the expectation of feedbacks.

The Limitations of Existing Mechanisms

Given current oil market conditions and the divergent interests of the various players, it is not clear where the response would come from if the price were to increase above the upper bound. One potential response would be for OPEC to increase production to bring the price back within the band. However, the response from OPEC in a rising market is not straightforward. First, the objective function of OPEC is not to impose a ceiling on oil prices. The objective of OPEC is to ensure that the market is well supplied – i.e. that supply disruptions are avoided. It does not have a mechanism or an agreed set of tools to lower oil prices. For instance, OPEC does not offer discounts on its crude oil or auction its spare capacity in an attempt to bring prices down when it thinks that oil prices are too high. This is especially the case if OPEC thinks that the market is well supplied (at a given price) and there is no additional demand for its oil. Moreover, there is an OPEC concern that increasing production without any coordination with consuming governments could result in an uncontrollable decline in oil prices. Finally, any attempt by OPEC to bring prices down could be confronted with popular discontent in the home country.

In fact, Saudi Arabia's position on this issue is unambiguous. When asked about whether it is possible for OPEC to contain price spirals, the Saudi Oil Minister Ali Naimi's response was clear – stating that this 'is the biggest challenge' and then reinforced his position by stating that 'it's very difficult. There are too many players in the market. It's impossible with so many players.' After all, one major lesson that we should have learnt from the previous boom–bust episode is that OPEC matters most when oil market fundamentals are weak. In a rising market, OPEC is just another market player, with some potential influence on the market, but no desire or willingness to play an active role. In a rising market, OPEC can be expected to play an active role only in the case of physical disruptions, as was the case when hurricanes caused much destruction in the US Gulf region, or in 1990 when Iraq invaded Kuwait.

What about oil importers? One of the very interesting features of the last oil boom was the lack of response from oil-consuming governments to rising oil prices. Other than playing the 'blame game' and criticising OPEC and speculators, the response by consuming countries was extraordinarily subdued. In part, this can be explained by geological and policy constraints.

There is one card that consuming countries could use to generate a feedback from high oil prices to the market, but which was not used in the last boom: the release of oil from strategic petroleum reserves. In the past, US governments have been reluctant to use this card, but this might change under the new US administration. If this 'oil weapon' is ever used, this would constitute a major shift in US energy policy from security concerns towards more active management of the market. This could generate a strong feedback in the market that could, in theory, place a ceiling on oil prices, at least in the short run.

Using the SPR or more generally establishing a global oil fund to police the upper bound is fraught with risks. The

release of oil from the SPR may not work or even backfire if the market interprets such an action as reflecting a sense of emergency and/or deteriorating market fundamentals. Furthermore, as the experience of the foreign exchange market has shown, speculators can attack the 'band' causing the SPR to deplete and lead to a collapse of the price band and uncontrollable movement in oil prices.

What about protecting the price floor? Here the response from OPEC is straightforward. The Organization would implement output cuts to prevent prices from falling below the floor. The largest uncertainty, however, concerns importing governments' response if prices fall below the floor. In theory, there might be some options available for importing governments. For instance, non-OPEC suppliers could support OPEC policy by announcing output cuts. Western leaders could send clear signals that low oil prices are damaging and provide public support for OPEC moves. Alternatively, importing countries may show willingness to support the price by creating artificial demand – for instance through building up the SPR. It is clear that these and other similar options require far reaching changes in policy that no importing government seems, so far, willing or even capable of implementing.

Thus, a fundamental weakness of policing such an oil price band is that it has to be managed by parties with very divergent interests. In a rising market, OPEC loses interest in policing the upper bound and, when prices fall, importing governments lose interest in policing the lower bound.

The Credit Crunch and the Long Awaited Feedback

The latest oil price cycle indicated that in booms the demand, the supply and policy feedbacks needed to put a cap on rising prices are rather muted. It was the impact of the credit crunch on global growth and on global oil demand that generated a powerful feedback into the market. In other words, the long awaited feedback into the oil market finally arrived in the third quarter of 2008. Three features characterised the nature of this feedback: (i) its impact was felt on the demand side; (ii) it mainly originated from outside the oil market; (iii) it has little to do with government policy. For a price band, this type of response is far from ideal.

Stabilising Future Expectations

Rather than aiming at stabilising spot prices within a band, the main objective of both oil-importing and -exporting governments should be to stabilise market participants' long-term expectations. As mentioned before, one of the main features of the latest oil price cycle was the unlocking of the back end of the forward curve. Since 2004 and until most of 2008, changes in the prices at the front end of the curve were normally associated with very similar changes in prices at the back end of the forward curve. This indicated that market participants virtually had no expectations that the oil price will revert towards equilibrium within the relevant horizon.

In theory, an oil price band could help stabilise long-term expectations. But given the limitations discussed above, the market can instead opt for a reference long-term oil price. Unlike the band, this does not require physical intervention in the oil market. The main criticism of this proposal is that it involves such a weak commitment that it would not change anything in practice. But this is not necessarily true. It has been long recognised in game theory that when individuals are confronted with large uncertainty, focal points may in some instances play an important role in providing a point of convergence for individual expectations. Some focal points may be *a priori* more reasonable or more prominent and noticeable than others. In the context of the oil market, the impact of the focal point would be stronger when governments of different countries agree and communicate their preference about the focal point.

