Energy Security Issues

The World Bank Group

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Executive Summary

This Briefing Paper has been prepared to provide an overview on global energy security issues and challenges in the short and long run. It suggests areas of focus where consistent approaches and global actions will help improve energy security.

Recent events in oil and other markets have brought the issue of energy security to the forefront. High and volatile prices raise concerns about short term risks to economic growth and about longer term energy security. Although it will mean different things to different countries, there is a strong common interest in ensuring the world can produce and use energy at reasonable costs and in a sustainable way to ensure the quality of life of the world's peoples.

Enhancing energy security will require a far sighted and cooperative approach internationally, as well as a variety of specific initiatives and interventions at the national and international level. Two particular issues loom large in this respect: the threat of global warming and its links to the use of fossil fuels; and, the lack of access to clean, healthy and affordable energy, including electricity, of a significant number of the world community's poorest members.

If the global community is to take a lead in promoting energy security then its approach should probably be best focused on three key pillars:

i. Energy efficiency - ***where the impact and return are large and the risks relatively low. The key is likely to lie in appropriate and consistent long term objective setting with the right policy and pricing frameworks to achieve these.***

ii. Diversification of energy supplies ***– where a complex set of issues need to be addressed on a fuel by fuel basis, but where some of the keys are going to a cooperative approach between energy importers and exporters, the facilitation of international trade and investment, and a long term , globally consistent approach to environmental issues (including climate change).***

iii. Dealing with volatility – where ***mitigation and effective management of its consequences is a more realistic objective in the short run than its removal. And where appropriate macro-policies, burden sharing and support for the weakest, and cooperation transparency and information sharing are ways forward.***

Potential Implications for International Action

Coordinated efforts by the international community can play a significant role in promoting energy security. An agenda for action could include the following key elements:

(i) Actively promoting more efficient use of energy in all economies through developing programs to agree broad sets of objectives and international benchmarking, and facilitate exchange of information and technologies;

(ii) Facilitating the access and security of cross border energy investment and transit, so as to allow global and national fuel and supplier diversity;

(iii) Building on the G8 commitment at Gleneagles to a low carbon economy and adaptation to climate change by integrating this with the energy security agenda;

(iv) Supporting and strengthening initiatives by international institutions and others to support the poorest countries in their adjustment to short term energy price shocks, and, in the longer run, to make healthy, clean affordable energy available to all their citizens; and,

(v) Promoting transparency about energy resources, use and production through the whole energy chain, especially in the critical oil market, by supporting and supplementing current initiatives and approaches as needed.

I. Perspectives on Energy Security

For the World Bank Group, energy security means ensuring countries can sustainably produce and use energy at reasonable cost in order to:

- Facilitate economic growth and, through this, poverty reduction; and
- Directly improve the quality of peoples' lives by broadening access to modern energy services.

However, the precise meaning of energy security will vary by country. Table 1 lays out one set of broad overlapping groupings which are based on three major criteria: (a) level of economic development, (b) endowment of energy resources, and (c) potential impact on global energy demand.

For energy producers, it is the ability to secure, long term and attractive markets for their natural resources that often underpin their economies. For the major industrialized economies, it is the continuing supply of energy that drives their economies and supports a high and growing quality of life. For poor countries, it is a vital ingredient in their paths out of poverty. Energy increases poor people's productivity and incomes; lighting and power improve their health and education and help them connect to the global market. If present trends continue, by 2030, 1.4 million people will still lack access to electricity, only 200 million fewer than today[1]. Annex 1 illustrates the disparities in household fuel consumption. Table 2 illustrates the disparities in access to electricity and Annex 3 provides estimates of the distribution of access by geographical region.

For all countries, though, there is a vital common interest, between producers and consumers and between rich and poor, in ensuring that the global economy finds the energy it needs to grow in a sustainable way.

In this respect, the attention directed towards the issue of energy security by the international community has been greatly heightened by the increase of oil prices to record levels in nominal terms, although prices are considerably lower than their peaks in the 1970s, over the past 18 months which has contributed to high volatility and rising energy prices overall. Rising and volatile energy prices pose a risk to the world economy and to all countries, but the poorer importing countries are less able to cope with increased prices. Importers generally are also concerned about the meaning of short term price shocks for longer term secure supply of reasonably priced energy.

Oil and gas exporters have been able to generate windfall profits from high oil and gas price levels. However, their trade relations with importers could eventually be harmed as a result of the negative impact on economic growth of high energy prices, although there are few signs of this yet.

[1] Jamal Saghir. Energy and Poverty Myths, Energy and Mining Sector Board, Energy Working Notes, No 4, May 2005

