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In a world where some regions and in some countries many people are becoming wealthier by the year, if not by the day, poverty still prevails. As our focus is on energy it is natural that our concern is with energy poverty. Robert Bacon whose work at the World Bank relates to this important issue, and Suleiman Al-Herbish, the Director General of the OPEC Fund for International Development (OFID), both contribute to a discussion on this theme.

Robert Bacon reminds us that energy poverty affects a very large number of people, not only in the third world. Recent estimates put the number of people who lack access to electricity at 1.5 billion; and the number of those who rely on biomass for cooking and heating at 2.5 billion. There is poverty, including in energy, in rich industrialised countries.

More significantly, the size of the problem will not diminish in the years to come unless a very ambitious remedial programme is designed and implemented. Energy poverty, which is about the lack of access to clean modern fuels, or inability to afford them when technical or commercial access is available, is detrimental to health and education and more generally to human wellbeing.

Suleiman Al-Herbish believes passionately in the need to reduce the numbers of those who presently suffer from energy poverty. Business as usual policies will only condemn the energy poor to be deprived of the use of cleaner and more efficient fuels. The issue is not receiving *effective* attention in the international debate despite the recent King Abdullah Energy for the Poor Initiative endorsed by the G20 and the International Energy Forum. The fight against energy poverty does not have a champion on the world scene as many other causes do.

In his contribution, Christopher Allsopp asks the important question where do the world economy and the international energy markets stand after the credit crunch? Put differently: are we facing the possibility of a W-shaped recession or are we out of the woods? Allsopp reminds us of an ignored fact: the USA and other economies were slowing down before the onset of the financial crisis. The response of the central banks was to offset recessionary forces by cuts in interest rates. Initially there was confidence that policies will solve the recessionary problem. The failure of Lehman Brothers destroyed this confidence. Yet, the recession although very deep was V-shaped. The recovery began in early 2009 thanks to the dynamics of the stock

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cycle, monetary and fiscal policies adopted by major countries and the cumulative effects of budget deficits that enabled de-leveraging by the private sector.

The recovery, however, will depend on the timing and scale of measures that governments may be minded to apply to solve the public debt problem. We cannot dismiss entirely the possibility of falling once more into recession. On this issue the prospects for the UK are perhaps bleaker than for the USA for example. Allsopp is fundamentally an optimist; I tend to be pessimistic. Nevertheless I hope that events will prove him right.

Natural gas considered in the past as oil's 'little brother' can no longer be dismissed in this, or in any other way. Its importance has been continually increasing over the past three decades not only because of increases in its share of total energy use but because of its dominant position in power generation. Natural gas developments throw out important issues for research and debate.

We have two contributions on aspects of these developments. Armelle Lecarpentier addresses the complex problem of gas pricing in Europe, and Stephen Bull reflects on the emergence of new supplies of what is labeled as 'shale gas'.

The gas pricing system in Europe involves two different regimes: spot prices in market transactions and prices indexed on oil in transactions undertaken under long-term contracts. This co-existence is obviously problematic; the system is coming under the pressure of competitive forces and oil-indexing is increasingly losing ground.

Initially, in the 1950s and 1960s, the discovery of two major fields – Groningen in the Netherlands and West Sole in the UK – led the companies involved to seek security of supply in the new markets gas was penetrating and a continuous flow of returns to the huge capital invested. To achieve both objectives they entered into long-term contracts with the buyers of gas and invented the Take-or-Pay concept. In such contracts indexation to crude oil or petroleum product prices was generally adopted.

The liberalisation of the UK gas market completed in 1998 had a significant impact on the market structure and the price regime. The UK national hub (NBP) is used by producers for indexing gas prices. Although several other hubs have emerged in Europe, the long-term contracts, agreed before the recent deregulation, continue to dominate the gas supply structure in Europe. Looking ahead, the trend seems to lead to a situation where spot prices become the major, if not the unique reference for the pricing of gas supplies. The current co-existence of two gas price regimes may not survive forever, but its demise is not imminent.

Recent excitement about the new production of unconventional gas in the USA is an interesting story. It reveals that important phenomena in the energy world that are sometimes predictable are not predicted, and also reminds us that Malthusian views about resources scarcity should be received with great caution. Over-pessimistic promoters of the peak oil theory are being reminded by the gas example that both geology and technology can spring major surprises.

Forum is interested in the complex problem of electricity markets and their regulation. We are lucky to have in this issue a contribution by John Rhys whose expertise acquired over a number of decades is remarkable. He addresses the problem of reforming the market structure in the UK, a problem that is concerning the regulator OFGEM. In a wide-ranging article Rhys examines critically, among other things, the benefits accrued in terms of costs and prices under the liberalised regime, the problem of securing the investments necessary to meet capacity objectives and low carbon sustainability. Rhys has a proposal: a central purchasing agency which will ensure the implementation of objectives while maintaining valuable competitive market structures.

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Energy Poverty

Robert Bacon discusses definitions of energy poverty and policies to reduce it

What is Energy Poverty?

Globally, energy poverty is extremely widespread, and projections suggest that, without aggressive policies to counter it, the level of energy poverty will remain high for many years to come. A commonly accepted and simple definition of energy poverty is that a household without access to electricity or clean modern fuels is energy poor. However, even in this definition the notion of access differs between users. Access to an energy source is generally understood to mean that the infrastructure to deliver that source exists in the neighbourhood of the house (e.g. there are electricity connections in the village or neighbourhood).

However, data related to this definition are rarely available at a national level and so a narrower definition is normally used. In this latter definition access is understood to mean that the household actually uses the fuel in question (there is an electricity connection to the house, or there is uptake of the fuel in question). On this basis a recent study by the United Nations Development Program (*The Energy Access Situation in Developing Countries*) reported that currently about 1.5 billion people in developing countries lack access to electricity, and for cooking or heating about 2.5 billion rely on biomass and 400 million rely on coal. Forecasts have suggested that, largely due to population growth, absolute numbers relying on biomass are not expected to decline over the next twenty years, while only a small decrease in the numbers without access to electricity can be expected.

A further distinction is made with fuel poverty – a household is fuel poor if it is unable to afford to purchase sufficient energy (although it has access). In the European Union considerable attention has been paid to fuel poverty where low-income households are too poor to purchase sufficient fuel for heating during cold winters. For example, in 2006, it has been estimated that 12 percent of households in England were fuel poor, with comparable levels in some other northern European countries.

Why is Energy Poverty a Special Concern?

In developing countries the dominant use of electricity among poor households that are connected is for lighting, with television being the next commonest use. At higher incomes other appliances using electricity may be purchased (such as fans, or refrigerators). However, it is rarely used for cooking or heating even at relatively high incomes. Without a connection to and use of electricity, households are very limited in the amount of lighting they can use. Kerosene lamps, candles, or torches are then the principal lighting sources, and all give weak illumination. Studies have attributed a number of benefits to having adequate lighting that include education (the possibility of more study time at home), extending possibilities for home production, and improved health (through knowledge gained from watching television).

Generally, studies of the willingness to pay for electricity suggest that, for small amounts of electricity consumption, households value the benefits well above the cost of the energy used. In areas where there is no mains electricity supply, the community will also suffer from a lack of lighting in schools and hospitals, and lack of refrigeration in hospitals. Diesel or petrol generators are often used as substitutes but are considerably more expensive and inconvenient. Fuel poverty, as seen in Europe, is mainly linked to inability to pay for sufficient heating, and this in turn is linked to a number of adverse health effects.

The use of biomass or coal for cooking and heating is extremely widespread and occurs over a very wide income range in developing countries. The alternative fuels for cooking include LPG, kerosene to a small extent, and natural gas in a few countries where there is an urban gas network (such as Pakistan). Electricity is used for cooking and heating only at the highest income levels outside of the industrialised countries. Biomass includes charcoal, firewood, straw, and dung whose use depends on availability and costs (direct and indirect).

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The linking of energy poverty to the use of biomass comes through two aspects. First, the use of biomass for cooking, and coal for heating in those countries where there is a major heating need, is associated with high levels of indoor air pollution. The inefficient combustion of biomass results in the emissions of particulate matter, carbon monoxide, hydrocarbons and other gases. Exposure to these causes bronchitis, emphysema, and other respiratory diseases. Worldwide, about 1.6 million deaths a year are attributed to the effects of indoor air pollution, with women and children being most at risk. Episodes of illness are correspondingly large. Recently, some studies also indicate that incomplete combustion of biomass and coal may be an important source of black carbon that makes a not insignificant contribution to greenhouse gas emissions. The relative emissions of

Table 1: Health Damaging Pollutants per unit Energy Delivered by Fuel: Ratio of Emissions to those of LPG

	LPG	*Kerosene*	*Wood*	*Roots*	*Crop residues*	*Dung*
Carbon monoxide	1.0	3.1	19	22	60	64
Hydrocarbons	1.0	4.2	17	18	32	115
Particulate matter	1.0	1.3	26	30	124	63

Source: Smith, Uma, Kishore, et al. 2000, US Environmental Protection Agency

various sources of biomass compared to those of LPG are shown in Table 1. All forms of biomass are much more polluting than LPG, or than kerosene.

Second, in rural areas biomass is usually collected, again mainly by women and children. Charcoal is a commercial product, and firewood may also be sold. In urban areas biomass is more often purchased, reflecting the lack of freely available supply. The costs of the time and effort to collect the biomass place a burden on families by restricting time available for other activities – particularly education for children. Energy poverty therefore reflects not only a lack of income to purchase modern and convenient sources of energy, but is also associated with adverse effects on the household's health, and the education of children.

Policies to Reduce Energy Poverty

Faced with the widescale incidence of energy poverty, predominantly in developing countries, international aid agencies and multilateral development banks have devoted a great deal of attention (if not financing) to various schemes to alleviate energy poverty. With respect to providing electricity, considerable efforts have been made to increase the level of electrification in rural areas, where the majority of households without access live (in Sub-Saharan Africa only 12 percent of the rural population have access to electricity, while in India 47 percent of the rural population are without access). Rural electrification tends to focus on larger communities that are cheaper to supply, while remote and small communities tend to be neglected.

Even when supply is brought to a village, not all households will choose to be connected. There are two reasons for this. First, the connection charge itself is large relative to the income of many households, and such households are often credit constrained and unable to borrow to finance the lump sum required. Second, the cost of electricity itself may be substantial, particularly in countries where the sector is inefficient or the costs of generation are high (for example, landlocked countries without hydro or fossil fuel resources that have to rely on imports). For low-income households interested to consume only a few kilowatt hours a month, these two factors present a barrier to uptake. For this reason, many governments look to subsidise either the connection charge (by a straight subsidy, or by spreading payments over time), or the electricity consumption of low-income households through a rising block tariff or a volume differentiated tariff (where metering exists), in which small amounts of consumption are subsidised either by larger users or through the government budget.

For villages where there is no distribution system, the total costs of lines and connections to bring electricity may be so large, relative to the ability and willingness to pay, that the total subsidy element would need to be a large fraction of the incremental cost. Where there are few existing high-income customers to help finance through a cross subsidy (paying above the cost of supply) then limitations on the government budget will restrict the rate at which access can be increased.

More recently, considerable attention has been given to off-grid sources of supply that may be better able to reach more remote communities. Suitable methods of generation are likely to be more environmentally friendly, including small-scale hydro, solar, and wind power. Costs will favour these off-grid solutions in certain circumstances, and are increasingly likely to do so as the cost of small-scale renewable declines.

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Policies towards reducing the damage from cooking with biomass do not limit themselves to encouraging households to switch fuel. Increasingly it has been recognised that households will continue to use biomass to cook even at income levels when it might be expected that they would switch to a 'superior' fuel. In particular, encouraging electrification is not likely to make a substantial reduction in the use of biomass because many households that have

Table 2: Use of Biomass as Main Cooking Source and Connection to Electricity Supply (%)

	Cambodia	*India*	*Kenya*	*Pakistan*	*Thailand*	*Uganda*
Use of biomass for cooking	93	70	82	73	37	96
Connected to electricity supply	18	64	18	83	99	11

Source: Bacon, Bhattacharya, and Kojima (forthcoming) World Bank

access to electricity continue to use biomass as their main cooking fuel. Table 2 shows the percentage of households for which biomass was the main cooking fuel in a number of developing countries, as well as the percentage of households that were connected to electricity supply. Even in Thailand, whose per capita income was at least double that of the other countries in the sample, and that had almost universal access to electricity, one-third of the households continued to rely on biomass for cooking.