In a rare precedent, King Abdullah of Saudi Arabia said in a newspaper interview that he considers $75 to be a 'fair' price for a barrel of crude oil. The Saudi Oil Minister, Ali Naimi, justified the target price as the 'price that marginal producers need to maintain investments sufficient to provide adequate supplies for future oil consumption needs.' The announcement of output cuts in October and in December 2008 did not help anchor market expectations around OPEC's preferred price. Saudi Arabia's signal about its preferred oil price was being washed out by news about the depth of the recession. However, as oil price movements started hovering above $60, Saudi Arabia's preferred price seemed to gain more influence. Coming from a key oil exporter with a strong capability to influence oil prices, the $75 may create a focal point in the market towards which investors' expectations converge.

However, the market should not be under any illusion that the new price target constitutes a stable equilibrium. While there is the possibility that the new price target set by Saudi Arabia may help in bringing about a convergence of expectations, the market may move to the $75 oil target but only to discover that this focal point itself is 'unstable'. This will occur if the expected feedbacks at the $75 oil price are slow or are perceived not to be forthcoming either on the demand side, the supply side, or both. Thus, in line with the idea of focal points, it is important to strengthen some of the feedbacks in the market.

Conclusion

It is clear that a necessary (but not a sufficient) condition for an oil price band to operate is an overarching political agreement between exporters and importers. Since oil creates rents, this in effect means that there must be a fundamental agreement on the distribution of these rents between oil exporters and importers. Given the divergent interests of significant parties, market participants (including financial players) are very sceptical about producer and consumer governments reaching an agreement about the distribution of oil rents which would be both credible and durable. The most that the market could ask for is a focal point towards which long-term expectations can converge. But even this requires some sort of basic international coordination, which is still not forthcoming. Until then, it is business as usual for the oil market.

Wind Power

John Constable and Hideaki Aoyama on wind power load factor in the United Kingdom

Introduction

The United Kingdom has ambitious plans to construct large fleets of wind generators both on- and off-shore. This programme is driven by the Renewables Obligation (RO), a support mechanism that adds around £1 billion a year to consumer bills at present and is forecast, in its current incarnation, to have cost the consumer around £32 billion in total by 2027. Revisions intended as part of the Renewable Energy Strategy to meet the EU's 2020 target of 15 percent of Final Energy Consumption must be expected to require an even greater levy on electricity users.

The effectiveness of the Renewables Obligation is difficult to gauge from build rates and total installed capacity, since it is not immediately evident that the RO encourages the selection of higher rather than lower load factor sites. Load factor is also a matter of considerable interest to investors, due to its effect on Internal Rate of Return (IRR). This article aims to move towards a better understanding of these matters via a statistical examination of the distribution of load factors in 2006 and 2007.

The monthly load factor for all renewable generators registered under the Obligation can be calculated from raw data issued by the regulator, the Office of Gas and Electricity Markets (Ofgem). These load factors are published in a convenient and where necessary corrected form by the Renewable Energy Foundation. Using this database we have extracted annual load factors for those operational wind farms for which a complete year's generation data are available in 2006 and 2007. This amounts to 139 sites and approximately 1,600 MW of installed capacity.

Overall Load Factor Distribution

A histogram of the data shows that the distribution does not fit the normal or log-normal curves; however, if the data is charted as a scatter plot (Figure 1) a striking feature becomes apparent.

There are two groups, the lower consisting of nine wind farms and the upper of the remaining 130, separated by a gap (indicated by a grey band) corresponding to a mean load factor of between 12.65 percent and 15.5 percent. Given this finding, it is preferable to consider these two groups separately, and in what follows we will concentrate on the upper grouping.

If we rechart the histogram for the upper 130 wind farms we find that the distributions now fit the normal and log-normal curves with acceptable accuracy and with smaller standard deviations (Figure 2).

Since the lower group size is small it is likely that statistical errors will be large; however, if statistical means of analysis are to be selected then the log-normal method should be preferred, since it covers the range 0 to + infinity, rather than the – to + infinity covered by the normal distribution. We note that the data in this set cover smaller, older, wind farms and we conclude that this is of little further interest here. In effect, our finding above enables us to separate the misleading data from the main data set.

Figure 1: Scatterplot of UK Wind farm Load Factor in 2006 and 2007

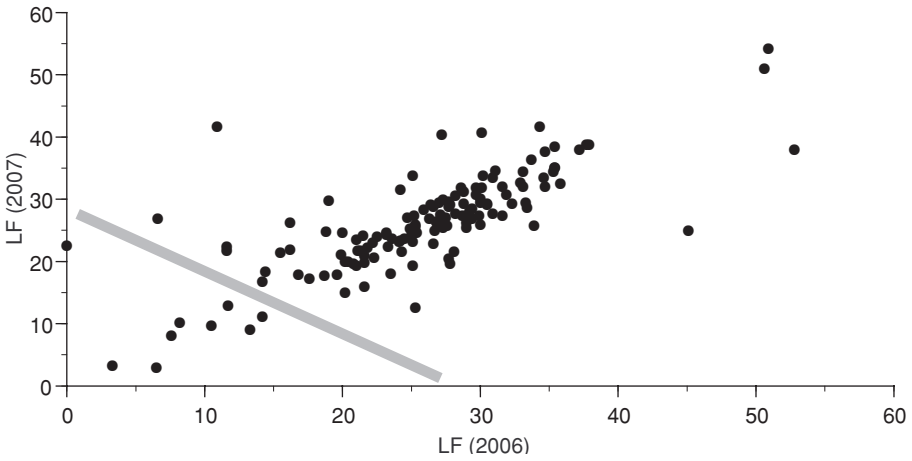
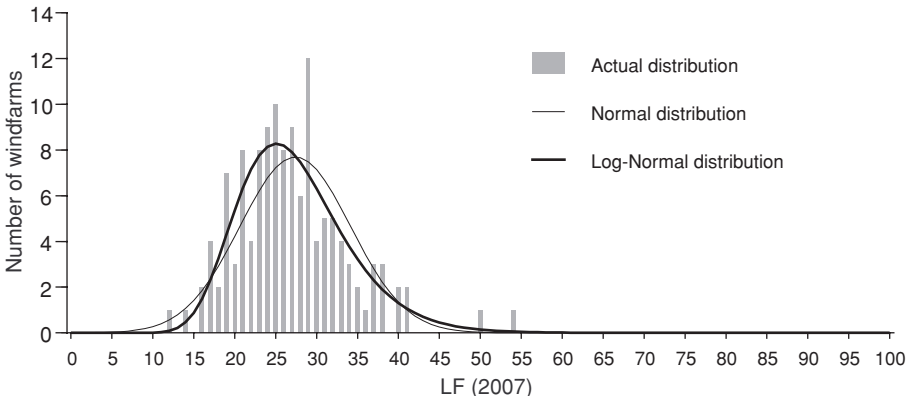