Table 1 Reviewing Country Perspectives on Energy Security

	Defining features	Priorities on energy security
Industrialized net energy importers	Ø GDP/capita income above $10,065 (1) Ø High per capita energy consumption – above 3,000 kgoe per year (2) Ø Decreasing trend in energy intensity; Ø Increasing gap between domestic energy supply and demand, with demand increasing slower than world's projected annual growth rate of 1.7 % till 2030 (3); Ø Well established energy infrastructure (E.g.: nearly universal access to electricity) (4); Ø Economy and households relatively resilient to energy price fluctuations (E.g.: $10 rise in oil prices causing less than 0.5 % drop in GDP) (5)	Ø Avoid disruption of energy supplies; Ø Diversification of energy supply sources; Ø Security concerns for energy infrastructure; Ø Technological solutions to reduce dependence on imported supplies
Major hydrocarbon exporting countries	Ø Varying GDP/capita from $260 (Chad) to $52,000 (Norway); Ø Large variations in annual energy per capita consumption – from 262 kgoe (Congo) to 26,888 (Qatar); Ø Mixed trends in energy intensity; Ø Sufficient supplies of energy resources (mainly hydrocarbon) in the foreseeable future; Ø Need for infrastructure development mainly for energy exports; Ø Economies vulnerable to boom and bust cycles dependent on world energy prices (E.g.: $10 rise in oil prices leading to 30 % growth in Angola's GDP).	Ø Long term markets at reasonable prices Ø Diversification of export markets for energy resources; Ø Securing capital and financing for investment in resource development and infrastructure Ø For less developed countries in this group: meeting people's basic energy needs and creating effective demand for energy services
Large emerging markets with rapidly growing energy demand	Ø Varying GDP/capita income from $620 (India) to $6,770 (Mexico), Ø Annual energy consumption per capita ranging from 514 kgoe (India) to 2,425 kgoe (S. Africa), Ø Mixed trends in energy intensity; Ø Demand to grow significantly above expected world's projected annual growth rate of 1.7 % till 2030 (E.g.: China's demand growing by 14 % in 2003); Ø Rapid growth in domestic energy infrastructure, though still insufficiently developed (E.g.: 57 % of the population lacking access to electricity in India and 34 % in S. Africa) Ø Economy and households relatively vulnerable to energy price fluctuations (E.g.: $10 rise in oil prices causing above 0.5 % drop in GDP, depending on the size of the economy and energy intensity).	Ø The ability to meet growing demand for energy from imported sources; Ø Diversification of energy supply sources; Ø Securing capital and financing for investment in resource development and infrastructure Ø Technlogical solutions to reduce dependence on imported supplies Ø Meeting people's basic energy needs and creating effective demand for energy services
Mid-income net energy importers	Ø GDP/capita income between $826-10,065; Ø For most countries, annual energy consumption per capita close to the world average of 1,631 kgoe, Ø Mixed trends in energy intensity; Ø Demand to grow above world's projected annual growth rate of 1.7 % till 2030; Ø Underdeveloped energy infrastructure; (E.g.: More than 10 % of population on average lacking access to electricity); Ø Economy and households relatively vulnerable to energy price fluctuations (E.g.: $10 rise in oil prices causing above 0.5 % drop in GDP, depending on the size of the economy and energy intensity).	Ø The ability to meet growing demand for energy from imported sources; Ø Securing capital and financing for investment in resource development and infrastructure; Ø Meeting people's basic energy needs and creating effective demand for energy services
Low income net energy importers	Ø GDP/capita income below $826; Ø Annual energy consumption per capita around or below 500 kgoe; Ø Mostly increasing trends in energy intensity; Ø Demand to grow above world's projected annual growth rate of 1.7 % till 2030; Ø Highly underdeveloped energy infrastructure; (E.g.: access to electricity for around 30 % of the population) Ø Economy and households highly vulnerable to energy price fluctuations (E.g.: $10 rise in oil prices causing above 0.75 % drop in GDP on average).	Ø The ability to meet growing demand for energy from imported sources; Ø Securing capital and financing for investment in resource development and infrastructure; Ø Meeting people's basic energy needs and creating effective demand for energy services

Source: World Bank

Notes: (1) In 2004, based on World Bank Atlas Method, (2) In 2001, according to World Resources Institute; (3) World Energy Outlook 2004, IEA, (4) In 2000, according to World Resources Institute, (5) World Bank estimates

From this perspective, there are two key issues of global concern dominate considerations of energy security:

- Ø Over the long run, to meet continuing global growth in demand for energy services, when in some key dimensions (such as long run oil supply, or absorption of carbon emissions) many commentators believe that global capacity to do this is looking more uncertain.

- Ø To manage the economic and energy market impacts of potentially continuing high and volatile energy (oil) prices. This is an immediate short term issue, but could remain a recurrent feature of energy markets.

Finding secure and economic sources of energy to grow has always been a challenge. In the past, it has called for ingenuity and perseverance, and also required international trade and cooperation. In the future this will also be true, although the specific challenges that must be addressed and their scale may be different. Energy demand growth is increasingly concentrated in the developing world and supply is being concentrated in a fewer number of countries.

In order to enhance global security over the longer term, broad based international cooperation is going to be needed in a variety of areas. This paper focuses on three:

(i) Energy efficiency – to reduce the rate of growth of energy demand;

(ii) Diversification and growth of energy supplies; and

(iii) Dealing with market price volatility.

II. Enhancing Long Run Energy Security

The Challenge

Recent oil (and other commodity) price rises, and continued rapid industrialization in China and India, have raised concerns about longer term energy security. Almost all mainstream energy forecasters predict growing global demand growth, underpinned by developing country growth and continued, albeit much slower, growth in demand in the industrialized economies. For example, the latest forecasts of the International Energy Agency (IEA) show total global energy demand increasing by more than 50% by 2030.

Meeting demand on this scale is going to be challenging with different energy sources each facing particular issues that need to be addressed on a country by country or on a global basis.