"Unless women or children can make a direct financial contribution to household income instead of collecting the free biomass, this is likely to be the preferred choice"

There are a number of reasons for this pattern and policies need to address all of them. First, in rural areas where biomass is free, there is a strong incentive to use it. Unless women or children can make a direct financial contribution to household income instead of collecting the free biomass, this is likely to be the preferred choice. Second, cooking indoors with biomass is a demerit good. Women cooking indoors are often unaware of the true health risks from the smoke and do not attempt to reduce it. Third, many households prefer to cook with biomass – the traditional flavour of such cooking is important in many cultures, and households are unwilling to give it up either in part or totally.

There are a number of policies designed to reduce the damage from cooking with biomass.

Reducing the costs of LPG (as the clean fuel substitute for cooking) may encourage some switching towards the use of LPG, but even where families do use LPG they also continue to use substantial amounts of biomass. Indeed, at higher levels of income households may use more of both biomass and LPG.

Encouraging the use of more efficient and cleaner biomass cooking stoves is seen as potentially the most direct way of reducing the damage from the use of biomass. Many cheap and improved stove designs have been tried, but as yet the cost of an effective and durable stove is quite high relative to the incomes of poor households.

Programmes of educating households (women especially) into the dangers of indoor air pollution and ways to reduce the risks may lead to a reduction in the exposure to the pollutants from biomass combustion. Recommendations could include: not cooking in the house; keeping children out of the kitchen; ensuring that there is a chimney and adequate ventilation; and knowledge of which forms of biomass are the most harmful. For higher income households the benefits of improved stoves, or alternative clean fuels can be explained.

The prevalence of energy poverty, and its likely persistence in the absence of policies to intervene in the patterns of household energy use, indicates that efforts to reduce its adverse side effects will be as important as efforts to reduce the level of energy poverty itself.

Suleiman J. Al-Herbish rejects the gloom and doom surrounding energy poverty

Introduction

Energy security is always high on the agenda of both consumers and producers but rarely does the international debate focus on those hundreds of millions of people without any access to modern energy. Authoritative studies suggest that, even in 2030, there will be 1.3 billion people without electricity: this figure is only 200 million below today's estimate, meaning that increased power generation capacity worldwide is expected only to nearly offset the additional needs created by an increasing population. Despite the genuine gains in development in many parts of the world, 'business as usual' policies will merely condemn many of the poorest to life without clean and efficient energy services. Such services are essential to advance human development and provide opportunities for economic and social progress. We, the OPEC Fund for International Development (OFID), certainly believe that the international community can do better than this.

In the concluding statement of the 12th International Energy Forum attended by Ministerial Delegations from 66 producer and consumer countries, we read that 'The fight against energy poverty has been unsuccessful so far.' We couldn't agree more with the general idea, as we know that 2.5 billion people are still lacking access to modern fuels to satisfy their basic needs. However, a closer look shows us that we cannot qualify the 'fight against energy poverty' as being 'unsuccessful', because what is called 'fight' has hardly begun. Indeed, the topic of increasing energy access has been on the international agenda since the World Summit in Johannesburg in 2002, but concern has rarely resulted in concrete commitments and actions on the ground. In fact, energy poverty has received too little attention to say that a real 'fight' was ongoing.

The success of fighting energy poverty in the two coming decades will depend on partner countries' (i.e. developing countries benefiting from international development assistance) political willingness to reform but mainly on the priority the international community would like to attach to this issue. Energy poverty should not continue to be considered the oldest orphan of the

international development debate. Climate change issues are here to remind us that we live in a globalised world, tackling energy poverty worldwide is of importance for all developed and developing countries alike. Providing universal, clean, affordable and sustainable access to energy will certainly be one of the key challenges of the twenty-first century. The Energy for the Poor Initiative launched by the King Abdullah of Saudi Arabia and supported by the G20 leaders and recently by the 12th International Energy Forum meeting is providing a new momentum to the fight against energy poverty allowing us to envisage scenarios with universal access to modern energy to all human beings by 2030.

"'business as usual' policies will merely condemn many of the poorest to life without clean and efficient energy services"

Magnitude – The Many Benefits of Combating Energy Poverty

The excellent economic performance of some regions of the developing world has improved energy access for many communities since 2000. Good progress has been made in East Asia, also in Latin America as electricity networks have been extended. But access to modern energy in South Asia or Sub Saharan Africa continues to lag the rest of the world. In South Asia 614 million people live without access to electricity whilst in Sub Saharan Africa the number of people living without electricity has risen to 587 million since 2000, despite a slight increase in the rate of electrification. Generating capacity is far below the needs of the population. Total installed generating capacity in Sub Saharan Africa (excluding South Africa) is about 30 GW, less than that of Norway whilst the population of the region is 150 times as large.

Electricity is important to support all kinds of income-generating activities, whether agricultural, commercial or manufacturing. Agriculture is by far the most important source of employment and incomes in developing countries and access to affordable electricity can provide a significant increase in productivity. Electricity can power irrigation equipment and allow rural communities to add value to crops by drying, processing and packaging. To face the challenge of food security, highlighted by the crisis of 2007 and 2008, world food supply will have to double by 2050 to nourish world population. This doubling of agricultural output on roughly the same available land can only be achieved by a substantial increase in productivity, by more water availability and consequently by enhanced energy accessibility.

Higher levels of mechanisation can make a vital contribution to raising growth rates by lowering costs and improving competitiveness, and mechanisation relies on electricity. Better communications may open new markets to farmers and producers and provide up-to-date information on price trends and selling opportunities.

Raising the income levels of rural communities can make a significant contribution to social stability by lessening the pressures to migrate to cities. Rapid growth of urban populations exacerbates environmental and social tensions in developing countries as cities rarely have the resources to meet housing and other needs.

Lack of access to electricity is not the only problem facing the energy poor. Clean fuels for cooking and transport are also in short supply. LPG and kerosene can provide efficient solutions for cooking and lighting and a reliable and affordable supply of vehicle fuels is essential if communities hope to move beyond subsistence agriculture and transport their produce to market. Diesel generators can also provide useful energy in the village to drive workshop equipment or power irrigation systems. Overall the consumption of modern energy per capita in the poorest countries is less than one-sixth that of developing countries as a whole.

It is now recognised that modern energy is needed in all sectors and for achieving all the Millennium Development Goals. Lower reliance on harmful biomass will reduce illness from serious respiratory disease. Modern energy creates opportunities for better medical care, education and communications. Access to the world of information will release human potential, opening doors to science and culture. How many exceptional brains able to make scientific breakthroughs may be found in the hundreds of millions of people newly enabled to play a fuller part in the life of global society?

Energy investments require large-scale commitments of resources over long periods of time. But once in place they offer enormous benefits to every businessman considering investment in manufacturing or process activity and every farmer planning irrigation or food processing projects.

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Why Are Many Countries Plagued with Persistent Energy Poverty?

Like income poverty, energy poverty has different causes in different countries. However to alleviate this curse there are broadly two protagonists who could play key roles in making energy accessible, affordable and sustainable: the international community and partner countries.

For the international community, energy poverty is not receiving enough attention in the international development debate. The priority attached to energy poverty has still not reached a

level commensurate with the dimensions of the problem.

In the international arena, the issue has just started to gain momentum. There are many international meetings taking place to address energy poverty but no international donors' conference has been organised to increase the assistance provided. Many non-binding statements are issued after high-level meetings but with little commitment on the ground. When oil prices reached levels higher than $140/bbl, there were many discussions at OECD level concerning the resilience of economies and the potential impact on the poor; but when the oil prices declined the debate on this issue just vanished.

From a policy point of view, energy poverty has no 'champion', unlike issues such as HIV-Aids, forest preservation, water, desertification and so on. Even at the UN, energy is considered as a cross-cutting issue. There are some laudable initiatives contributing to the international debate such as UN-Energy, which is an inter-agency mechanism to coordinate energy-related issues within the UN system; also UN-CSD (UN Commission on Sustainable Development) under UNDESA, which addressed energy issues at UNCSD-15 without reaching a consensus on how to alleviate energy poverty. Both UNDP and UNIDO have developed real expertise in the field on how to tackle energy poverty but they work with relatively limited resources.

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UN meetings and results are necessary as they shape the local, regional and global policies. Indeed, Agenda 21, the United Nations Millennium Development Goals, the Johannesburg Plan of Implementation, the Monterey consensus all provide development goals. However the results on the ground are implemented slowly. One can observe that most low-income countries still have not implemented an appropriate economic and financial environment to alleviate energy poverty. Besides the UN and some countries, other players are not so powerful as to be able to raise the energy poverty flag high enough.

From a financing point of view, the international effort to assist poor developing countries is increasingly fragmented. This fragmentation of the development aid is not helping to implement the specific focus needed for alleviating energy poverty. The fragmentation is characterised by the welcome emergence of the private sector in international cooperation but also by the multiplicity of potential donors; in fact this is in contradiction with the so-called Paris Declaration where over 100 countries and institutions, among them OFID, called for more effectiveness in dispensing assistance. Fragmentation means that partner countries are dealing with a high number of donors giving sometimes relatively small amounts of money – and requiring more bureaucracy simply to keep track with them. The alleviation of energy poverty is therefore 'drowned' in a myriad of other development issues with little effectiveness on the ground.

Regarding climate change issues, for the past decade many analysts considered that making energy accessible to the poor would drastically increase CO_2 emissions. Although this opinion later appeared to be an exaggeration, it was used as a reason not to trigger a real fight against energy poverty, which would have been detrimental to the planet. In fact, there appeared to be a tacit international consensus to postpone the accessibility of energy for poor countries until so-called green energy technologies could be scaled-up technically and economically.

We know today that many research centres among them the IEA have recognised that with the current trends of the fuel mix, if electricity access is generalised then there will be an additional increase in global energy-related CO_2 emissions of just 1.3 percent by 2030. Even if one allows for model uncertainties, this percentage remains very low. International cooperation and assistance in combating energy poverty should not be preconditioned by stringent conditions regarding renewables. In fact, switching from traditional biomass to sustainable modern biomass or a fossil fuel such as LPG would protect the forest and have a beneficial impact on deforestation. Moreover, without requiring fundamental technological breakthroughs, some scientists are devising development paths for Europe and North Africa to reach 100 percent of electricity produced from renewables by 2050. Consequently, climate change issues should not be used as an argument to impede the fight against energy poverty.

From the energy markets point of view, with a diversified energy mix including both renewable energy and fossil fuel, it is now recognised that the additional progressive demand for oil and gas generated by much wider access to energy by poor countries will not significantly disturb markets.

"From a financing point of view, the international effort to assist poor developing countries is increasingly fragmented"

Regarding partner countries, they also bear their share of responsibility in not providing energy access to a large portion of their population. Energy access is not at the forefront of many governments' preoccupations, especially in the poorest countries. There are many impediments such as poor governance, a history of conflicts, mismanagement of utilities, lack of an enabling environment conducive to investment, corruption, inappropriate and badly targeted policies as well as a lack of regional vision in fostering trade in energy.

Fortunately there are developing

countries showing appreciable progress in alleviating energy poverty. Thanks to appropriate reforms and targeted electrification programmes, China, India, Vietnam and Brazil do have success stories to tell in the field of energy access. They have improved the access for their citizens substantially in the last two decades. However all across sub-Saharan Africa, and in parts of Asia, too many people are still living without basic energy services.

Urgency of the Issue of Energy Poverty for the Low Income Countries

The close links between economic growth and access to affordable supplies of modern energy have already been highlighted. This linkage was well illustrated in recent years. From 1990 to 2000, total primary energy consumption in the developing countries rose at an annual rate of 3.6 percent: this growth rate increased to 5.6 percent from 2000 to 2007. The rates of growth of the network energy services were the highest of all the energy sources. This growth has accelerated sharply since 2000 particularly in Asia, in line with the fast growth of industrial and commercial activity. The annual average growth rate of both gas and electricity demand from 2000 to 2007 was over 6 percent for the developing countries as a group.

Concentration on the electricity sector can obscure the important contribution of fossil fuels in reducing energy poverty. In 2007, electricity only accounted for some 15 percent of total final energy consumption in developing countries. Regarding manufacturing and commercial operations, however, there is usually no alternative to grid-sourced electricity as a single source of flexible, scalable and economic energy to satisfy mechanical, lighting and communications needs. This logic underlies the fast growth rates for electricity demand that are a feature of most medium-term assessments of the energy outlook for developing countries.