Figure 2: UK Wind Farm Load Factor Distribution 2007: Upper Group



Standard Deviation of Load Factor

On removing these data from the main data set we see that the standard deviations of load factor in both 2006 and 2007 are substantial, namely 7.2 and 6.7 around a mean of approximately 27 percent. Put another way, the overall mean is a poor guide to the performance of any particular wind farm.

A closer analysis reveals that variability is particularly marked for smaller wind farms, and though reduced for larger wind farms is still substantial. Figure 3 charts mean load factor against installed capacity (upper lines), and standard deviation against installed capacity (lower lines).

The mean is more or less stable for wind farms over 15 MW, though the standard deviation remains at around 4. For sub-15 MW wind farms the mean is volatile, and the standard deviation is high.

This is to be expected for several reasons. For example, the mechanical failure of one or two turbines in small wind farms will cause a larger proportional impact on annual load factor than it would in larger wind farms. However, we have no way at present of determining the significance of this and other similar effects.

While acknowledging the role of such other causal influences, we hypothesise that since larger wind farms are more costly to develop, and require more capital to construct than smaller ones, companies involved in their planning are more likely to focus on available wind resource to ensure adequate return on capital. By contrast, smaller wind farm developers will be more speculative. It may also be the case that developers of larger wind farms are more likely to intend long-term ownership of the site, rather than an early exit through sale of the consent.

Refining the Understanding of the Load Factor Distribution

While the observed data are an approximate fit to the normal distribution it is clear that they are not a close fit. This can be confirmed by a more sophisticated examination. For example, let us take the upper load-factor group of 130 wind farms in the 2007 data. If the data obeyed the normal distribution, the skewness would be consistent with a distribution with a centre equal to 0 and a standard deviation of 0.21. However, the observed positive skewness is 0.89, which is some 4.15 times the standard deviation (i.e. the bulk of the distribution is towards the lower load factors on the left, with a long tail towards the higher load factors on the right).

We also note that the skewness of the log-normal distribution is 0.75, which is in reasonable agreement with the data, and suggests that it is a fair descriptor. However, for the same data set the kurtosis, the measure of the peakedness of the distribution, is 4.83, which tells a very different story.

Similarly, the normal distribution for kurtosis has a centre at 0 and standard deviation of 0.43, so the observed kurtosis is 11.2 times the standard deviation, which is large. Overall, therefore, we conclude that, strictly speaking, the achieved Load Factor data do not obey a normal or log-normal distribution.

While this is not particularly surprising the very large degree of kurtosis is so. In fact the distribution is leptokurtic, in other words it is particularly sharp-peaked compared to the normal distribution. If we chart the average LF distribution (averaged for 2006 and 2007) this is clearly apparent (Figure 4).

It should be noted that this plot includes data for all 139 sites and that the skewness is only 0.032, the low value resulting from the fact that the large positive skew of the upper cluster is cancelled by the addition of the lower cluster. However, the kurtosis is 4.59, some 11 times the standard deviation of 0.42 for the normal distribution. The log-normal distribution's kurtosis is 4.51, a value similar to that of the data, but the distribution is a poor fit.

We can further split the data into a lower installed capacity group and a higher installed capacity group, so that kurtosis of each group is smaller. For example, we can split the data at x MW and calculate the kurtosis of the lower group and upper group, and then the square sum of kurtosis. With values of x from 1 to 20 the square sum was minimised at around $x = 3$. With the optimised installed capacity boundary set at about 3 MW the kurtosis of load factor in each group is about 5.5 and 4.6 times larger than their standard deviations. While these values are far smaller than those noted above, they are much larger than, say, the 1.96 required for matching with the normal distribution at a 95 percent confidence level. Consequently we can conclude that grouping windfarms by their installed capacity values does not yield normal distributions for load factor.