An important concern is the belief held by some analysts that global capacity to substantially increase oil production will be increasingly constrained by the size and distribution of the geological resource base. They consider that, as a result, prices are likely to stay at high levels, and may even rise further if demand continues to grow. Other forecasters, though, suggest that there is still scope for growth in oil supply capacity, particularly in countries with large reserves and low production costs, and this will happen and will eventually bring down prices. For

example, the World Bank's own forecasts[2] assume as a central case that prices will come down to $40 barrel by 2010. The International Energy Agency[3] is predicting $35 barrel by 2010. In a recent presentation, the OPEC Secretariat[4] gave the view that prices in real 2004 dollars will fall gradually to $20-25 barrel to 2025.

In all cases, however, oil production looks likely to become more concentrated on a relatively small group of low-cost producers in the Middle East with significant market power, and most forecasters stress the inherent uncertainty and wide range of possible outcomes of future price forecasts. Views about long term prices are vital inputs to many energy investment decisions that have long lead times and a capital stock that turns over only very slowly.

Overarching the longer term energy outlook are two major issues that should be the concern of the global community and that should inform its approach to energy security:

(i) The threat of climate change (Annex 2), poses issues for the continued growth in use of fossil fuels (coal, oil and gas) – that for more than 200 years have been the most convenient and cost effective fuels for modern economic development – and are likely to continue to have cost advantages (excluding any consideration of possible externalities) in some important uses for a long period to come. The July 2006 G8 Gleneagles Summit has increased awareness of climate change as a development issue, within a framework of affordability. There are two distinct but related components to this challenge – supporting affordable, low carbon energy and infrastructure systems, and helping to adapt to climate change. As the impact of climate change disproportionately affects the health and well-being of the poor, this agenda is of mainstream importance to the energy poverty-reduction agenda. In this context, the G8 requested the World Bank Group, to prepare an "Investment Framework" to accelerate investment in low carbon energy systems and to increase the level of assistance to developing countries to help them adapt to climate change and thus helping them responding the challenge of energy security.

(ii) Access to reasonable cost, reliable energy supplies will be an important factor in promoting growth and poverty reduction. As well, a significant number of the world's community, among them the poorest and most vulnerable, do not yet have access to affordable energy that can make their lives more healthy and more productive (Table 2). Current forecasts show only slow progress in some areas. Addressing these needs, too, should be a key task of the global energy security agenda. A global effort to finance access requires strong policy support, to eliminate the international and domestic barriers to investments in resources and new technologies, in particular for expanding grid and off-grid electricity and modern cooking and transport fuels. The needs of the urban and rural poor must be addressed separately, although common solutions can include capital cost subsidies targeted to benefit the poor, removing fuel taxes that prevent inter fuel substitutions and hurt the poor, and facilitating competition in fuel distribution. Low oil and gas prices would help protect the poor during the process of transition to low-carbon energy.

[2] Development Prospects Group, The World Bank, October, 2005
[3] International Energy Agency Reference Scenario, World Energy Outlook (WEC) 2005
[4] OPEC Oil Outlook to 2025, OPEC Review Paper, 2004

Table 2 In-home Electricity Access by Region *(Sources: IEA and World Bank)*

Country or region	Population without in-home access (million)	Population without in-home access (%)	Region's share in those without access (%)
South Asia	800	47	49.3
Sub-Saharan Africa	525	75	32.4
East Asia	220	12	13.6
Latin America	45	10	2.8
Middle East and North Africa	30	9	1.9
Total	1,620	30	100

Improving Energy Efficiency

Improving energy efficiency is a 'win-win' option for addressing concerns about energy security:

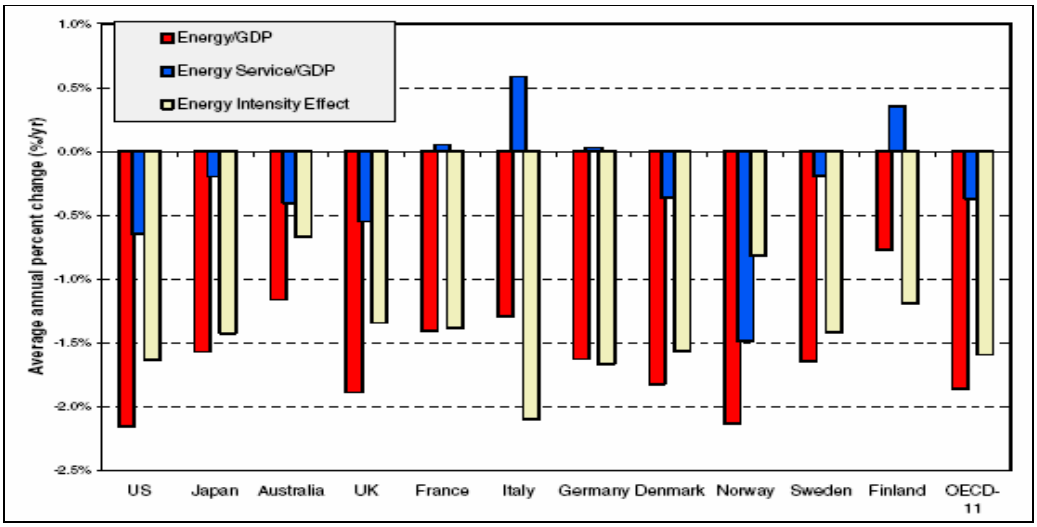
- Ø Energy efficiency and demand side measures will often be the most cost effective, low risk and versatile approach to reducing the need for energy and associated infrastructure;
- Ø Energy production efficiency improvements can increase effective energy supply (and exports) and reduce costs;
- Ø Efficiency savings generally realize significant environmental benefits through reduced emissions of greenhouse gases and local air pollutants.