Such expectations may be consistent with macroeconomic projections and historical trends but they may underestimate the constraint of limited and ageing generation capacity, especially in the low-income countries. Total electricity consumption in these countries increased by 60 percent from 2000 to 2006. Over the same period total generating capacity increased by only 27 percent. Updating the analysis to 2010 suggests that the low-income countries are facing severe pressures on generating capacity.

Indeed if 2000–2006 growth rates of demand and capacity had been maintained, by 2010 the average capacity utilisation required of these countries would be 45 percent. IEA data for developing countries, which includes countries with much more modern generating equipment than most low-income countries, suggest that realised capacity utilisation percentages in 2007 clustered around 40–43 percent for Latin America, Africa (excluding South Africa), China and India. Electricity utilities in the low-income countries will only be able to meet such projected demand for power if they achieve remarkable increases in capacity utilisation.

"Thanks to appropriate reforms and targeted electrification programmes, China, India, Vietnam and Brazil do have success stories to tell in the field of energy access"

More likely, as soon as pre-crisis demand patterns are restored, the power market will tighten further leading to higher costs, increased outages and brownouts. The high costs and unreliability of the electricity supply will act as a constraint on the growth of GDP – moreover such a constraint will operate over the medium term since investments in generating capacity take years to come into operation. In addition to the economic aspect, constraints on the electricity generating capacity will make adaptation measures to climate change extremes by energy poor countries even more difficult.

Over the past ten years electricity consumption in the low-income countries has probably doubled but total generating capacity has only increased by about 50 percent. Most spare capacity in the generating industry has been absorbed over this period and economic growth in many of these countries may be threatened by aggravated power shortages unless investment in generation is stepped up as a matter of urgency.

A Key Lesson from the Financial Crisis

The recent financial crisis has taught us a lesson: whenever an important issue is given high priority on the international agenda and a concerted, consensual, unified, resolute solution is provided by the international community, then success follows. Banks in the USA and Europe benefited from substantial bailout plans. Some US$ 1300 billion was injected into the banking systems of the advanced economies, a policy that rapidly improved the banks' liquidity and trading performance. In contrast, the regulation of financial and commodity markets aiming at reducing excessive speculation received only lip service, as the issue was not considered to be of sufficient priority, particularly for the USA.

Building on this lesson, it is reasonable to assert that if combating energy poverty in developing countries is given appropriate priority (and followed by concrete actions), it will allow a departure from the 'business as usual' pattern and permit us to envision a world free of energy poverty by 2030.

The Way Forward – Solutions

In order to face the challenges raised by the scaling up of energy access, the proposed solutions should address both partner countries and the international community. For partner countries, on the basis that a one-size-fits-all solution does not exist, the barriers to energy access mentioned previously should be addressed. In short, partner countries

should develop or reinforce inclusive policies, regulatory frameworks and institutions that facilitate investment (both public and private) and encourage trade to make energy accessible and sustainable. They should also implement pro-poor financing mechanisms with the involvement of local communities to make energy affordable. There are success stories in India, China and Vietnam that could be emulated. However, in order to develop the appropriate enabling environment, poor countries need specific support in human resources and institutional capacity building.

Equally or more importantly, the energy poverty issue should be more visible on the international agenda. Not a single financial institution no matter how large it is, not a single country no matter how rich it is can tackle the issue of energy poverty by itself. Energy poverty alleviation needs collective international solutions.

This challenge has been recognised, notably by the leaders of OPEC at the Third OPEC Summit in Riyadh in November 2007. The Riyadh Declaration mandated the OPEC Fund for International Development (OFID) as well as the other OPEC Member Countries aid institutions to align their programmes to eradicate energy poverty in developing countries, a task to be achieved in cooperation with other financial institutions and the energy industry. Since the last OPEC summit, OFID alone has committed close to $450 million in energy poverty alleviation covering 22 operations in 17 countries.

In the spirit of the Riyadh Declaration, King Abdullah of Saudi Arabia during an ad-hoc meeting of producers and consumers launched what has become known as the Energy for the Poor Initiative, which underlined the prime importance of extending energy access to the poorest countries. The Initiative embodies the political will expressed in the Riyadh Declaration in a plan of action to encourage the wider participation of both public and private sectors and to leverage the effectiveness of the initial seed capital.

Today OFID is contemplating together with other institutions, among them the World Bank, a medium-term programme of $5 billion to contribute to alleviating energy poverty. OFID is coordinating its actions with the World Bank.

This important initiative has enabled the prioritisation of energy access in the international development debate, at a time when the oil barrel reached its highest price ever. Since then energy poverty alleviation has gained new momentum. OFID is doing its utmost to support and increase this momentum within the international community.

Conclusion

Three years ago, OFID proposed for the first time at an international conference that energy poverty alleviation be designated as the ninth Millenium Development Goal. The aim was to provide more international visibility in the development debate for the issue of energy poverty as well as to include it specifically in national development plans. I am pleased that this idea has received general acceptance and that recently 66 Energy Ministerial delegations of producer and consumer countries at the 12th International Energy Forum held in Cancun, Mexico, in March, 2010, recognised the advantage of defining such a goal for the international community. Such a goal would, indeed, provide the needed coherent global vision to address energy poverty.

As in the case of climate change negotiations, the 'business as usual' attitude in solving energy poverty should not be an option. Leaving 1.3 billion people on the side of the road by 2030 is just not acceptable. The Energy for the Poor Initiative is showing us that we can be bold and ambitious in our vision: universal access to affordable, acceptable energy should become a reality for all.

The Credit Crunch and International Energy Markets – What Now?

Christopher Allsopp

Two years ago, oil prices were on their way up to the peak of $144 on 3 July 2008 – which was followed by a spectacular collapse to a low of $35.5 on 23 December. At the time of writing, they are now up again to about $85 – having been trading in an implicit band of around $70–80 for several months. Clearly, the most important driver of these extreme swings in the oil price has been the world economy – or more accurately, perceptions about the financial crisis and anticipations about the likely course of the 'great recession' and the recovery.

This article takes stock of some of the lessons and, tentatively, tries to draw out implications for the, still very uncertain, future. It starts with a brief recap of the history of the great recession, focusing on the policy response. The next section looks forward at the domestic and international policy problems and the final section concludes with some general remarks about the interactions between global macroeconomic developments and the markets for oil and gas.

The Great Recession

Before the financial crisis, the big question was why rising oil and other commodity prices – which delivered a shock comparable to (or larger than) the big oil crises of the 1970s – did not lead to world slowdown or recession, which would have moderated the demand for oil and checked or reversed the price rises. Essentially, the reason for the difference was that the recent rise did not lead to general inflation, especially in industrial countries. Second round effects, on inflation and on nominal wage rises were almost entirely absent. With (flexible) inflation targeting policies in most OECD countries, any recessionary effects from rising oil prices (which act like an increase in indirect taxation in consumer countries) would be offset as Central Banks sought to meet their mandates.

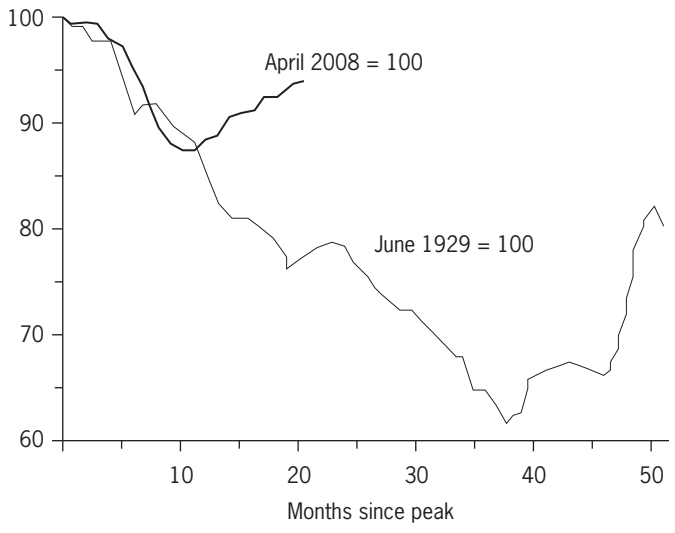
The USA and some other countries were clearly slowing before the credit crunch. With low inflation in the OECD – despite soaring oil and other commodity prices – the prospective recession was a recession that central banks thought was neither necessary nor wanted. The response was predictable – offsetting cuts in interest rates (early and aggressive in the USA) to head off the recessionary forces. At the same time, the nature of the financial problems, which started in the summer of 2007 with the sub-prime crisis in the USA, were becoming apparent; but it was widely assumed that the impacts on the real economy would be limited – i.e. that offsetting policies and bail outs would do the trick. This all changed in September 2008, with the bankruptcy of Lehman Brothers and rescue of the US insurance giant, AIG. The decision not to bail out Lehman Brothers was a huge shock to the system – and the world economy seemed to 'fall off a cliff' in the last quarter of 2008 and into 2009.

An interesting indicator of the robustness of confidence in the efficacy of offsetting policies is the behaviour of oil prices – which, despite the developing financial crisis and the stream of bad news during the first half of 2008, continued to rise to their peak in July 2008, before beginning their rapid fall. The low point for spot prices, around the beginning of 2009, coincided roughly with the maximum degree of pessimism about world prospects – and the upturn since correlates closely with developing confidence in global recovery.

The V-shaped Pattern of Recession and Recovery

As noted, there was considerable confidence during the early stages of the financial crisis that policy responses would be sufficiently powerful to limit the downturn in global output. After Lehman Brothers collapsed, confidence that policy would, or could be, powerful enough evaporated. Dire comparisons were made with the great depression of the interwar years. In an influential study, Barry Eichengreen and Kevin O'Rourke showed, early on, that the initial phases of the downturn were worse than interwar – though with the important caveat that policy would be different this time (see Figure 1).

Figure 1: World Industrial Production Interwar and 2008–2010



Source: *Eichengreen and O'Rourke*

In fact the recession, though very deep, was V-shaped – with recovery setting in during the first quarter of 2009. Three features help to account for the V-shaped pattern.

The first is the world stock-building cycle. Really large and rapid movements in the world economy are usually the result of the stock-building cycle. World trade, especially in manufactures (and particularly autos) simply collapsed in the last quarter of 2008. To many observers' surprise, the worst hit countries were not those that depended on financial services, but those that depended on manufacturing – countries like Germany and Japan and also China. But a stock cycle has a natural dynamic: when stocks have been off-loaded, it naturally reverses. Moreover, the bigger and quicker the downturn, the more likely it is that there will be a rapid reversal. Essentially, this is what happened. Both the fall and the recovery have been bigger than expected and a large part of the explanation is the virulence of the international stock-building cycle.

Policy

The second was, indeed, policy. The scale of the crisis, especially after Lehman Brothers collapsed, was not generally foreseen. But the response, though muddled at times, was, in broad terms predictable. Interest rates were, in stages, cut to the bone – to near zero in the USA and in many other countries. As the zero bound for interest rates was approached, fiscal packages were announced – spectacularly large in China, large in the USA and more minor but significant in Europe. At the same time, asset relief schemes, liquidity provision and quantitative easing added up to an extraordinary international policy package. And, eventually, it was large enough. Meltdown was avoided. Financial markets were stabilised – as indicated, for example, from data on interest rate spreads. And the perception that policies were actually working and that recovery would occur spread across financial and commodity markets. Major stock markets recovered – by about 40 to 50 percent. Important too, especially for oil and commodity markets, were the data coming out of China. Their offsetting policy, based on fiscal, credit and administrative measures (and directed largely to infrastructure) resulted in average GDP growth for 2009 of about 8.7 percent – with the economy growing at over 10½ percent in the last quarter of the year and 11.9 percent per year in the first quarter of 2010.

The conventional view is that policy put a floor under the contraction of the world economy and sparked recovery. There is a worry that as stimulative policy measures fade (some are temporary and time limited) and as the boost from the stock-building cycle goes away, the world recovery will falter – leading to very low growth or even to a double dip (or a W-shaped profile). This misses an important part of the dynamics at work – namely, the influence of budget deficits in major countries.