Figure 3: Mean Load Factor and Standard Deviation of Load Factor (LF) charted against installed capacity (IC)

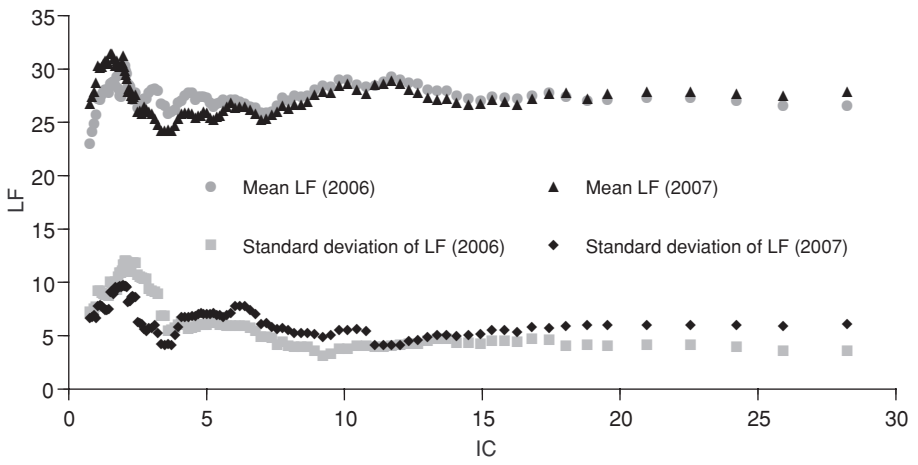
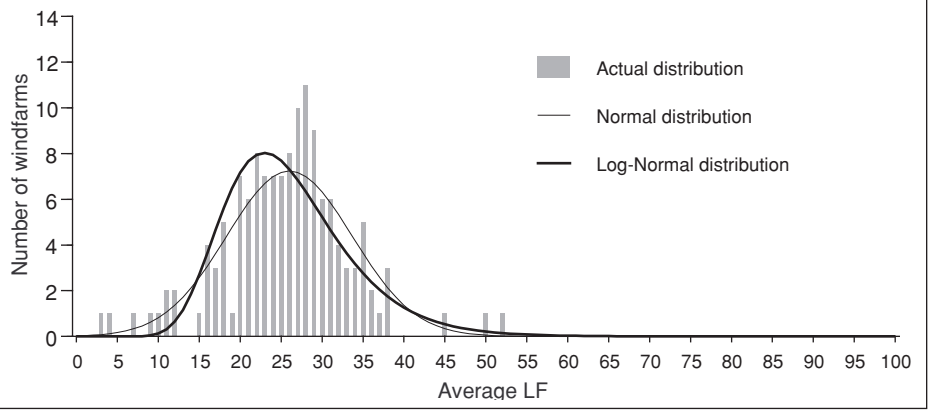


Figure 4: Average Load Factors 2006 to 2007



Discussion: Load Factor Distribution, Standard Deviation and Subsidy

As noted above, the Renewables Obligation entails a significant increase in prices to consumers and future iterations of this mechanism will further increase this levy, with wind power expected to be the major beneficiary. In the light of this, it is clearly a matter of concern that the funding produces optimal results, and there has been widespread concern that the system has serially rewarded the least capital-intensive technologies, initially landfill gas and latterly onshore wind, to the exclusion of others.

We acknowledge these broader concerns, but will put them aside to ask if our analysis sheds light on whether the RO is encouraging the wind sector itself to develop in an optimal fashion through the selection of high wind sites.

The reasoning behind this criterion is that the total capacities that are viable and economic in the UK in any foreseeable time frame (up to 2020 say) will be limited by system balancing problems and the costs and availability of solutions. It is therefore important to ensure that as much energy (MWh) is generated from the limited capacity (MW).

No closely reasoned estimate of the capacity limit has been offered, and it is arguably difficult in principle without further empirical experience of system behaviour. However, we venture the suggestion that the figure of approximately 10 GW is plausible since it is just under half of minimum load in the United Kingdom (ca. 25 GW). At 27 percent load factor this would yield approximately 24 TWhs, which is about 6 percent of UK total generation. We note, as a matter of interest that Denmark and Germany combined have integrated only a little more than this, 7 percent, even with very considerable interconnection and the availability of the balancing services of Norwegian hydro.

The UK is only weakly interconnected, with a 2 GW link to France, and with a 1 GW link to the Netherlands under construction. Further connections may occur, but this will take time, and in any case study of empirical experience in Denmark suggests that the value of interconnection may be limited. It should be recalled that interconnection is a route to a balancing solution, not a balancing solution in itself.

Other measures such as demand control and storage are promising but the speed of their deployment at scale must be regarded as questionable.

Assuming that the UK's wind capacity will be limited, it is important that the load factors of selected sites are optimised. This is in itself an argument for offshore wind, where achieved load factors at mature sites in Danish waters are approximately 40 percent. It is well known that the original design of the RO failed to encourage offshore development, and government has subsequently introduced differential rewards, 'banding', to address this matter.

Furthermore, the current load factor data do not suggest to us that the Renewables Obligation subsidy system is motivating the pursuit of high load factor sites onshore. Specifically, the very large magnitude of the standard deviations suggests a lack of focus on energy yield.

That is to say, if developers were prioritising wind resource when selecting a site we would expect to see distributions with smaller standard deviations, or possibly a significant general negative skewing towards higher load factors (i.e. the bulk of the distribution would be towards the right of the graph). In fact what we observe is a positive skewing (the bulk of the distribution is towards the left of the graph, with a long tail to the right).

One possible interpretation of this finding is that the RO has not motivated the selection of high wind sites. However, we note that a few very high achieving sites in Scotland and Northern Ireland are largely responsible for the observed skew; if the top six sites are removed then the skewness falls to 0.1. Even granting this, the fact remains that the distribution is not skewed towards higher load factors.