A recent study by the International Energy Agency (IEA) provides a detailed analysis of how much of this decline was due to energy efficiency improvements (the "intensity effect" in Figure 1) and how much as a result of structural changes ("energy service / GDP" component in Figure 1). As illustrated in the figure, this decrease in energy intensity has been mainly credited to improved energy efficiency, which has covered a variety of end-uses such as appliances, vehicles, industrial processes and space heating.

Recent studies, for example, suggest that the EU could save 20% of its current energy use in a cost-effective manner through energy efficiency measures. Around half of this could come from the application of existing measures, such as Community directives already in force or under consideration[5]. For appliance efficiency, for instance, the International Energy Agency estimated that implementing best available technologies through policies leading to a Least Life-Cycle Cost for end-users would deliver up to 642 TWh of savings by 2010 and 1,110 TWh by 2030, compared with current policies. (IEA 2002)[6]. Introduction of more energy efficient vehicles could lead to a substantial reduction in demand. In fast growing emerging economies, it is estimated that the transportation sector will absorb 43% of energy demand by 2025 as compared to 31% in 2002 (IEA, 2004).

[5] Commission of the European Communities, "Doing More with Less: Green Paper on Energy Efficiency, 2005.
[6] International Energy Agency, "Cool Appliances," 2002

Figure 1 Changes in energy per GDP broken down into changes in energy service per GDP and energy intensity effect, 1973-1998



(Source: IEA 2004)

There are also opportunities for improving energy efficiency in the developing countries where such measures have been a lower priority. In particular, rapidly growing developing countries can influence the efficiency of their rapidly growing stocks of energy using equipment. Industrialized countries, with their pioneering role in technological progress, can significantly augment global efforts aimed at improving energy efficiency. This could involve measures such as harmonization of energy efficiency codes, adoption of minimum energy performance standards, and coordination of energy efficiency labeling for major end-users. Such measures could be complemented with initiatives aimed at raising a global awareness on energy efficiency.

Wide experience has shown that national initiatives will be most effective when they:

- Put in place consistent and comprehensive policies for achieving energy efficiency that use pricing (including consideration of externalities), taxation, regulation and other forms of support to effectively achieve long term efficiency objectives.
- Take a systematic approach along the energy value chain through an integrated and systematic approach composed of a series of complementary measures all along the energy value chain.
- Promote energy efficient transportation and urban management systems, for example, from more energy efficient individual vehicles, transport corridor planning and traffic management, spatial urban planning, more efficient district heating systems and improved building codes.
- Also focus on efficiency improvement in energy production and transportation for example in more efficient power plants and reduced transmission and distribution losses, or through reduction in gas flaring and methane leakages.
- Support technologies for fostering and realizing large potential energy efficiency improvements such, as for example, end-use areas, such as lighting, appliances, transportation vehicles, and commercial and industrial equipment. Existing known technologies offer substantial potential for improvement if widely implemented.

- Promote international efficiency standards that help set benchmarks and encourage progress in efficiency globally.

Developing and Diversifying Energy Supplies

Developing Energy Supplies

Improvements in energy efficiency will not remove the need for substantial energy investment, especially in developing countries where energy growth will, in many cases, be starting from very low levels per capita. The IEA has highlighted the huge global investment requirement needed for the period of 2003-2030 in order to meet its predicted demand forecasts[7]. Total investment of around USD 16 trillion is dominated by USD 10 trillion in power generation, transmission and distribution. The oil and gas sector will require about USD 3 trillion and the coal sector USD 400 billion. Of the total, developing countries will require almost half of the global total.

In order to encourage efficient investments on this scale, governments will, in the case of power sector investments[8] need to:

- Promote policies that secure adequate cash flows in the public sector to help finance new investment and maintenance, rather than allow state utilities to be inefficient or not fully recover cost.
- Encourage new private investment through streamlining investment procedures, improving clarity and enforceability of contracts, and creating conditions that attract and facilitate competitive private investment within a framework of competition[9].

In the case of the oil sector, challenges include:

- Increasing the effectiveness of National Oil Companies (NOCs), or state-dominated joint ventures, that account for a major part of the world's oil and gas supply and its future growth, by creating governance frameworks that optimize the efficiency of operation and investment (including trade-offs between state investment in exploration and production, and non-oil sector public expenditures.). Under existing institutional frameworks, a substantial portion of the necessary global investment in oil and gas production capacity will come from a handful of Middle Eastern NOCs, so their governance frameworks will be of paramount importance.
- Reducing barriers to private investment: In some countries, particularly those with limited sector experience and access to capital, private investment can make a major contribution. Finding ways to effectively exploit the dynamism of private investors while meeting national concerns will help mobilize needed investment and facilitate the spread of new technologies and processes[10].
- Improving transparency in the oil sector: Transparency in the oil sector, from consumption, stock, production and resource base and also about revenue flows[11] and

[7] World Energy Outlook 2004, IEA
[8] Closing the Electricity Supply-Demand Gap, The World Bank (forthcoming)
[9] Ranjit Lamech and Kazim Saeed, *What International Investors Look for when Investing in Developing Countries*, Energy and Mining Sector Board Discussion Paper no 6, May 2003
[10] Kalpana Kochhar, Sam Ouliaris, Hossein Sammiei, *What Hinders Investment in the Oil Sector*, International Monetary Fund, February 22, 2005.
12 The World Bank is a partner with DFID of the UK in the Extractive Industries Transparency Initiative (EITI).
[11]

uses, contributes to create a better investment environment, as well as to better use resource revenues which, in turn, helps make for a more stable supply.