The cumulative effects of budget deficits

In fact, the largest difference between the present cycle and the great depression of the interwar years is the toleration of rising budget deficits. In many countries these have risen to extraordinary levels. The OECD estimate for the *average* (General Government) deficit in 2009 was 8.2 percent of GDP – a deterioration from 2007 of 7 percent of GDP. (The estimate for the USA is 10.7 percent of GDP, and for the UK it is 13.3 percent of GDP). The swing to deficit far exceeds the discretionary fiscal stimulus applied by industrial countries and reflects the 'automatic stabilisers' (reduced taxes and increased expenditures) as the economy fell into recession. This is a powerfully stabilising force. This toleration contrasts with attempts by governments in the interwar period to avoid budget deficits by raising taxes or cutting expenditures.

The significance of the rise in budget deficits can be put a different way. It is widely agreed that the financial crisis, the credit crunch and the swing to pessimism about economic prospects delivered a massive shock of a balance sheet kind to the private sectors of most countries. Businesses and households in the private sector needed to get out of debt: they needed to invest less or to save more. In the jargon, they needed to 'deleverage'. As a matter of accounting, however, this is only possible if some other sector moves into deficit.

In a closed economy (i.e. ignoring the external current account position) the mirroring would be exact – the improvement of the private sector balance would exactly match the deterioration in the budget deficit. For an open economy, the public sector deterioration would equal the private sector improvement minus any swing toward surplus in the current balance of payments.

There are a number of implications for an assessment of the current situation and macroeconomic prospects – some optimistic and others more worrying, especially for the longer term.

On the optimistic side, if public deficits are seen as offsetting (or allowing) 'deleveraging' by the private sectors of recession-hit economies, they provide a powerful and cumulative force for recovery. The reason is simple. The requirement for 'deleveraging', though it may be large, is finite. An indebted consumer, for example, who succeeds in saving, does get out of debt – and is then likely to start spending again. Similarly, a deleveraging firm or financial institution, if it succeeds in running a surplus, improves its balance sheet – and is likely to return to more normal behaviour. Essentially, there is a financial stock/flow cycle – which has analogies with the stock-building cycle referred to above (though it is likely to be slower). Also, the process of balancing private sector 'deleveraging' with public sector deficits is cumulative. If the required amount of private sector deleveraging were (say) 10 percent of GDP, one year's public deficit of a similar size would be sufficient. If the required deleveraging were 20 percent, then two years deficits would suffice, and so on. One can add that, once the recovery is seen to be underway, the pressure for private sector deleveraging will abate – as expectations turn more positive.

In fact, the typical pattern after financial crises is a very large swing to surplus by the private sector – which then comes back as private sector balance sheets adjust. For example, in the UK, in the early 1990s, the private sector swung from a deficit of about 4 percent of GDP to a surplus of about 6 percent of GDP in a single year (a swing of about 10 percent of GDP). At the time, the public sector deficit rose to 8 percent of GDP. But as the private sector came back (as savings decreased and as private investment expenditure rose) the public deficit was eliminated, and actually moved to surplus within five years. (Tax and expenditure programmes did have to be adjusted to bring about this favourable outcome). The Swedish banking crisis of the late 1980s produced an even larger swing in the positions of the public and private sectors – which reversed as the private sector surplus came down and as the external current account improved.

The Dynamics of Recovery

This brief account suggests that a number of factors account for the pattern of recession and recovery: obviously policy (especially monetary policy but also fiscal offsets limiting the downturn); the natural dynamic of the stock-building cycle, and the cumulative effects of fiscal deficits in allowing private sector balance sheet adjustment (deleveraging). As noted, there is a worry that, as the stock-building effect fades and as temporary fiscal measures (such as cash for clunkers) are taken off, the recovery will falter – with, according to some analysts, the danger of a double dip (or W). The most powerful force making for continuing recovery, however, is the one least discussed – the cumulative effects of the counterpart budget deficits themselves.

But there is a serious downside to this optimism. This is that mounting concern over budget deficits and debt will lead to premature tax rises and expenditure cuts – before private sector deleveraging has run its course. That would be a reversion to the kinds of policies that led to the Great Depression. The timing of exit strategies is crucial.

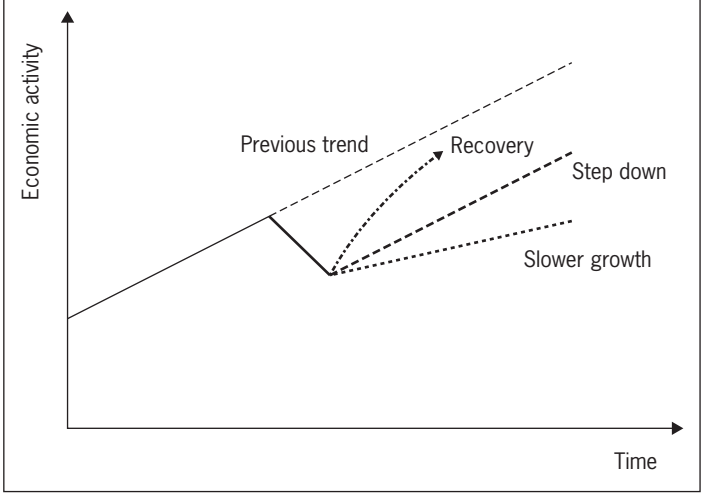
Policy Problems Looking Forward

Prospects and Risks

Consensus forecasts – such as those of the IMF – suggest that the recovery will proceed over the next few years at about the same rate of growth (in PPP terms) as before the crisis – that is at about 4 to 5 percent per annum. Though such a V-shaped pattern sounds good it involves a large step down from the previous trend. The downward 'level effect' is probably about 6 to 10 percent of global GDP.

There are upside and downside risks compared with the 'consensus'. On the upside, 'deleveraging' may proceed quickly and the perceived need for it will diminish as confidence improves. This could lead to a period of above average growth (there is plenty of capacity) and a move some way back towards the previous trend. The downside risk is that growth will be slower due, for example, to continuing problems and restraints emanating from the financial sector. A double dip – a further shift down in the recovery path – is most likely to result from premature fiscal or monetary tightening.

Figure 2: Alternative Scenarios



The Policy Challenge

As recovery proceeds, policy-makers would like to have higher, more normal interest rates, substantially better and more sustainable fiscal positions and enough (internationally coordinated) macro-prudential regulation of the economy to ensure that the problems of the recent past never recur. But is it possible to get all these things right under current circumstances? It is certainly not going to be easy.

The strong pressure is for the fiscal authorities to move first (but not too soon). But with fiscal tightening the implication is that interest rates are likely to remain low – unless the recovery is considerably faster than the consensus expectation. The deflationary effects of fiscal restraint may mean policy interest rates have to remain low for quite a long time.

But policy-makers do not like low interest rates either. If interest rates do remain low whilst there is a revival of global growth, there is a danger of financial instability. Real interest rates would be very low at the short end – and could be negative. (The relationship that matters is actually between real interest rates and growth). Combined with high liquidity, this could set off asset price booms, and encourage high leverage – a repeat of the past, risking boom and bust. It should not set off general inflation if countries are mindful of avoiding generalised excess demand, but asset price booms are increasingly seen as an additional threat to stability.

This is where regulation, and particularly, macro prudential regulation comes into the picture. The idea behind it is to prevent the conditions that led to the recent crisis – by constraining finance. It is not at all easy to design – especially as, to be effective, it would need to be internationally coordinated. But it is probable that a combination of risk aversion (resulting from the crisis) and regulation would at least postpone excessive risk-taking and asset price drifts and bubbles for a number of years.

The dilemmas appear acute. But is there any way of squaring the various circles, or improving the trade-offs? Essentially, the problems arise because of an incipient surplus of savings over investment in the world economy. This means that policy-makers appear to face either continuing fiscal deficits or uncomfortably low interest rates. A more normal picture of fiscal prudence and reasonably high interest rates would seem to require lower private savings or higher investment and a resolution of the payments imbalances between countries such as the USA and Asia.

What Kind of a Picture Looking Forward?

An essential feature of the macroeconomic background is uncertainty and the continuation of serious policy challenges. Conventional forecasts are not very useful when one of the few near certainties is that the 'consensus' is likely to move about – driven by events. Financial and commodity markets will be driven by the same underlying set of forces.

Given the many policy challenges, the key question is whether policy-makers will, in broad terms, succeed in doing what is necessary. The assumption that, with inevitable lags and hesitations, they would succeed in offsetting a potential financial collapse and a world downturn on the scale of the 1930s has proved right so far. But this was crisis management, which tends to concentrate the mind. Looking forward, the problems are more 'normal' but still very grave. Exit strategies will be hard to design – and the dilemmas referred to above will be hard to resolve.

For example, the fear of protectionism has, so far, been unfounded. But the threat will continue – and perhaps increase during the recovery period. The best guess, given that the threat is so well understood, is still that it will be largely avoided.

A greater threat arises from the re-emergence of international imbalances and the disparate positions of deficit and surplus countries. For countries with serious medium-term fiscal and financial problems, exchange rate depreciation is an attractive option, even if it arises from the pursuit of domestic policy choices (such as the continuation of low interest rates combined with fiscal consolidation). But such policies only add up if other countries – surplus countries as a group – are prepared to tolerate revaluation.

We have argued above that interest rates may well remain low – due to the imperative for fiscal consolidation in some major countries, including the USA and due to the likelihood that private savings will remain high in the aftermath of the crisis.

Paradoxically, this increases the pressure on regulatory authorities to tighten up and to introduce countercyclical 'macro-prudential' measures to stave off asset price rises and potential boom/bust scenarios. There are huge, and so far unresolved, challenges here. But the bottom line may be a situation of low real interest rates combined with tighter regulation and credit restraints.

It is not just forecasters and oil market experts who don't know how all this will work out. Market operators will closely watch every turn as policy issues come and go and as policy-makers appear likely to succeed or fail. These public signals may have exaggerated importance in a situation of large underlying uncertainty, leading to considerable volatility and swings in the 'consensus' – and hence in oil and other energy prices. An overall picture of relatively rapid growth, firm but volatile oil prices, and low interest rates, with considerable downside risks if policy-makers lose their nerve or make mistakes as the world economy remains 'fragile'. Interesting times!

Gas Matters

Stephen Bull's reflections from the frontline of US shale gas

The US shale gas phenomenon has captured the global energy audience with a vigour that few would have predicted just five years ago. An abundance of clichés and tabloid-style banners have been written by consultants, banks, journalists and companies alike, with headlines ranging from the climatic 'Shale Gale' to the nationalistic 'In Shale We Trust' and the painfully ebullient 'One Shale of a Good Time'. Leaving headlines aside, there is indeed something significant occurring within the US energy industry, which may have global consequences. Is this a new paradigm? Absolutely. As Tony Hayward, BP's CEO, said recently at Davos 'Unconventional gas will transform the entire energy production landscape in the United States… and alters the U.S. energy outlook for probably a hundred years.' The consequences and effects of shale gas are still in the early stages and a Klondike feeling is still prevalent here in the USA. The spillover of the shale gas paradigm goes further than just redrawing supply and demand curves; it will also affect policy issues, the regulatory and competitive environment and importantly climate issues with global consequences. In this article, the author reports from the frontline of the shale gas revolution, covering a concise history of shale plays, the competitor environment, the gas supply paradigm, the view from Capitol Hill and offers some final thoughts on the future direction of the industry.

The Compact Shale Story

Shale gas experimentation started in the Texas Barnett Shale in the 1980s, with Mitchell Energy drilling the first well into the Barnett formation in 1981. The Barnett Shale is part of the Fort Worth Basin where production started from shallow conventional reservoirs in the 1950s. Geologists scanning the basin noticed thick black organic rich shale close to Barnett Spring Creek, named after John W. Barnett who settled in the area in the 1870s. It was declining production from the Fort Worth Basin that pushed Mitchell energy to experiment with horizontal drilling and completion techniques in the play. It was not until the mid–late 1990s with higher gas prices and proven developments in fracture stimulation that the Barnett was seen as an economic success. Devon Energy Corp. initiated the first of the big acquisitions in the US shale play by acquiring Mitchell Energy for $3.5 billion in 2001. From this point on new shale plays mushroomed including the Fayetteville (Arkansas), Woodford (Oklahoma), Haynesville (Louisiana/Texas) and the Marcellus (Appalachia). Five years ago these names were more geological references; today they are household names in the US gas industry. The list will expand over time including the Eagle Ford, Utica, Horn River, Niobrara, Green River and many others plays.