From an investor's perspective the large standard deviations suggest that national mean or generic load factors are a poor indicator of probable site quality. Another possible inference is that either the sites and site layouts are not being selected to maximise load factors, or else many of the pre-build assessments of potential load factors are flawed. There appears to be a limited understanding of meteorology in the wind farm literature, which may result in poor decision-making in site assessment. Location-specific data and wind speed data at the appropriate height are essential when considering the value of any proposal or any existing wind farm. Lest it be thought such matters are minor considerations we note a recent investor presentation by Scottish and Southern Energy, one of the most experienced of wind farm operators in the United Kingdom, in which it is observed that a '10% increase in yield, ~ 1% increase in IRR'.

That is to say, even apparently small variations in load factor, two or three percentage points, can have a significant impact on project economics.

At a sophisticated level of engagement the leptokurtosis observed in the distribution is both very striking and difficult to explain. One possibility is that there is a certain amount of erroneous generation information (relating to around 10 wind farms) in the current data. We note that from the outset in 2003 the annual reports of the Office of Gas and Electricity Markets (Ofgem) concerning the Renewables Obligation have, on the basis of a handful of audited sites, expressed concern with regard to the under-reporting of input electricity, and various issues with metering quality. In the light of this, one possible interpretation of the leptokurtosis is that some wind power operators are providing estimated generation data. We have discussed this matter with Ofgem, who inform us that they consider the scale of estimates authorised due to meter failure and other problems are unlikely to be significant. We note that a comprehensive audit of wind farms might reveal other sources of error.

We have also made a brief examination of the 38 wind farms with a load factor between 26 and 30 percent to determine whether there is any common feature, such as geographical proximity, or shared technology or common ownership that might account for the leptokurtosis, but we detected nothing of apparent significance. A further possibility is that these wind farms have a particular feature of site design, layout for example, in common, and this is an area for further research.

In view of the large public subsidies for wind power, we believe it is in the public interest that more detailed performance data for existing wind farms are made available so that these issues can be studied in greater detail and future decisions based on the best available understanding.

Malcolm Keay considers the paradoxes of wind power

Introduction

The development of wind power in recent years has been full of paradoxes – and this is in itself something of a paradox, given that the power of the wind is easy enough to understand, indeed to experience directly, on a windy day.

Among the most obvious paradoxes are the following:

- **New but old.** Wind power is normally classified among the so-called 'new renewable' energies along with such sources as wave power and photovoltaics. But of course wind is one of the oldest sources of power, and has been exploited for millennia. What is new, of course, is the use of wind power to generate electricity, a process which first took off in the USA in the early 1980s, driven by the tax credits then on offer. The focus of action then moved to Europe where wind power expanded rapidly in countries such as Denmark, Germany and Spain, encouraged by high support prices.
- **Environmentally friendly but environmentally objectionable.** Wind power is thought by many to be environmentally friendly, given that it is a renewable source with no CO_2 emissions from operation. But one of the biggest problems for wind developers in the UK is the considerable opposition to new wind farms on environmental grounds. Many more wind farms are rejected at planning stage than, for instance, gas turbines.
- **Secure but unreliable.** Again, the proponents and opponents of wind power take diametrically opposed views. On the one hand, wind is an indigenous, renewable source, not dependent on imported fossil fuels. On the other, it is intermittent and unpredictable (or perhaps more precisely uncontrollable).
- **Economic but subsidised.** This is another contentious area. Wind is argued by its proponents to be nearly competitive with fossil sources – and fully competitive once environmental externalities like CO_2 emissions are taken into account in prices. On the other hand, wind power has always been dependent on government support – and that need seems to be increasing. One part of the answer to this paradox is relatively simple – there is no such thing as the cost of wind power in general; there are only the economics of particular projects at particular places at particular times. Two broad generalisations seem safe however: wind is generally not competitive with conventional (non-renewable) sources of generation, but is generally the cheapest of the 'new renewables'. Furthermore, the economics of wind power are affected by two trends which tend to move in opposite directions – on the one hand, as the technology improves, costs tend to fall; on the other, since the costs are site specific, the best sites tend to be used first so leading to a rising cost curve over time. Proponents of wind power tend to emphasise the former, though it seems recently to have levelled out (and even went into reverse as the price of inputs soared earlier this decade). It is the trend in site economics that now seems to be predominating, in the UK at any rate, as the focus of development moves offshore.

However, this article is concerned with a further anomaly:

- **UK – well placed but lagging.** The UK has probably the best wind resource in Europe, but the development of wind power (and indeed of all renewables) has been slow. Despite decades of government support, the UK remains at the bottom of the European league in relation to the penetration of renewables in its energy system, languishing along with such states as Hungary and the Czech Republic, well below Portugal and Ireland, much less Germany or Denmark.

European and Global Background

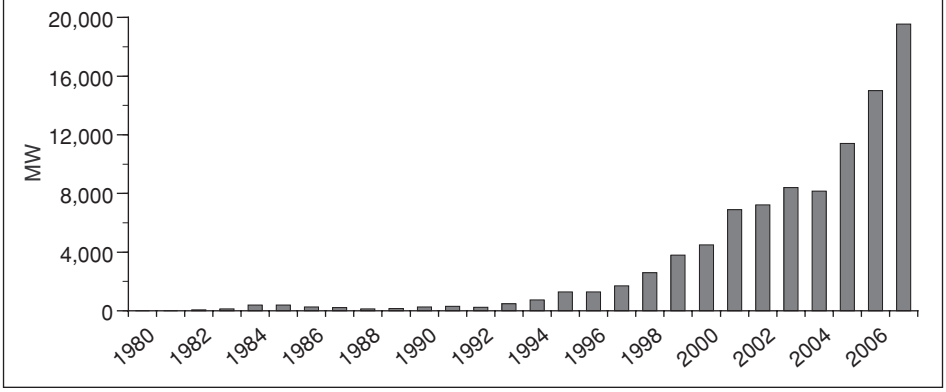
According to the European Wind Energy Association, in 2008, for the first time, wind energy was the largest single form of new power capacity in Europe, as shown in Figure 1.