Diversifying the energy portfolio

Energy portfolio diversification can help in reducing energy security risks to individual countries and to global markets. At a global level, changes in the energy mix are slow to be realized. Table 2 shows changes over a since, 1980 in this respect from when the share of oil in total global energy has fallen from 46 percent to 39 percent. IEA currently estimates that petroleum's share in world energy consumption will drop only by about 1 percent by 2030.

Table 3 **World Energy Consumption by Fuel Type.** **(Quadrillion BTU and percentages)**

	1980	1990	2002
Petroleum	131 (46)	136 (39)	159 (39)
Natural gas	54 (19)	75 (22)	95 (23)
Coal	71 (25)	90 (26)	98 (24)
Hydroelectric	18 (6)	23 (7)	27 (7)
Nuclear	8 (3)	20 (6)	27 (7)
Total	285 (100)	348 (100)	411 (100)

Source: EIA

On an individual country basis, energy shares can change more quickly and Annex 1 shows how this happened for European countries over a twenty year period. These shifts reflect partly government strategies, but also changes in national resource endowment, and response to price changes. Thus, a shift towards nuclear power in France and Belgium helped to alter the national fuel mix away from petroleum and coal. For many countries, the discovery of natural gas or completion of cross border pipelines (for example the UK and Germany) had a similar impact on the share of petroleum and coal in the national energy consumption.

Looking forward, forces for the diversification of energy supplies are going to be:

- Continuing natural process of consuming and producing countries in prudently diversifying their energy mix by fuel and by supplier/customer.
- Global reaction to the threat of climate change that should lead to a move away from carbon intensive emitting fuels.
- Some tendency to move away from oil where possible, given its potential high price level and volatility, and also given longer term concerns about resource availability.

Some of the most important options in this respect are:

- Promoting natural gas consumption: Environmental concerns and technological progress cutting the cost of gas pipeline and LNG projects have fostered the penetration of natural gas in a growing number of countries. Policy changes that allow gas's competitive strengths (including environmental) to show through, and regional/bi-lateral cooperation that reduces the uncertainty and risks of large long lead time capital intensive projects and facilitates cross border and third party trade, innovative supplier/consumer pricing arrangements, are all areas where gas use can be promoted.
- Accelerating the development of renewable energy and distributed energy: Promoting hydropower taking into account fully encironmental and social considerations is one area that offers large opportunities for portfolio diversification. Besides its potential contribution to securing low carbon development, it is a versatile generation option, able to rapidly adjust to load variations and instantaneous changes in demand. Meanwhile,

off-grid renewable energy, such as wind and solar power, and micro turbines are sometimes the least cost for providing energy services to rural population.

- Ø Nuclear energy: There have been increasing calls for higher priority on nuclear energy mainly in industrialized countries. Based on the experience of some EU countries, as well as Japan and Korea, nuclear power plants can contribute to a country's energy security through reducing its dependence on fossil fuels. However, concerns about waste disposal, nuclear proliferation and public perceptions about safety, have undermined public support for nuclear power. International cooperation focused on nuclear safety is warranted.
- Ø Support for clean coal: Clean coal technologies that could crucial in securing an environmentally sustainable future, have so far faced powerful constraints in terms of competitiveness against other sources of energy. Industrialized countries can largely contribute to their penetration through supporting R&D that will raise their competitiveness. But there may also be more readily achievable benefits in some countries through improved pricing mechanisms and more selective coal mining and better coal preparation.
- Ø Enhancing fuel switching capability: Promoting technologies with enhanced capabilities to switch at short notice between fuels can enhance the energy security of countries. The viability of such technologies can often be significantly improved through allowing market forces set the price of competing fuels.

Facilitating energy trade

Overlaying all discussion of energy security is the importance of international trade. Already a major share of energy supply crosses international borders. Despite the possible growth of renewable energy and nuclear and increased energy efficiency this will likely increase[12]. Trade extends well beyond raw energy products and includes oil product distribution and in some regions electricity grids.

Energy interdependence is therefore a key and enduring aspect of international affairs. Governments have a continuing role to play in helping facilitate cross border trade and investment. This can include ensuring appropriate national legislation, international and bilateral treaties that facilitates trade and transit, and an open process of dialogue where suppliers and customer work to achieve mutually acceptable processes and approaches to common energy trade and security issues.

One specific area related to energy trade where there has been relatively little progress so far in some regions, particularly in the developing world, is electricity system integration. Integration offers potentially large benefits in terms of long term security, economies of scale and access to more competitive fuel sources, as well as short term reliability. LNG is another area where the potential for trade growth is high.

III. Managing Short Term Volatility

For the global community, the key short term risk to energy security appears to be that volatile and high prices will disrupt economic growth. While overall growth has continued to be relatively strong through the current, demand driven, oil price rise, there is a risk that sharp and

[12] IEA estimates that by 2030, 63 percent of oil will be traded internationally (up from 46 percent in 2002), 26 percent of gas (up from 15 percent in 2002), and 15 percent of coal (up from 14 percent in 2002). Sources: World Energy Outlook 2004, IEA

sustained price rises in the future may lead to reductions in consumer or business confidence that lead to a more significant impact. Moreover, the implications of such trends will be disproportionately negative for lower income countries, creating obstacles to global efforts to reduce poverty.