The shale gas experience is a classic oil and gas story of tenacity, markets, money and technology. The combination of these elements has created a supply picture completely overlooked by almost all analysts as US shale gas production increased eightfold within a decade. The aggressive advances made on the drilling and completion learning curves and the rapid application of latest technologies to new plays cannot fail to impress. For example, it took 22 years for the Barnett to produce 1 billion cubic feet per day (bcf/day) gas production. To reach 1 bcf/day in the Fayetteville it took five years and just three years in the Haynesville. Average Initial Production (IP) rates have consistently moved higher in shale plays, lateral lengths drilled have increased and recovery rates are improving consistently. The average gas output per rig day in the Haynesville and Fayetteville is now twice that of the Barnett. The service sector has been a key driver in this technology development. Shale gas production is more capital intensive than drilling conventional vertical wells and growth in the horizontal drilling and completions sectors has led to increased industry consolidation from the E&P service industry, as seen in the Baker Hughes–BJ Services merger and Schlumberger's takeover of Smith International.

"The consequences and effects of shale gas are still in the early stages and a Klondike feeling is still prevalent here in the USA"

The Billion Dollar Club

The money has certainly been flowing in terms of acquisitions, divestments and joint ventures within the US shale gas plays. As seen in Table 1 the deal count for USD +1 billion deals came in two phases. After the Devon–Mitchell deal, it was the US Independents that dominated the first acquisition wave around 2005–2007, combining their normal appetite for acquisitions with fast and aggressive organic land grabs. By 2008, a second wave of deals can be observed driven by the dual forces of the Majors seeking new growth platforms and US Independents suffering from aggressive acquisitions and liquidity issues as gas prices fell and credit markets dried up as the economy weakened. If shale gas represents a new paradigm for natural gas supplies, the Majors had to be part of this, acquiring not just long-life resources and growth potential, but also a must have skill set for global applications.

The US shale gas business is highly attractive and distinctly unconsolidated; hence the entry choices are diverse. Statoil, BP and ExxonMobil

Table 1: US Shale Gas Deals exceeding USD 1 billion

Year	*Buyer*	*Seller*	*Transaction Value in USD billion*	*Play*
2010	Reliance	Atlas Energy Inc	1.7	Marcellus
2010	Mitsui	Anadarko	1.4	Marcellus
2009	Total	Chesapeake Energy	2.2	Barnett
2009	ExxonMobil	XTO Energy	41.0	Haynesville, Woodford, Marcellus, Fayetteville
2009	BG	EXCO Resources Inc	1.05	Haynesville
2009	Atlas Energy Inc	Atlas Energy Resource LLC	1.01	Antrim, New Albany, Marcellus
2008	Statoil	Chesapeake Energy	3.37	Marcellus
2008	BP	Chesapeake Energy	1.9	Fayetteville
2008	BP	Chesapeake Energy	1.75	Woodford
2008	Quicksilver Resources	Collins & Young Holdings, L.P.; Hillwood International Energy; Chief Resources LLC	1.30	Barnett
2008	Plains Exploration & Production Co.	Chesapeake Energy	3.15	Haynesville
2007	BreitBurn Energy Partners L.P.	Quicksilver Resources	1.45	Antrim
2007	Atlas Energy Resources, LLC	DTE Energy Company	1.25	Antrim
2006	Devon Energy Corporation	Chief Oil & Gas LLC	2.20	Barnett
2006	TCW private equity (Citigroup, Credit Suisse First Boston, Societe Generale)	CDX Gas LLC	1.17	Barnett, Fayetteville
2005	Chesapeake Energy	Columbia Natural Resources	2.2	Marcellus
2005	XTO	Antero Resources Corp	1.04	Barnett
2001	Devon Energy	Mitchell Energy	3.5	Barnett

have made the biggest bets so far in terms of acquisitions and are serious about global applicability. BG and ENI for example have chosen smaller deals maintaining exposure to technology and gaining knowledge. The latest entrants include 'national' energy companies including Total of France in the Barnett (with Chesapeake Energy), Mitsui of Japan (with Anadarko) and Reliance of India (with Atlas) both in the Marcellus, the largest and potentially most prolific US shale gas play. What makes the current wave of acquisitions particularly interesting is that non-US companies are using the US Independents as National Oil Companies. By teaming up with these 'US NOCs' through non-operated joint ventures – and not full out acquisitions – such deals pass with less nationalist scrutiny. One of the strongest cases of the US gas lobby in Washington DC is energy security hence participation from the Norwegians, French, Japanese and Indians noticeably takes a different form than full out corporate acquisitions, as for example ExxonMobil's USD 41 billion takeover of XTO. The failed CNOOC acquisition of Unocal in 2005 still bears lessons for non-US energy companies pondering larger corporate acquisitions. Joint ventures also reduce the human resource risk apparent in making take-overs of companies possessing people with a desirable skill set and knowledge base who may simply leave the company.

Paradigm Supply Shift

The USA is the world's largest and most studied gas market, yet the rapid supply growth from US shale gas was never predicted. All supply analysts pointed towards two 'facts', falling domestic supply coupled with growing LNG imports and huge scale investments required to develop Alaskan gas. Energy companies expected the same, developing strategies for US LNG imports from Russia, West Africa, the Middle East and South America. In the Energy Information Agency (EIA) 2005 outlook US LNG imports were expected to reach 6 trillion cubic feet (tcf) by 2025. In the 2010 forecast, the figure is around 1 tcf. Last year's report from the Potential Gas Committee (PGC) stated that the USA had a technically recoverable resource base of 1836 (tcf) based on a reassessment of shale gas. Total future supply, which includes the US Department of Energy's proved gas reserves, is estimated at 2074 tcf, a 35 percent increase over the previous evaluation. The report captured the headlines with the promise of 90 years of supply at current consumption rates and another step in the direction of energy security. This kind of

dramatic shift in supply forecasts is rare in the oil and gas world. New frontier basins challenge our existing supply logic, for example the North Sea, or the Brazilian sub salt, but what makes this different is the huge inventory of gas in the USA. Shale gas is cheaper to produce than conventional onshore gas, it does not demand immensely sophisticated technology, it will continue to benefit from technological innovation, and supply is highly reflexive to market signals with low entry and exit barriers. About two-thirds of the US gas production is expected to come from unconventional plays by 2018, implying a different cost curve than previously expected. What makes shale gas different is not limitations on productive capacity or resource availability but the size of the market. All of which represents a paradigm shift, but does DC get it?

The View from the Hill

The effect of shale gas on future US gas supply has not gone unnoticed in Washington, but gas does not quite capture the attention from Capitol Hill it deserves. Despite natural gas supplying 22 percent of US electricity and representing around 25 percent of total energy use, natural gas has generally been the poor relation in the energy lobbying industry compared to oil and coal. At a recent conference organised by the Center for Strategic and International Studies in Washington, DC Joseph Aldy, special assistant to President Obama for energy and the environment, said that natural gas was indeed 'neglected' in energy policy. The main reason is that natural gas is not viewed as a strategic fuel in terms of national security or dependency. Aldy says that DC does 'get it' when it comes to the national gas inventory created by shale and the environmental benefits of switching from coal to gas for electricity generation, but the industry should not expect special treatment. The US administration though is very happy to see this technology exported to other countries. On the legislation front there are two climate bills doing the rounds in DC (the Waxman-Markey bill and the Kerry-Graham bill) although it is unlikely that Senators are going to vote for measures that will increase energy prices ahead of the November congressional elections which generally makes Congress more partisan and less productive, particularly after the bitter battle over health care legislation. A climate legislation vacuum in DC may actually help the natural gas industry as the lack of a clear policy on the future cost of CO_2 emissions means few electricity generators are likely to bet on new coal-fired plants. In fact the next wave of coal-fired plants (planned years before) could be the last.

"The USA is the world's largest and most studied gas market, yet the rapid supply growth from US shale gas was never predicted"

The short-term gas demand outlook is not bullish, but low gas prices certainly help make the US industrial sector more competitive and the growth in shale gas is providing new jobs in areas of high unemployment, particularly in West Virginia, Pennsylvania and Louisiana. The natural gas industry has never really had a significant lobbying presence in DC previously, but this is changing and the industry is on the offensive against coal. The gas industry is also on the defensive too. The regulatory environment is closely following shale gas drilling, as legislators assess the environmental impacts. The biggest concern is the effect, if any, of hydraulic fracturing (fracking) on potable water supplies. New York State has essentially stopped all shale gas developments in the state pending further investigations. The federal Environmental Protection Agency will begin a second research study to investigate the impact of fracking on water quality and public health. The previous report in 2004 concluded that that there was no evidence that fracking polluted water supplies, but the report was criticised for focusing on fracking in coal bed methane and justifying an amendment to the 2005 Energy Policy Act that excluded fracking from coverage under the Safe Drinking Water Act. Given the enormity of shale gas resources and public concerns for water quality, the gas industry has to accept that clearance from the EPA is required and, if accepted, would actually boost the case for shale gas as a safe, domestic, reliable and environmentally preferable alternative to coal.

The State of the Gas Nation

So where are we today? At prices below USD 4/Btu at Henry Hub, the gas market is hung-over after the shale gas supply shock and weaker demand caused by the recession. The market is clearly oversupplied and despite 42 percent less wells drilled in 2009 than 2008, production remains robust. This has been driven by superior production rates from horizontal shale wells vs. conventional verticals. Some commentators claim that the United States is in an unconventional gas bubble. Private drillers have already exited accounting for just 9 percent of the unconventional gas rig count, but 49 percent for conventional oil and gas drilling. Given the state of the economy and little extra switching capacity from coal to gas, the supply side is likely to give before any significant demand growth strengthens gas prices. The main companies drilling for gas will be those exercising drilling carries (Chesapeake, Anadarko, Atlas) and companies that are comfortably hedged or flush with new owners (XTO – supported by ExxonMobil). Further consolidation is likely within the unconventional gas sector implying a shift away from the smaller private players to the mid-sized US E&Ps and their foreign joint venture partners. Larger, more financially capable players in the gas sector may reduce the supply volatility so prevalent before in the US gas sector. This may encourage the conservative power industry to sign up to long-term stable supply contracts at the expense of coal. The implication is a different business model for many existing

players, providing more predictable returns, and the possibility of new entrants including utilities. The USA is sitting on a phenomenal inventory of hydrocarbons and the rest of the world will feel its effect through changes in supply patterns, new sources of demand and quite possibly an easier transition to a lower carbon world.

Armelle Lecarpentier considers the evolution of European Gas Pricing

Introduction

The European market is characterised by a 'hybrid pricing model' with the co-existence of market or spot prices, determined on trading centres by the supply-demand conditions, and oil-indexed prices, established in long-term contracts between major gas suppliers and incumbent clients. As Howard Rogers noted in *Oxford Energy Forum* (November 2009), this pricing pattern can be sustainable and solid as long as the following 'rules of engagement' are in place:

- Continental European pipeline gas import contract prices adhere to the contractual formulae based on a time-averaged relationship to gas oil and fuel oil,
- Continental buyers/midstream players can engage in hub trading and LNG diversions as long as they honour their 'Take-or-Pay' commitments under the long-term pipeline gas contracts.

But the current European and global economic context has put this system under pressure and the greater pricing spread between oil-indexed and market prices has required substantial rearrangements of the traditional contractual and pricing structure of the European gas supply to limit drastic market-share losses in an increasingly competitive environment. There have been recent signs that the European market has been more prepared to abandon oil-price-linked formulae in long-term contracts and this evolution will grow in scale as long as the current gas glut persists over the next few years. The pricing system in long-term contracts in Continental Europe has already shown some changes, and the declaration made by Gazprom in March 2010 that it was willing to peg 10 to 15 percent of its gas sales to its incumbent European clients to spot market prices heralded a major evolution in the European gas market's structure in the coming years. The international association CEDIGAZ has analysed the current European pricing context and its future prospects.

The Growing Role of the Spot Market

In order to monetise the huge gas resources discovered at the birth of the European gas industry in the 1950s and 1960s, including finds such as the Groningen field in the Netherlands in 1959 and the West Sole gas field in the UK's North Sea in 1965, natural gas suppliers decided to implement long-term take-or-pay gas supply contracts. These were considered as the most appropriate instrument to ensure the economic viability of capital investments over time while securing outlets for the gas produced. Under these contracts, the natural gas price is based on the netback market approach, so that the maximum purchase price that the gas purchaser is willing to pay is calculated by subtracting the transport and distribution costs from the average price of competing alternative non-gas fuels. These contracts have a traditional duration of 20 to 25 years and contain a 'Take-or-Pay' clause that obliges the buyer to take and in any case pay for a minimum quantity corresponding to the 'Take-or-Pay' level, which is typically equal to approximately 80 percent of the Annual Contract Quantity (ACQ). The pricing formulae negotiated in European long-term contracts are generally based on an average of heavy fuel or home heating oil prices over the previous six to nine months, but in some cases (some Algerian contracts), gas prices can be directly linked to crude oil prices.