This follows years of rapid global expansion – a growth rate of over 30 percent per year in wind capacity over the past ten years as shown in Figure 2.

This growth has taken place in many of the countries you might expect to be prominent in this area – Denmark, Germany and Spain and (after a period of low interest) the USA. But it should be stressed that it is not solely an OECD phenomenon. China and India are both active in the manufacture of wind turbines and in the development of domestic wind generation. Indeed, China is currently the most dynamic wind market in the world, having doubled its wind capacity in each of the past three years.

Such developments, along with the renewed interest in the USA, led the World Wind Energy Association to conclude, in its report for 2008, that: 'North America and Asia catch up in terms of new installations with Europe, which shows stagnation.' That is, it describes as stagnation a year when in Europe, wind led the league table on new power plant installation!

Figure 2: World Wind Annual Additions (MW)



Wind in the UK

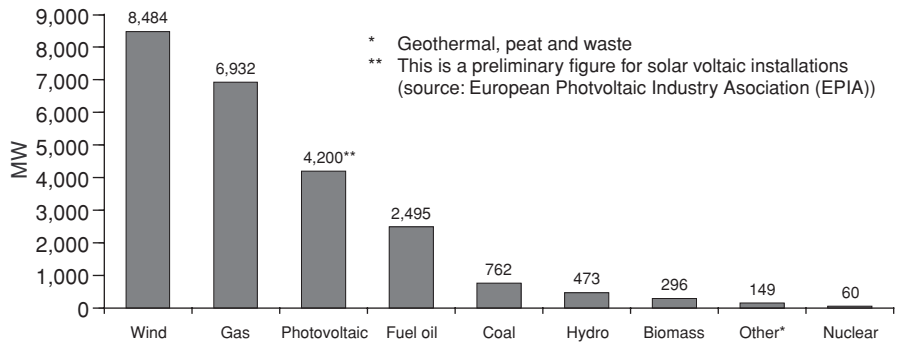
While the UK has seen significant wind development, against this background its efforts seem feeble. Wind currently accounts for less than 2 percent of electricity generation – under 1 percent of the energy supplied in the UK.

Why the slow rate of development? One thing is clear – it is not for lack of government policies and targets. Wind has been given significant policy support for the best part of two decades. This came first through the so-called Non Fossil Fuel Obligation (NFFO), which operated during the 1990s. It had some successes; although only relatively small quantities of wind generation were built, the technical cost of wind power fell significantly. In the second NFFO round in 1991, the average cost of wind was around 11p/kWh; by the time of the fourth NFFO round in 1997, the cost had fallen to between 3 and 4p, leading some to conclude that wind would soon need no subsidy. In practice, of course, wind has needed continued and increasing support, now given primarily through the Renewables Obligation (RO) scheme described below. Onshore wind power, being generally the cheapest renewable source, tends to be the favoured option under the RO.

The UK had a target of 5 percent of electricity to come from renewables by 2000 and 10 percent by 2010. The first has already been missed; the second will no doubt also be missed – it was only in 2008 that the proportion of renewables finally reached the 2000 target. It currently stands at a little over 5 percent; wind is about one-third of this total. For 2020 the UK initially had a target of 20 percent of power from renewables. This was widely regarded as unrealistic, but has actually been increased in line with the EU's target of 20 percent of energy from renewables by 2020. The UK share of this target is for 15 percent of energy from renewables by 2020. This may not sound overly onerous but it applies to total energy supply, not just electricity; given the current low rate of renewables penetration (only 2¼ percent of UK energy) the increase required of the UK is in fact the most ambitious in Europe. Furthermore, since most of the renewable energy will in practice be in power generation, the new goal translates into a target of over 30 percent of power generation from renewables, most of which will have to be wind power. The government recently published a new Renewable Energy Strategy setting out how it proposed to meet this target.

Is the UK likely to stop being the laggard in Europe? This seems unclear.

Figure 1: New Power Capacity Installed in 2008



Source: EWEA and Platts Power Vision

There have been three main factors underlying the slow progress in this country:

- **Environmental objections.** These have been much stronger in the UK than in other European countries and the planning process has taken longer and proved more risky – about half of proposed onshore wind projects are rejected, though offshore projects have fewer problems. Private wind developers often describe this as the main drawback of operating in the UK.
- **Form of support.** Under the RO scheme in the UK electricity suppliers have to source a certain proportion of their power from renewables, a proportion that rises year by year. Renewables generators receive income both from the direct sale of their power and from the sale of certificates (called ROCs). Suppliers must have enough certificates to cover their quota, or pay a buy-out price (which is in turn fed back into the renewables support system). The current price for a ROC is around 5p/kWh; at recent power prices of around 4p, onshore wind operators therefore receive over double the income of conventional generators, while offshore projects get even more help. The system is fairly market friendly but entails considerable uncertainty as to the future value of the ROCs, which constitute most of a wind generator's income. Most countries have gone for rather simpler systems involving Feed In Tariffs (FITs) or premia – a fixed price or premium for renewable electricity. Such systems are used in the fastest growing wind markets like Germany and Spain, and China has a comparable approach, based on tenders for new wind power projects; the US has a variety of support systems in different states. Nearly all studies show that FIT systems are much more effective at encouraging new renewables capacity, because of the greater certainty they provide. Recently the IEA concluded that well-designed FIT systems have 'proven to be both effective and cost-efficient' while quota systems 'showed higher transactions costs and turned out to be much less effective and more costly than expected'.
- **Difficulties of operating offshore.** Given the environmental difficulties onshore, the UK has to look offshore for most of its future wind capacity. But the offshore environment is very challenging, risky and expensive and it is by no means clear whether it will prove feasible to deliver the results the government is aiming at. A 2004 Report by the House of Lords Committee on Science and Technology commented that 'the potential obstacles to large-scale wind development remain formidable' and that 'it remains to be seen whether offshore wind power can fulfil the vital role assigned to it.' The NAO has also pointed out that risks and costs are likely to be high for offshore wind and that the potential is very uncertain. Support for offshore wind has increased but these practical questions remain.