Numerous studies have provided estimates about the effect of oil price shocks on the global economy. Though consensus on the precise magnitude of the impact is lacking, most of them agree that oil shocks reduce the overall economic growth. An IEA study determined that economic growth was affected negatively in the two years following the price hikes of 1973/1974 and 1979/1980[13]. An IMF study conducted in 2000 estimated that a USD 5 per barrel increase in the price of oil reduced the level of global output by around ¼ percent over the first four years[14]. A more recent study by the World Bank forecasts that the increase in oil prices in 2005 is expected to slow global economic growth by about a ¼ percentage in 2006[15]. In general World Bank studies have shown[16] that the lower income countries dependent on oil imports appear to be the worst affected by oil shocks.

Oil market outlook

History shows that current high oil and other commodity prices should eventually come down as supply and demand respond to high prices. But there will be lags in these responses because of the long lead times usually required to make new energy investments, turn over the capital stock, and even to change users' expectations and behavior.

However, even those forecasters who believe that prices will eventually retreat from today's levels, and that global supplies can be developed to meet increased demand at prices below today's, believe that, for the short term, the balance between global demand and supply capacity will continue to be very tight and it likely that prices could remain high or increase. The latest short term forecasts of the Energy Information Administration (EIA) of the US Department of Energy[17], for example, predicts that prices will remain above 2005 level through 2006.

Reducing the potential for oil price shocks in the short term

In a market where the balance between supply capacity and demand is tight, and below historical levels, effective mechanisms to significantly reduce the risk of further price volatility are few in the short term. This is mainly because:

- On the demand side, capacity to switch industrial fuels is limited in the short run and, consumers tend to be relatively price insensitive in industrialized countries, but more price sensitive in developing countries. Government efforts to manage demand in the short term through administrative fiat or exhortation, may have a short term impact but have their own costs on consumers and business.
- On the supply side, high prices should eventually lead to increased new investment. While long lead times for new production development mean the short term supply response is limited, governments can help by removing unnecessary barriers to urgent needed investments.

[13] *Analysis of the Impact of High Oil Prices on the Global Economy*, International Energy Agency, May 2004, p. 6
[14] "The Impact of Higher Oil Prices on the Global Economy", *International Monetary Fund*, December 2000, p. 15
[15] *Global Economic Prospects: Economic Implications of Remittances and Migration*, The World Bank, November 2005, p. 5
[16] Robert Bacon, "The Impact of Higher Oil Prices on Low Income Countries and on the Poor", *ESMAP Report* No 299, March 2005, pp.: 14-15
[17] EIA, Short Term Energy Outlook, November 2005

- Ø Strategic stocks held by consuming countries are likely to have a limited role to play because of their relatively small size. They are more likely to be held in reserve or only used, as was the case with the recent release of 29 million barrels of crude oil by the USA and International Energy Agency, to meet perceived specific shortages in the market.
- Ø The role of OPEC and other major oil producers to address price volatility problems is significantly constrained due to the current lack of spare capacity

Coping with Price Volatility in the Short Term

Allowing markets to work. A key lesson of past oil price shocks has been that even when prices are rising sharply, allowing markets to work has avoided physical shortages of crude oil and products. Physical shortages have most commonly arisen, when governments have stopped markets from balancing supply and demand, for example, by trying to administratively constrain price increases and direct scarce supplies to priority areas.

Supporting the most vulnerable. In some cases, governments may consider that groups in the community need to be assisted to help manage the welfare impacts of adjusting to high energy prices. International assistance and programs and funds may also be appropriate to help the poorest countries manage and adjust to the impact of large oil price increases.

Not Subsidizing Consumption Generally. Attempts by governments to shield users in oil consuming countries from high international prices, have usually had adverse consequences. Such efforts have often proven to be unsustainable because of the high budgetary costs of doing so, especially when prices have remained high longer than might have been initially expected. Measures adopted by governments to protect users from increased prices will also tend to dampen the potential short term stabilizing impact of increased international prices on demand.

Applying Appropriate Macro-economic Policies. Governments need to apply appropriate macro economic policies that realistically account for the impact of high oil prices on their economies and that use a variety of macro-economic approaches to try and ensure that the impact of sharp rises in oil prices is mitigated.

Greater Transparency. For both short term management and understanding of longer term oil markets and for helping setting a course for the longer term, reliable information about the oil market is important for analysis and policy making. In the short term, information about flows (production and consumption) and stocks of crude and products, and prices, is essential for assessing market developments. For the longer run, a good understanding of the resource base and potential production capability is vital in coming to reasonable views about ranges of possible outcomes in terms of supply, demand and pricing. Such views are a key input into decision making about energy choices with long term consequences.

The "Joint Oil Data Initiative (JODI)[18]" managed by the Secretariat of the International Energy Forum (IEF)[19] has made a start in addressing the collection of information on production, consumption and stocks. At its meeting at Gleneagles, G8 Heads of Government expressed strong support for JODI. In so far as information about reserves is concerned, the United Economic Nations Commission for Europe (UNECE) has initiated a dialogue with the EIF Secretariat, IEA and OPEC on the classification of energy reserves and hosted a conference of

[18] Joint Oil Data Initiative (JODI) made up of organizations from producing and consuming countries - APECEurostat, IEA, IEFS, OLADE, OPEC and UNSD - http://www.jodidata.org

[19] International Energy Forum (IEF) whose objective is to improve and enhance dialogue between energy consuming and producing countries - http://www.iefs.org.sa

experts meeting in July 2005. This could form a good basis to progress an issue that is now seen as increasingly important for energy security.