The British gas market was the first in Europe to undertake gas market deregulation, which was fully implemented in 1998. It is the only European market where the national hub (National Balancing Point, NBP) is used by producers as a reference index for gas supplies. UK spot gas trading volumes are currently about 1000 bcm/year (compared to consumption of 93 bcm in 2009).

> "The European market is characterised by a 'hybrid pricing model' with the co-existence of market or spot prices … and oil-indexed prices"

Although the NBP appeared as the unrivalled leading gas hub in Europe in terms of trade volume (which is commonly used to assess the liquidity of a gas hub), some Continental European gas hubs have developed strongly and the community of traders has continued to grow in line with the liberalisation process, which was stepped up by the provisions of the second directive (2003/55/EC) that took effect in July 2004.

The Zeebrugge hub was the first short-term market created in Continental Europe. In the years 2008 and 2009, several all-time highs in its net traded volumes were recorded. In 2009, traded quantities soared by 44 percent to a new record volume of 62 bcm, while the churn factor remained unchanged at 5.0.

Besides Zeebrugge, the Dutch gas trading platform TTF (Title Transfer Facility) has become the largest gas hub in Continental Europe, both in terms of physically supplied volume (the quantity of gas supplied on this hub equates to around half of the total domestic consumption) and trading volume, which amounted to 64 bcm in 2008.

Other Continental European gas hubs include the French PEG Nord, the German GASPOOL and NetConnect (NCG), Italy's PSV and Austria's Baumgarten.

Despite these developments, it should be noted that in 2009, the TTF hub was trading roughly only 15 percent of NBP volumes. Indeed, the long-term contractual relationships established prior to the deregulation between producing countries (Netherlands, Norway, Russia and Algeria) and traditional historic operators still largely dominate gas supply on the Continental European gas scene, with a market share of approximately 75 percent in 2009.

Recent trends, however, have shown that the Continental European market is in an improving position to make spot prices referential and reliable signals for the efficient usage of gas transactions. In the fourth quarter of 2009, the NCG and Gaspool market centres emerged as two major hubs in Continental Europe. The trading rate recorded on the NCG Hub even outstripped that of Zeebrugge in the last few months of the year. Moreover, the Continental European gas hubs have significant potential for improvement in their liquidity and efficiency in the future, partly due to the LNG surge in the Atlantic Basin.

Oil and Gas Price Decoupling: Causes and Consequences

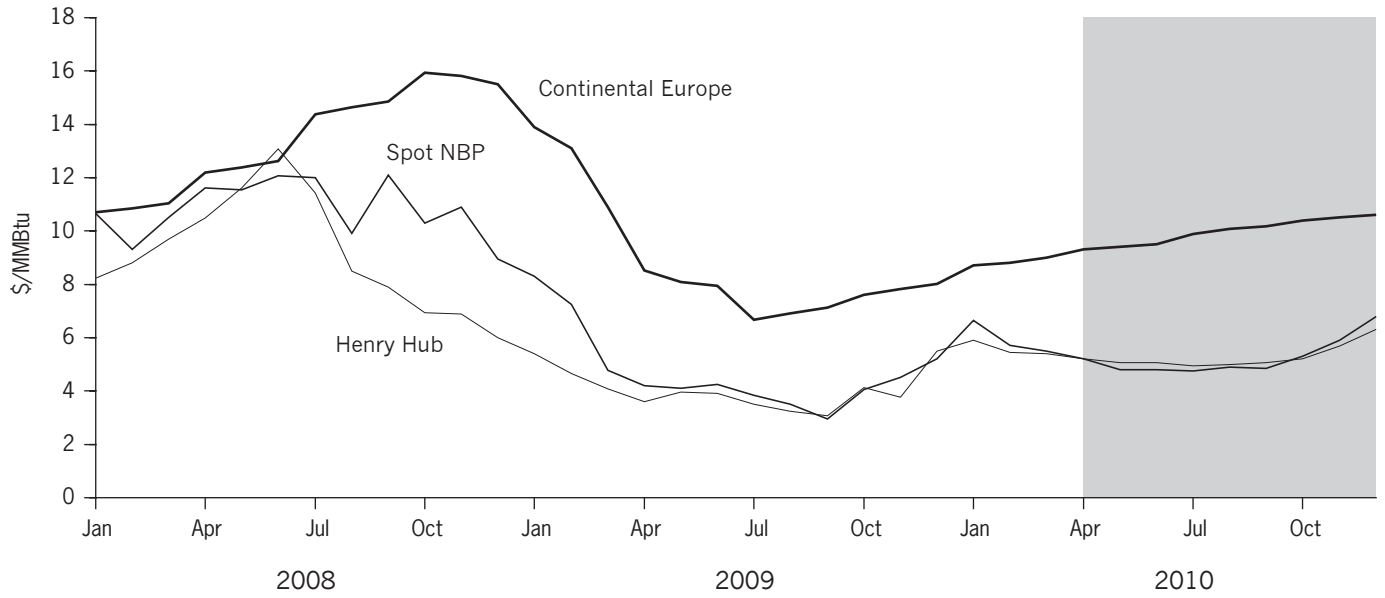
Recent gas developments and the prevailing economic conditions since 2008 have given rise to new price trends whose main consequences have been a pronounced 'disconnect' between spot prices and oil-indexed prices (see Figure 1). The greater imbalance between soaring supply and declining demand have created 'a gas bubble' on markets, which has led to a collapse in market prices dictated by fundamentals. From August 2008 to March 2010, these prices remained about 50 percent lower on average than oil-indexed gas prices set in long-term contracts in Continental Europe and Asia. This new macroeconomic pattern can be attributed to the combination of the following factors:

(1) The growing role of unconventional gas production in the United States

In 2009, the marketing of US-produced gas continued to expand, despite poor economic conditions and a 45 percent reduction in the number of active rigs during the first five months of the year. In the same year, LNG imports showed a modest absolute increase of almost 3 bcm. The growth in US gas production was mainly explained by a boost in the exploitation of unconventional gas sources, whose productivity through horizontal drilling techniques has increased. In fact, the number of vertical active rigs fell by 54 percent in 2009, while horizontal drilling activity declined by only 16 percent. The production of shale gas in particular was least affected by the economic crisis and enabled US production to keep growing, mainly for the following reasons:

- Many shale gas reservoirs continued to obtain positive rates of return at prices of $3.5–5/MBtu. The production of shale gas on the Fayetteville Shale (Arkansas) and the Haynesville Shale (Louisiana) in particular, increased tremendously in 2009, while the Barnett Shale (Texas), which shows relatively

Figure 1: The Decoupling of Oil-indexed and Spot Gas Prices



Source: *World Gas Intelligence, US DoE, CEDIGAZ*

higher production costs (evaluated at around $5/MBtu on average) saw more modest developments.

- Large-scale producers have selected the best and most productive wells to be drilled through high grading.

(2) *The commissioning of plentiful LNG supply capacity in 2009, primarily from Qatar (+31bcm) but also from Indonesia (+10 bcm), Yemen (+5 bcm) and Russia's Sakalhin (+12.8 bcm).*

Russia and Yemen, which became new LNG exporters in 2009, exported 6.61 bcm and 0.42 bcm respectively in their first year of operation according to CEDIGAZ. The global LNG industry is now in a situation, in the short term at least, of weak demand and an oversupply of LNG.

The economic and pricing context in 2009 gave LNG a competitive edge in the Atlantic Basin, where LNG demand increased 26 percent to 88.7 bcm in 2009, under the impetus of the United Kingdom (+9.2 bcm) and Belgium (+3.7 bcm), against a 2.4 percent drop in Asia-Pacific (CEDIGAZ estimates). Spot LNG purchases increased strongly because of a rise in 'flexible' LNG that was sold in the Atlantic Basin under contracts linked to hub market prices and with no restrictions on sales destinations. Indeed, most LNG contracts for European purchasers are for equity LNG that is taken by liquefaction project operators for marketing and branded LNG, such as ExxonMobil and Total in the Qatargas II and RasGas II projects. The volume of 'flexible' LNG is expected to increase strongly from 38 Mt in 2008 up to 120 Mt/y in 2015, adding increasing pressure on prices arbitrages as LNG has recently become a price maker for North West Europe. This growth in flexible and spot LNG supply would favour the growing importance of spot price indexation in European supply contracts.

Table 1: Evolution of the Natural Gas Supply Portfolio of GDF SUEZ

	2008		*2009*	
	Volumes in TWh	*In %*	*Volumes in TWh*	*In %*
Short-term purchases	309	25	393	33
E&P production	37	3	69	6
Long-term supply contracts	815	66	717	60
Others	74	6	17	1
Total	1235	100	1196	100

Source: *GDF SUEZ*

(3) The destruction of European gas demand under the effect of the economic recession

According to initial estimates by CEDIGAZ, real natural gas consumption in Europe (Central Europe, Norway and Turkey included) dropped by 6.4 percent to 531 bcm in 2009, with double-digit decline rates recorded in Spain (-11 percent), Turkey (-11 percent), Hungary (-21 percent) and Romania (-14 percent), as well as in Bulgaria, Greece, Slovakia, Finland and some Baltic countries. Only three markets (Belgium, Sweden and Latvia) actually raised their gas consumption level. The largest absolute decreases were recorded in the United Kingdom (-7.4 bcm), Italy (-6.9 bcm), Spain (-4.2 bcm), Turkey (-4.1 bcm) and Hungary (-3.0 bcm). In fact, these five markets account for 70 percent of the drop in European gas consumption in 2009.

In contrast to LNG, European pipeline imports from Russia, the Netherlands and Algeria fell by 12, 14 and 16 percent respectively in 2009 (CEDIGAZ estimates), attesting to the fact that European purchasers were tempted to reduce their long-term contracted volumes as much as possible to exploit pricing arbitrages.

The Cases of France and Germany

Germany considerably cut its gas purchases from its three major long-term traditional sources, Russia, Norway and the Netherlands, by 18 percent from the first half to the second half of 2008. In the same period, the average European border price from these three sources soared 36 percent and the average German border price increased only 22 percent, while the three main supplier countries continued to share 95 percent of the German gas supply. In 2009, imports from other European sources

(including main spot purchases from the United Kingdom) increased by 21 percent, contrasting with a modest growth in purchases from the three major traditional sources. In February 2010, Gazprom and E.ON Ruhrgas reached an agreement on payment arrangements for E.ON under the Take-or-Pay clause and agreed on a consensus to introduce a spot market variable (10 to 15 percent) in existing supply contracts.

In France, the comparison between the gas procurement portfolio of GDF SUEZ in 2008 and 2009 shows that the company increased its spot purchases by 27 percent in 2009. On the contrary, long-term contracted import gas volumes were reduced by 12 percent in the same year. Imports contracted with the Netherlands fell even more dramatically, by 38 percent, following the transformation of a long-term contract (previously held by Distrigaz before the GDF SUEZ merger) into a short-term deal.

When is the End of the Oil and Gas Price De-correlation Due to Occur?

It is commonly agreed that the global LNG industry will continue to face an oversupply for the next two years at least, keeping spot prices at much lower levels than oil-indexed prices. Recent data on forward prices indicate that the current large gap between Atlantic spot prices and oil-indexed prices in Continental European long-term contracts is set to prevail in 2010, as shown in Figure 1.