Prospects for 2020

The government recognises the problems but has so far tended to address them piecemeal. First, as to the measures taken to address the three issues mentioned above:

- **Environmental objections.** A new Planning Act is designed to speed up the planning process for so-called Nationally Significant Infrastructure Projects – to include offshore wind farms over 100MW and onshore farms over 50MW. The aim is to provide planning decisions within nine months of the start of the process. The process will be supported by a renewables National Policy Statement setting out why development is in the national interest. However, the new system remains to be tested.
- **Form of support.** The government appears to have no very strong argument for continuing with the ROC system – it says only that changing to a FIT system would cause delay and uncertainty and might be incompatible with the liberalised power market in the UK. Nonetheless, the government recognises that it will need to change and extend the support – for instance, by using FITs for small generators, developing the RO system to give extra certificates for more expensive technologies such as offshore wind, perhaps adding floor prices and 'headroom' (to maintain ROC price levels), reducing exposure to electricity price fluctuations and so on. But these measures would add significant extra complications, reduce the importance of market signals and get rather close to picking winners. Furthermore, in many cases, extra capital grants of various sorts are needed to promote offshore technologies.
- Meanwhile the development of **offshore wind** remains very difficult. The UK regards itself as a world leader in offshore wind, but the quantities are still very small – less than 1GW of capacity. It remains a very expensive and high-risk technology, requiring significant injections of government support. Although it was announced with much fanfare, the decision earlier this year to go ahead with the London Array offshore project only demonstrates the scale of the problem. The Prime Minister played up the announcement, claiming that: 'The London Array is a flagship project in our drive to cut emissions by 80 percent by 2050 and meet future energy needs.' But the first phase announced in May amounts to only 630MW. The government's target for offshore wind is 25GW. If this is to be built by 2020 to meet the EU target, we would need three or four projects of the scale of the London Array every year, which would need tens of billions of pounds of high risk capital (some £46 billion according to the government's consultants SKM), at a time when credit availability is a major problem. Recently, there seems to have been a shift in emphasis back to onshore wind, perhaps judging that forcing communities to accept wind turbines onshore will be easier than

meeting the physical and financial challenges offshore. Nonetheless, offshore wind remains central to government strategy.

Overall, the programme looks both expensive and unlikely to be realised. Even on the government's optimistic assumptions, renewables appear to be one of the least cost-effective forms of carbon reduction and would be likely to show a significant negative net present value (NPV), even after taking account of the value of carbon emissions reductions.

Furthermore, while the measures discussed above may have some effect in facilitating renewables investment, they do not address another fundamental problem: that if it is to meet the EU target, the UK will need a complete makeover of the country's electricity system. Meeting the renewables target will involve:

- A change in the industry's **cost structure,** which would almost certainly have to be reflected in a change in its market structure. For instance, the scenarios examined by the government's engineering consultants during the consultation process showed that on a business as usual (BAU) basis, marginal costs (mainly fuel) would account for some three-quarters of the cost of each kWh. On the central renewables scenario, marginal costs would be only around one-third of the total; most of the rest would be fixed capital costs, but there would also be a large component for grid management and balancing to cope with the intermittency of wind. It is doubtful if present pricing structures, based on a price per kWh, would be effective. Among other consequences, they would produce significant periods of zero or negative prices at times when wind generation exceeded demand, along with extremely high prices at times of high demand and low wind generation. Since the total cost of the system would be significantly higher than on a BAU basis (at least one-third higher, and probably significantly more), this would produce an extremely odd price structure. The prospect of such volatility would create significant risks for investors.

- Changes in **regulation.** Most of the cost in the present system comes from market-led decisions on power generation investment and operation. In the renewables scenario, network investment (a regulated monopoly function) would soar – over ten times as much would be needed, and it would need to be coordinated with the generation investment. Grid and balancing costs (an administered market) would also be nearly ten times as great as on the BAU scenario. Furthermore, the main element of system cost would be the capital investment in renewables projects – some £60 billion – nearly all of which would be dependent on the government support offered. In other words, most of the cost of the new electricity system would not arise from the free operation of market forces, and economic regulation would need to adapt to this new situation.

- Changes in **operation** would also be required, particularly if the government is successful in encouraging the construction of new nuclear plant and improving energy efficiency. If this happened and the renewables targets were met, there would be considerable periods of time when generation from what are normally regarded as inflexible plant (wind and nuclear) would exceed demand. It is not clear whether price signals would be enough to discourage the surplus generation. Even the negative power prices quoted above might not do the trick – wind generators would still get an income from their ROCs, so might prefer to go on generating, while nuclear generators face significant costs in ramping production up and down and would also be reluctant to do so. UK wind and nuclear plants have not in the past been designed to operate flexibly in response to market signals and may not be able to do so. It is likely that, in practice, much plant would simply have to be stopped from generating at certain times (that is, be 'constrained off' the system). Meanwhile, fossil stations would essentially have to act as back-up for the intermittent wind plants and operate at an unattractively low load factor (30–40 percent for new plants; much lower for older plants kept on the system). Until the new operating regimes were clearly understood, this would create major risks for investors. Generating plants have lifetimes measured in decades so anyone investing in generation now will have an interest in the post-2020 regime and will want some idea of what it might involve.