Initiatives for information sharing should not be limited to the oil sector. Good information about other energies, technologies and policies is also an important component of helping address short and long term energy security issues

Implications for International Action

Coordinated efforts by the international community can play a significant role in promoting energy security. An agenda for action could include the following key elements:

(i) Actively promoting more efficient use of energy in all economies through developing programs to agree broad sets of objectives and international bench marking, and facilitate exchange of information and technologies;

(ii) Facilitating the access and security of cross border energy investment and transit, so as to allow global and national fuel and supplier diversity;

(iii) Building on the G8 commitment at Gleneagles to a low carbon economy and adaptation to climate change by integrating this with the energy security agenda;

(iv) Supporting and strengthening initiatives by international institutions and others to support the poorest countries in their adjustment to short term energy price shocks, and, in the longer run, to make healthy, clean affordable energy available to all their citizens; and,

(v) Promoting transparency about energy resources, use and production through the whole energy chain, especially in the critical oil market, by supporting and supplementing current initiatives and approaches as needed.

Annex 1. Energy consumption by fuel type in select OECD countries in 1973 and 2002

(in percentage)

	Oil		Gas		Coal		Hydro		Nuclear		Other	
	1973	**2002**	**1973**	**2002**	**1973**	**2002**	**1973**	**2002**	**1973**	**2002**	**1973**	**2002**
OECD total	53	40.5	18.8	21.9	22.4	20.5	2.1	2	1.3	11.1	2.4	4
EU 15	59.1	40.2	10.5	23.5	25.1	14.6	1.5	15.7	1.7	1.6	2.1	4.4
Belgium	60.4	40.7	15.4	23.8	24.1	11.9	0	0.1	0.1	21.9	0	1.6
Canada	49.6	34.1	23.1	29.9	9.5	11.7	10.4	12	2.5	7.8	4.9	4.5
Czech Republic	19.6	20	2.2	18.2	78	48	0.2	0.5	0	11.4	0	1.9
Denmark	88.5	42.8	0	23.2	9.7	21	0	0	0	0	1.8	13
Finland	64.7	30.4	0	10.6	12.2	19	4.3	2.7	0	16.8	18.8	20.5
France	67.3	33.5	7.3	13.7	15.8	4.9	2.2	1.9	2.1	41.8	5.3	4.2
Germany	48.1	37.3	8.5	21.9	41.4	24.7	0.4	0.6	0.9	12.4	0.7	3.1
Italy	77.7	51.9	11	34.3	6.3	8.1	2.5	2	0.6	0	1.9	3.7
Japan	77.9	49.4	1.5	12.8	17.9	19.4	1.8	1.4	0.8	14.9	0.1	2.1
Korea	61.9	50.1	0	10.4	37.6	22.6	0.5	0.1	0	15.4	0	1.4
Norway	52.4	28.6	0	22.4	6	3	41.6	40.6	0	0	0	5.4
Spain	73	51.3	1.8	14.3	17.2	16.5	4.7	1.5	3.3	12.5	0	3.9
Turkey	51.3	40.6	0	19.6	21.1	26.3	0.9	3.9	0	0	26.7	9.6
UK	50.5	34.8	11.4	37.9	34.6	15.8	0.2	0.2	3.3	10.2	0	1.1
US	47.5	39.3	29.7	23.5	17.9	23.7	1.3	0.9	1.3	9.1	2.3	3.5

Source: Energy Balances of OECD Countries 2001-2001, IEA

Annex 2 Background Note: Climate change and Energy security

Climate change, along with ozone depletion, is one of the first truly global environmental concerns, and the first with major energy implications. The accumulation of scientific evidence over the course of the 70s and 80s pointing towards the risks of enhanced climate change due to increasing anthropogenic greenhouse gas (GHG) emissions led to a first international policy response in 1992 with the adoption of the United Nations Framework Convention on Climate Change. The Convention's ultimate objective is to stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". This was subsequently backed in 1997 by the Kyoto Protocol to the Convention which sets a timeframe for emission reductions in industrialized countries; the Kyoto Protocol entered into force in February 2005.

Representing over 80 per cent of anthropogenic greenhouse gas emissions, the production and use of fossil fuels is at the heart of both the problem and the solution. Although Kyoto Protocol countries are increasingly active in trying to reduce energy-related emissions, achieving the goals of the Convention will require more actions, with growing repercussions on our energy system.

Government interventions in the energy sector in a context of multiple policy objectives, i.e. in response to geopolitical energy security, power system reliability and climate change policy drivers inevitably affect, in one way or another, the fuel and technology mix of the country. For industrialized countries the internationally binding climate change policy driver is the Kyoto Protocol, under which signatories have agreed to reduce their emissions of greenhouse gases by an average of 5.2 percent by the commitment period of 2008-12 compared to a baseline of emissions in 1990.

The majority of measures taken toward compliance with this treaty in particular or with any national objective to reduce GHG emissions in general will inevitably alter the fuel and technology mix and will thus influence power supply availability and energy security. Conversely, policy incentives intended to increase energy security (i.e. the reduction of import dependence through direct or indirect import penalization) shape domestic fuel and technology mix, affecting the carbon intensity of that economy and its contribution to climate change. The table below illustrates the interaction of climate change and energy security policy measures associated with the most important energy options.