"There have been recent signs that the European market has been more prepared to abandon oil-price-linked formulae in long-term contracts"

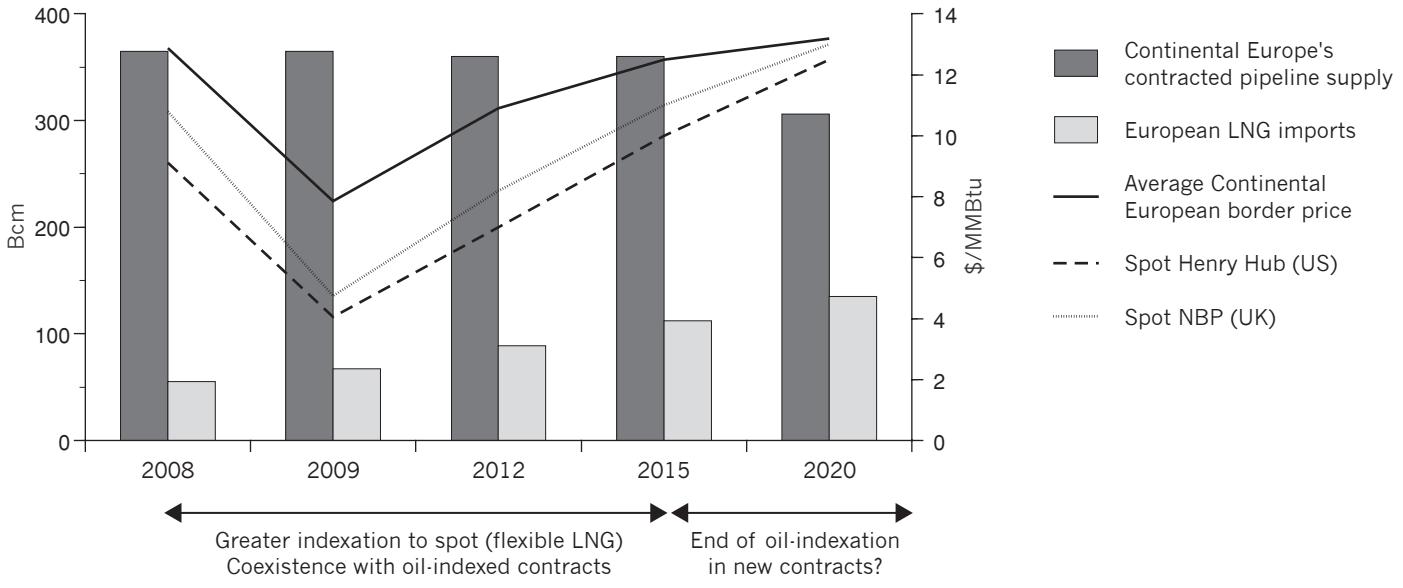
However, the opinions of analysts differ with regard to the degree by which supply will exceed demand – the length of time that the gas bubble will last – and the future price of spot LNG supply. Many experts have predicted a persistence of the global LNG glut until 2015 at the earliest.

Recent information on the recovery of gas-fired power generation in Asia and gas consumption in many European countries may be a signal of the first signs of a quite rapid gas demand rally, and suggest a more bullish pricing scenario from 2012 to 2013 than previously anticipated.

In the High Demand Scenario of CEDIGAZ, based on solid economic recovery, the global gas fundamentals will alter over the 2012–2015 period, leading to a gradual re-coupling of spot and oil-indexed prices, as shown in Figure 2.

Given the context of rising 'flexible LNG supply' in the Atlantic Basin, it is predicted that spot indexation will account for a fast-growing share of European gas imports in the next few years, resulting in downward pressure on the average European border price. As shown in Figure 2, the long-term contracted volume of Continental Europe from extra-EU27 sources will start to drop dramatically after 2015 and new additional or extended contracts will have to be signed to fill the soaring gap between supply and demand in that period. And the possible reconnection of oil-indexed and gas prices post-2015 will not ease increased questioning about the maintenance of a price indexation to oil-products, whose role as alternative substitute in the netback market approach has become less and less relevant.

Figure 2: Natural Gas Prices Outlook and European Gas Supply (High Demand Scenario)



Source: *CEDIGAZ*

Reforming UK Electricity Markets

John Rhys

How Should OFGEM Approach the Issues of Security and Sustainability?

The recent OFGEM consultation on gas and electricity markets has been seen as radical and controversial because, in a context of security and sustainability objectives, it questions the effectiveness of the current market structures for the UK energy sector. In this it reaches a very similar set of conclusions to the October 2009 Committee on Climate Change Progress Report to Parliament on Meeting Carbon Budgets. This article concentrates on electricity and argues that, at least for the power sector, OFGEM's concern is well founded and should imply a radical reappraisal of market arrangements. This is especially important given the central role of the power sector in achieving targets for reduced CO_2 emissions.

If anything the OFGEM arguments for more radical reforms are understated. This paper seeks to:

- examine more critically the sources of the benefits, in lower costs and prices, that have accrued under the post 1990 market regimes;
- consider whether current trading and system operation structures would be technically consistent with the generation technologies likely to form part of the new low carbon energy economy;
- discuss the main market problems posed for securing the investment necessary to meet key objectives of adequate capacity and low carbon sustainability;
- argue that a central purchasing agency for the power sector could deliver the main policy objectives for the sector while retaining the most important features of competitive market structures.

Post 1990 Experience. Assessing the Gains from Regulation, Competition and Other Factors

It is the attribution of the efficiency gains and substantial cost and price reductions following the major market reforms and privatisations in 1990 that largely drives argument over the advantages of current market arrangements, and especially over particular features such as the forms of electricity trading or supply competition. OFGEM implicitly attributes a substantial part of past gains to the current structure of trading arrangements rather than to the body of 1990 reforms as a whole; this conditions its assessment of the risks associated with more radical changes to current trading and market structures.

However, a very high proportion of historical efficiency gains and falls in consumer prices post 1990 derived directly from factors which cannot legitimately be ascribed either to particular features of the market structure or even to the existence of a competitive market per se. In particular, and taking the whole period since 1990, the most important factors promoting lower costs and prices included:

- Elimination of high cost UK coal, which disappeared as initial vesting contracts were phased out in the 1990s. This reflected abandonment of the policies of successive UK governments in forcing the electricity industry, the CEGB, to support the UK coal industry. Privatisation and competition may have provided a convenient cover for this policy change, but this gain would have occurred under any form of regulated or competitive industry.
- The simultaneous advent of relatively new technology in the form of combined cycle gas turbines (CCGT); since this was and is an international technology, the innovation and its development cannot be ascribed wholly or in part to UK market liberalisation.
- The combination of this factor – CCGTs – with a period of low energy commodity prices, and cheap and plentiful gas.
- Very substantial increases in efficiency, and cost reduction, in natural monopoly elements of the sector, especially distribution costs; these however were driven by a combination of regulatory and private sector incentives, not by market arrangements for generation and supply.
- With CEGB assets sold off at below book value, and significant capacity surpluses through much of this period, both the need and ability to earn a full return on the capital value of historic investment were largely removed.

These factors should condition any assessment of the effectiveness of competition per se as the prime driver of efficiency and cost reduction.

There is substantial evidence, especially post 1990, of significant improvements in generation efficiency, most notably in power station operation and availability, driven partly by competitive market pressures and partly by disciplines arising from private ownership of the facilities. This was reinforced by reductions in concentration within the industry in the late 1990s, driven by post-1990 competition policy concerns.

However it is very hard to argue convincingly that these gains resulted from *particular* characteristics of the competitive market structure and rules since 1990 or 2000, and certainly not from the particular feature of supply competition per se, the component of the competitive framework most directly affected by more radical reforms such as a supplier obligation or a central buyer. Indeed Richard Green argued in 2003 that retail competition can raise wholesale prices, corresponding to reduced efficiency and ultimately higher consumer prices, in comparison with a market based on long-term contracts and a regulated supply business.

One further factor deserves mention – the 2001 NETA changes. Inter alia this removed the element of capacity payment, with an inevitable short-term downward effect on prices. However failure to provide an alternative means to reward capacity contradicts the fundamental economics of the power sector, especially the link between market driven prices and investment. It is now widely held to be a

significant part of the security of supply issue.

We should not therefore assume that established advantages and benefits, accruing from a structure built around competition and private investment, would necessarily be compromised even in quite major modifications to the current structure.

Technical Requirements for Trading and System Operations in a Low Carbon Non-fossil Future

One of the great technical achievements of the radical market design for the 1990 privatisation was that it successfully replicated the operational optimisation embodied in the CEGB merit order structure into a market bidding arrangement. Without this feature the market would have been substantially and visibly less efficient at its inception, undermining claims for the virtues of competition in promoting efficiency. It was a pre-condition imposed on the market design.

It also demonstrates the link between the technology of power generation and market structure. Pre-1990, system operation was based on deployment of flexible fossil fuel plant that could respond to meet continuously changing demand for a non-storable commodity. Central control scheduled and dispatched the lowest marginal cost plant in ascending order of merit. Post-1990 this worked through a bidding process which, conceptually at least, encouraged players to bid at marginal cost, and corresponded exactly to the merit order ranking employed within the command and control system of the CEGB. Notwithstanding the NETA modifications to trading arrangements, this close connection remains.

However a future low carbon world is likely to have very different plant operating characteristics, dominated by relatively inflexible plant (nuclear), plant with intermittent and/or stochastic characteristics (renewables), and in the medium term much greater opportunities for positive/negative storage through different types of more flexible demand (e.g. to serve the transport sector). Faced with very different technical and economic characteristics, where a high proportion of plant may have zero marginal cost but technology specific limitations on flexible response to load changes, electricity markets and system operations will need to be defined very differently. Efficient system operation for example may depend on more complex forms of optimisation defined over weeks or months rather than hours or days.

Some issues associated with current arrangements have already been highlighted in the 2009 Pöyry report on wind variability, paradoxically the problems for viability of fossil-fired generation dependent on price spikes and infrequent operation, resulting from intermittent wind power. We should expect new problems as both the number of new non-fossil technologies and their contribution increase.

Optimising the operation of generation based largely on a variety of non-fossil or non-thermal technologies is inevitably a much more complex task than simply stacking the short-run marginal costs of generating plant in a one stage, one price, auction process. If it is amenable to an auction process at all, it would probably be to a multi-stage auction with complex structures and no very clearly defined output of a single 'price' for each period.

We cannot assume therefore that a market built around the notions of daily or half-hourly optimisation and pricing will remain 'fit for purpose', or that the current structure is capable of incremental evolution to a new and more complex system of market 'auctions', let alone any bilateral trading equivalents, that will still deliver short-term operational efficiency.

This emphasises the central importance of having market arrangements that are compatible with the predominant technologies of the day. If we are seeing an evolution towards a set of technologies with very different operating characteristics, both on the supply and demand side, then we shall need very different market structures. We cannot assume a natural incremental evolution from the rules that exist today, or even that a similar market structure will be possible or optimal.

Problems in Securing Low Carbon Investment and Adequate Capacity under Current Market Structures

OFGEM correctly focuses on the primary issue for market arrangements as being how to ensure high and unprecedented levels of investment, to meet both security and low carbon targets, all against a background of an aging plant stock. Several difficulties exist and are apparent in current market structures.

Perverse treatment of financial risks. OFGEM correctly observes that 'investments with stable operating and fuel costs (such as nuclear and wind) could be viewed by … suppliers as more risky than investments whose costs vary with volatile global fuel costs.' Fossil fuel plant will continue to be at the margin for some time and hence to set price. So fossil plant gets a degree of protection (varying by type of fuel and efficiency) equivalent to partial pass through of fossil fuel price volatility. This intrinsically discriminates against non-fossil plant; a pass through of fuel costs for incumbent forms of generation creates a barrier to entry of new technologies.

Asymmetry in treatment of capacity risk. Another unsatisfactory feature of current arrangements is the fundamental asymmetry between the risks of under- and over-provision, and in particular the conflict this creates between market and social objectives for the power sector.

From a societal perspective, the net costs of over-provision may be relatively small. There is a significant resource cost in over-investment, but it is partially offset by earlier retirement of less efficient plant. Under-provision on the other hand is commonly seen as near catastrophic. Inelastic demand is not choked off by prices, and the outcome is load disconnection and potentially widespread loss of output across all sectors of the economy. It is a 'market failure' that cannot be ignored by governments.

However, from an individual investor perspective, and in the absence of long-term contracts, it is over-provision that presents worse outcomes, through a collapse of prices. Restoring equilibrium by closing capacity invites regulatory intervention on competition grounds. Under-provision, by contrast, implies higher prices and better returns.

This asymmetry was balanced in the 1990 arrangements

through market mechanisms established specifically to provide continuity in security of supply – a penal incentive requirement on public suppliers to buy in the market up to a price intended to reflect the value placed by consumers on secure supply – the Value of Lost Load (VOLL). This feature was discontinued under NETA, abandoning a fundamental link between setting a security standard and explicit assumptions about the costs of system failure.