Sooner or later, the government will have to design a completely new electricity market and regulatory system around its environmental policy goals. It has already acknowledged this trend in part, recognising that 'there has been an increasing shift recently towards a more active role for government'. However, it has not so far been prepared to define its new role in energy markets with any clarity.

This leads to a final paradox – while the government is clear about its goals for renewables, almost everything else is still unclear. Are the targets any more credible than their predecessors? They appear to be both unrealistic in practical terms and highly costly; however, unlike their predecessors, they are now legally binding – will that make a difference? What further support might be forthcoming for wind power when it becomes apparent that the UK is not on track to meet its targets? What changes will be needed to electricity markets and when might they take place? What role will the government and regulators play? It is likely to be some time – especially given the prospect of a general election – before these questions receive substantive answers. This uncertainty can only act as a disincentive for potential investors in power generation.

Asinus Muses

Foxy lady

The US *telenovela* The Life of Sarah Palin continues to delight as its heroine stands down as Governor of Alaska to follow an unspecified 'higher calling'. This higher calling apparently includes writing op-eds criticising Obama's cap-and-trade plan. But as pointed out by her fellow larger-than-lifer John Kerry (who always looked to Asinus like a cartoon pilot), it was curious that an article on cap-and-trade had not one mention of climate change. Republican thinker and Palin cheerleader Bill Kristol, a subscriber to Asinus's farmyard theory of politics, commented that 'maybe she's crazy like a fox'.

Plus ça change...

In his last column was Asinus unfair to Exxon in suggesting they are indifferent to alternative energies? After all, the company has started to invest in algae-based biofuels, and they are also working on battery technologies for electric cars. On the other hand Exxon also funds (among others) the climate change-denying, and ironically named, Heritage Foundation. The Foundation claimed in December that 'growing scientific evidence casts doubt on whether global warming constitutes a threat,' suggesting a curious lack of concern for the heritage of future generations.

Limitless ambition

The G8, at least, is convinced of the threat of climate change and has agreed to 80 percent cuts in carbon emissions by 2050 from 1990 levels. Actually it says '1990 or more recent years,' so if they can get in quick with a big increase in emissions then the required cuts will be less onerous. In the words of the British Secretary of State for Energy and Climate Change the G8 also agreed 'to limit worldwide temperature rises to no more than 2°C'. This is like committing not only to drill for oil, but to strike it. While they're at it, Asinus thinks the G8 should agree to limit the clouds that mar the English summer sky.

An ill wind

Asinus continues to monitor the idea of an agreed or reference oil price, to which the latest convert is the European Union's Energy Commissioner Andris Piebalgs. He recently declared that '$70 per barrel, the current price, definitely does not impede the recovery of the economy.' Before everyone starts declaring how much easier life would be with a stable oil price, spare a thought for the poor analysts and traders whose livelihoods depend on its volatility. It's an ill wind that blows nobody any good, as they say.

Speaking of which, T. Boone Pickens has scaled back his planned adventure into wind farming in the light of a lack of infrastructure in his great state of Texas and a lack of capital in the economy. Instead of 4000 megawatts in Texas he is now planning 1000 megawatts in a yet-to-be-decided location. Asinus assumes he'll be trading in his 10-gallon hat for a 2½-gallon hat.

Render unto Caesar what is Caesar's

A good test case for Paul Segal's argument in this issue, that each country's resource revenues should be handed out as cash payments to its citizens, would be the ever-fractious Peru. Peru's prime minister has resigned in the face of massive protests and a general strike, called in opposition to recent Presidential decrees over land rights. Indigenous people who live on the land in question felt the decrees favoured mining companies over them. In a tradition going back at least to Spanish colonial times when the Crown was never the villain, President Alan García has shifted the blame to his underlings and has just appointed his third prime minister in three years. Before yielding to the protesters García had declared that they should not prevent mineral exploitation because 'Peru's riches belong to all Peruvians'. In a country where annual fuel and mining exports are worth over US$600 per person but more than a quarter of the population live on less than US$500 per year, this would seem more appropriate as a slogan for the protesters.

Brazen People

BP, as part of a consortium with China's CNPC, has become the only western oil company to win a contract for an Iraqi oil field. The Iraqi government had planned to sell eight contracts but deemed all other offerings too greedy. In order to secure the contract the consortium had to come down from $3.99 per excess barrel extracted to $2. BP therefore manages to maintain revenues just above those of the Somali pirates who, as reported in February's column, achieved $1.50 per barrel. But with such close valuations, does this represent an alternative reference price for oil?

Given the risks in Iraq, an FT blogger has suggested that the B in BP stands for brazen. This theory has been supported by a group of young bloggers in Azerbaijan, one of whom used to work in public relations for BP, who have been arrested after having posted a satirical video of a donkey giving a press conference. It seems that the government imported donkeys from Germany at highly inflated prices, raising suspicions of dirty dealing. But, as the donkey explains in the video, it is more expensive than the humble domestic Azeri donkey because of its European education: it can speak three languages and play the violin. Asinus agrees with the authorities that such cruel satire is quite inappropriate: it makes those European donkeys without such talents, Asinus included, feel quite inadequate.

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