Energy policy drivers, although seemingly very different in nature, are connected through their respective relationships to the fuel and technology mix. Actions taken in the scope of one energy policy driver would therefore have repercussions on other energy policy drivers. An integrated approach to energy policy making is such that aims to achieve different policy objectives as efficiently as possible.

Most scientific experts agree that climate change induced by human activity is occurring and that further change is inevitable. The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2001) and also the forthcoming IPCC 2006 report predicts that average global temperatures will rise between 1.4 and 5.8 degrees Celsius over the next 100 years, a rate of warming higher than any that has occurred over the past 10,000 years. IPCC's report concludes that most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.

Interaction of Climate Change and Energy Security Policy Measures

Energy option	Climate change impact	Energy security impact
1. Changes to the power generation mix		
• Promoting renewable energy sources	Positive (zero greenhouse gas emissions)	Positive (renewable energy can often be sourced domestically)
• Switch from lower to higher carbon content fossil fuels such as coal	Negative (higher level of CO2 emissions per unit of electricity generated)	Positive (Coal is a relatively secure source of energy because many countries have domestic supplies, and global supplies are relatively well distributed)
• Switch from higher to lower carbon content fossil fuels	Positive (lower level of CO2 emissions per unit of electricity generated)	Negative or positive (depends on country)
2. Changes to the mix of transport fuels		
• Increase in biofuel use	Positive (biofuels can be zero rated for CO2)	Marginally positive
• Increase in natural gas use	Marginally positive (depends on alternatives)	Neutral
3. Increasing import diversity	Negative or positive (depends on country)	Positive
4. Alternative oil transport routes and sources	Neutral/Negative	Negative/positive (keeps import dependency but diversifies supply routes)
5. Increasing domestic production of fossil fuels	Negative (depends on fuel)	Positive
6. Energy efficiency measures	Positive	Positive
7. Clean energy technologies	Positive	Neutral
8. CO2 capture and storage	Positive	Neutral (technology in demonstration phase)

About 75 percent of the cumulative GHG emissions during the past 150 years have been emitted by industrialized countries. As a result of this energy-led development, their per capita GHG emissions today are five times higher than those of developing countries who now face the daunting task of enhancing energy utilization while protecting the environment. At the same time, the IPCC also concludes that most less-developed regions are especially vulnerable to the projected adverse impacts of climate change.

Despite uncertainties about where changes in climate will occur (the regional patterns), by when (the rate of change), and by how much (the magnitude), there is little debate on at least two key points:

- Because of the rapid build-up of GHGs, the earth's overall temperature will warm significantly, precipitation patterns will change, and sea levels will rise.
- The adverse impacts of projected changes in climate conditions will pose major development challenges for most developing countries in the tropical and subtropical zones.

In developing countries, where human activities are already close to the margin of tolerance for current variations in climate, the impacts of the projected changes are expected to be far reaching, adversely affecting virtually all aspects of social and economic life for the poorest of the poor. For instance, in countries where yields from dryland, non-irrigated agriculture are already near their maximum temperature tolerance, even small changes in temperature could have a devastating impact on agricultural output, with attendant consequences for food security. Similarly, changes in precipitation patterns associated with climate change could adversely affect the availability and quality of water, especially in areas where scarcity is already a problem. Sea level rise could displace millions of people living in low-lying areas of the Ganges River and the Nile delta and threaten the existence of small island states.

Such wide-ranging and far-reaching environmental, social and economic impacts – happening anywhere – will not take place without serious consequences for the society as a whole in an interconnected world: there is no global security without addressing climate change

Annex 3: Forecast Electricity Access by Region

Table 10.A4: **Projections of Urban and Rural Electrification Rates by Region** (%)

	2002		2010		2015		2020		2030	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
North Africa	99	88	100	96	100	96	100	96	100	97
Sub-Saharan Africa	52	8	55	12	58	16	62	21	70	30
Africa	**62**	**19**	**65**	**23**	**67**	**26**	**69**	**30**	**75**	**38**
China and East Asia	96	83	98	88	100	88	100	88	100	89
South Asia	69	33	73	40	77	44	81	46	88	50
Latin America	98	61	100	68	100	71	100	73	100	76
Middle East	99	78	100	85	100	87	100	90	100	95
Developing countries	**85**	**52**	**88**	**57**	**89**	**58**	**90**	**59**	**92**	**61**
World	**91**	**58**	**92**	**61**	**93**	**62**	**93**	**63**	**94**	**65**
For reference:										
Total number of people without electricity (million)	*275*	*1 347*	*289*	*1 267*	*290*	*1 249*	*295*	*1 210*	*287*	*1 106*

*(Source: **World Energy Outlook 2004**, IEA)*

Annex 4. Impact of Oil Prices on Net Oil Importing African Countries Grouped by Per Capital Income as Percentage of GDP (2003 base)

Per Capita Income range	*Oil Vulnerability*	*Effect of 33% Oil Price rise on GDP*	*Effect of 72% Oil Price rise on GDP*
<US$200	0.044	1.4	3.0
US$200-US$300	0.028	0.9	1.9
US$300-US$1000	0.034	1.1	2.3
>US$1000	0.030	1.0	2.1
All countries	0.032	1.1	2.2

Source: Robert Bacon and Adib Mattar, ESMAP, August 2005
Oil Vulnerability is defined as the ratio of the value of net oil imports as a percentage of GDP