In the context of low carbon investment, this asymmetry is even more pronounced. Over-investment implies over-achievement of sector carbon targets, and hence more carbon-efficient operation of the sector. Within a rationally administered framework of national targets this would in principle allow more carbon allowances to be 'spent' in sectors such as aviation where consumers implicitly attach a much higher value to their use of fossil fuel and resulting emissions. Given that current carbon emissions are typically valued or priced at well below most estimates of their social cost, according to the Stern Review and other sources, this would be a large offsetting social gain, albeit one whose incidence may be very diffuse.

Background of uncertainty. OFGEM suggests one problem is a heightened perception of risk and hence high costs of capital. However nominal interest rates are at an all time low, and according to most of the canons of modern finance theory, investment in well regulated utility industries, with risks that are not heavily market correlated, should be low risk and low beta. Anything else implies lack of confidence in the regulatory framework. The real difficulty therefore is in attracting high levels of investment against a backdrop of *contractual* or *regulatory* uncertainty.

The most obvious historical parallel for a high investment transformation of the power sector in a modern economy is the highly successful decarbonisation of the French power sector in the 1980s and 1990s, the scale of which was certainly comparable to the challenge facing the UK today, and which was accomplished primarily through the state sector (EdF).

A more convincing statement of the problem, therefore, is to consider how the necessary and very high levels of investment can be achieved through private investment and an appropriate balance of regulation and competition in electricity markets.

Carbon prices. Markets, essentially through the EU Emissions Trading Scheme (ETS) have so far failed to deliver carbon prices that are sufficiently high and stable to support necessary investments in low carbon generation technology. This may reflect unwillingness by governments to countenance adequately tight emission limits, and this has led OFGEM, among others, to consider carbon price fixes as one possible solution.

*Coordination***.** Finally, in parallel with the system operation issues posed by new technologies, there are analogous questions of coordination, not considered by OFGEM, in the choice of investment: to determine what combinations and proportions of technologies in the generation capacity mix are technically feasible in meeting future load patterns. Coordination issues also include incorporation of decentralised options, along with their associated infrastructure requirements, choice of sites for wind power, to maximise diversity, and for CCS, to minimise new infrastructure costs for pumping and storage of captured CO_2. This suggests a possible need for an overall investment framework, in the form of additional powers and responsibilities for the National Grid, or for a new power-purchasing agency with responsibility for ensuring adequate capacity and meeting sectoral emission targets.

Finding the Right Path to Effective Reform

The main problems identified in achieving essential investment relate therefore to carbon prices, contractual or revenue certainty for investors, potential inadequacies in system operation and trading linkages as the sector moves away from conventional fossil technologies, the coordination and timing of investments in capacity and infrastructure, and adequate incentives to ensure security of supply.

OFGEM (and the Committee on Climate Change) propose alternative approaches to reform, on a spectrum from incremental changes to existing trading arrangements, including very significant measures such as a carbon floor price, to more radical institutional changes, such as additional supplier obligations or a central agency. The essential strategic choice is between reliance on a series of possible 'fixes' to correct deficiencies in existing market structures, or introduction of formal obligations to provide adequate security and meet emissions targets.

The analysis above suggests that the first approach has several deficiencies: the general problem of trying to second guess markets, the potential proliferation of complex additional rules, schemes and instruments, and failure to address the implications for market structure of fundamental technology-driven change in the sector, all of which will add to investor uncertainty and carry significantly higher risks of not delivering on the objectives.

The more radical options, for a supplier obligation or central agency, are similar, in that the first might naturally evolve into the second with suppliers creating a jointly owned agency to meet obligations, and in that both tend to imply limitations on supply competition. Such an agency offers the most certain prospect not only of securing an adequate quantum of low carbon investment, as well as supply security, but also of securing a balance of different types of capacity and load management options compatible with secure and efficient system operation, and of coordinating that with the necessary infrastructure investments.

The agency would in effect become the major purchaser and wholesaler for the sector, inviting tenders for new capacity, and coordinating its programme with associated infrastructure investment by the National Grid. With properly designed and implemented tenders and contracts, this would retain both competitive pressures in building new plant and incentives for efficiency in operation. Its obligations would encourage a diverse balance of capacity types technically compatible with maintaining supplies, and higher reserve margins to ensure adequate security.

Competition in retail supply could continue but would have to focus on competition in the true supply functions of providing a billing service, rather than exploiting consumer inertia or lack of information as to the true wholesale price of electricity as a commodity.

As a purchaser and wholesaler the agency would also provide a natural channel for support to innovative solutions in the sector, including economically viable decentralised generation capacity. It would also be able to contract for existing capacity, and this would help to encourage a natural transition from existing commercial arrangements.

This paper is based on the author's recent submission to OFGEM Consultation Document 'Project Discovery'

LETTER

On Oil Peak or Peaks

Dear Editor,

I read with interest your article on Peak Oil in the most recent *Energy Forum*, and would like to provide some additional reflections on this subject. Primarily, the trends in oil (and gas) continue to surprise the majority of experts in the energy sector. Our industry is still unable to design a model that can explain what has actually occurred during the many years in which the Peak Oil debate has intensified, but failed to materialise. There are at least two reasons for this, one being we simply can't model human creativity and that we are unable to predict major events and their consequences; just two major examples that most modellers did not see coming – the fall of the wall and the attendant collapse of supply from Russia (and its rise) and the rise of China.

The Peak Oil debate needs to be discussed considering the dynamics of resources, supply, demand, and oil prices. It is no secret that since modern exploration of hydrocarbons began in the early 1900s, the estimates for global resources and reserves have been increasing – at present economically available resources exceeded 10 trillion barrels of oil in place and 25,000 trillion cubic feet of gas in place. Recoverable reserves, currently estimated at 10 percent of the resources in place, have also been increasing. In the last three years, we have had major upward revisions as a result of the US shale gas boom, the Australian coal bed methane boom, the discovery of oil and gas in Brazil's sub-salt formations in ultra deepwater and access to Iraq. And all of these have 'suddenly appeared! Why were we not able to model or predict any of these developments and discoveries or why could the industry not see 10 trillion barrels of oil in place in 1900? History shows that there has never been a shortage of resources, only a temporary shortage of human creativity and plenty of inadequate models and predictions.

Oil and gas production capacity has continued to expand at varying rates and to hold even as some countries and NOCs lost control of their operations – global oil capacity is now above 91 mbp/d and gas capacity above 50 mboep/d. Some major oil-producing countries which had experienced historical peaks in the past, such as the USA, Russia, Saudi Arabia, Iraq, Canada and Colombia, are now once again expanding and in some cases exceeding or about to exceed their historical peaks. Curiously, decline rates, one of the most important parameters in the Peak Oil equation also seem to be the least understood phenomena. Analysts and CEOs have 'simplified' relevant factors such as geology, wells drilled, recovery methods, marginal economics, investment trends, politics, and economics (to name a few) of some 80 countries and 800 companies in the globally accepted 5 percent factor for decline rate. But when one looks at how much liquids capacity has expanded in the last ten years and how much new capacity has come on-stream, the 5 percent simply is not comprehendible; it has been much lower. Growing supply has always been a long-term challenge, not only since 2000. All Peak Oil models have been, undoubtedly, far too simplistic on the supply side.

Finally, demand, a central factor in the Peak Oil debate continues to surprise us and to transform this debate. Following the recent re-rating of the oil price, global oil demand has been flat for the last three years. Prior to which, oil demand growth had been strong, driven by China and developing countries, but today the world consumes 12–13 mbp/d less oil than what the top modellers were predicting some ten years ago. In fact, in the last decade major downward revisions have been made to long-term demand prospects with profound implications (no one expects OECD demand to ever recover), but the Peak Oil alarmists have cared to not notice this trend. We are now told that global oil demand in 2025–2030 is expected to be around 100 mbp/d, but this is 40 mbp/d less than expectations a decade ago. The story for gas demand is similar, particularly in the USA, where major downward revisions have been made over the years, and the world is now facing a major glut. One can only concur that the impact of price, technology (especially), consumer patterns, and substitution (to name a few) has also proven difficult to model.

Ivan Sandrea

Ivan Sandrea is Vice President of Strategy for International Exploration & Production, StatoilHydro.

Asinus Muses

Lovelock's Second Principle

Science makes progress by unifying apparently disparate phenomena. When Newton discovered the principle of gravity he simultaneously explained the motion of the stars, the descent of an apple from its tree, and the path of an arrow through the air. Darwin's theory of evolution explained the diverse forms of life on this planet on the basis of one simple principle. James Lovelock's infamous Gaia hypothesis has not yet reached the status of these great theories, but Lovelock appears to have stumbled across another principle whose explanatory potential is breathtaking. We refer to *the principle of human stupidity*, invoked by the environmental thinker as the explanation for our collective failure to understand and to tackle climate change. 'We're not that bright an animal… I don't think we're yet evolved to the point where we're clever enough to handle as complex a situation as climate change,' he states, citing, in addition, the presence of a great number of 'dumbos' even in the scientific community. Yet just as Newton's other great discovery, that of the differential calculus, led to a universe of applications undreamt of by its originator, Asinus is confident that this first use of the Lovelock principle is just the tip of the iceberg. Those diplomatic exchanges on which Asinus is so fond of reporting; sub-prime mortgages and the banking crisis; the more extreme reaches of postmodernism; English plumbing; all these mysteries and more instantly become explicable once we accept Lovelock's new insight.

US EIA: SNAFU

The application of the principle does, however, require judgement. Take the US Energy Information Administation's recent report on its historical predictions for energy demand, supply and price, going back to 1982. The average percentage error of its predictions for production and consumption has been very respectably below 10 percent. But the error in their price predictions has averaged more than 50 percent for both oil and gas, and more than 40 percent for coal. While Lovelock's new principle is surely part of the explanation, Asinus reminds the reader that it must be applied with care. The real question remains: are the dumbos in the EIA, or are they the buyers and sellers of hydrocarbons?

Demanding the impossible

A suggested answer comes in a paper by Dermot Gately and Joyce Dargay on the future of oil demand, towards which Asinus has ambivalent feelings. It's always a pleasure to see a consensus of officialdom punctured, but unnerving when the message is that the EIA, IEA and OPEC have all underestimated future oil demand out to 2030 by about a quarter. Official estimates assume, apparently without justification, that the income elasticity of demand will be substantially lower in the future than it has been so far. Dargay and Gately argue that the efficiency savings that took place after the oil shocks of the 1970s are unrepeatable, and that it was the collapse of the constituent economies of the Soviet Union that kept oil demand in check through the 1990s – presumably, or at least one hopes, another unrepeatable experience. At the newly predicted rate of demand growth, supply, of course, will not be able to keep up. The oil price, after a year of sobriety around the $65–$80 range, made a drunken lurch to $87 in early April. If Dargay and Gately are right, it looks like the oil price may be heading for a long-term binge.

DeLong's long shot

Berkeley Professor of Economics J. Bradford DeLong may have had a jar too many before giving a speech titled 'After Copenhagen, What?' His answer is four-pronged: 'pour money like water' into research on carbon-reducing research; beg the rulers of China and India to get on board, on the basis of their long-term interests; nationalise the US energy industry; and restrict future climate negotiations to seven large 'countries' (one of them the EU), presenting the rest of the world with painful trade sanctions if they don't sign up. Asinus can't help feeling that in number three, at least, the professor's usually keen sense of real politik has deserted him. Obama didn't even nationalise healthcare and Republicans declared him a communist (in addition to a Muslim, baby-killer, Satanist and terrorist). That energy nationalisation may be the optimal policy does not imply that the US political system will allow it happen. DeLong forgets Mark Twain's famous precursor to the Lovelock principle: 'Suppose you were an idiot. And suppose you were a member of Congress. But I repeat myself.'

It's an ill wind

The Icelandic ash cloud, having grounded flights over much of Europe for several days, has thereby exposed its silver lining: carbon emissions due to transportation have probably been reduced by several million tons, outweighing the approximately 200 thousand tons a day emitted by the volcano itself. Australian climate change sceptic Ian Plimer has claimed that, 'Over the past 250 years, humans have added just one part of CO_2 in 10,000 to the atmosphere. One volcanic cough can do this in a day.' Given that the largest volcanic eruption of recent years, Mount Pinatubo in the Philippines in 1991, contributed the equivalent of about one-700th of the carbon produced by humans in the single year 2006, Asinus finds himself again reaching for Lovelock's new principle.

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