Rising to the energy challenge: key elements for an effective EU strategy

EPC Issue Paper No.51

December 2006

By Jørgen Henningsen

ISSN 1782-494X

GROWTH AND JOBS

Table of Contents

About the author

Jørgen Henningsen is a Senior Adviser to the European Policy Centre on energy and the environment.

Foreword

By Hans Martens

When the European Policy Centre set up its Task Force on '2025: Europe Beyond Lisbon', and was deciding what issues to focus on, the sustainable management of natural resources in Europe was an obvious choice.

Europe's traditional dependency on external supplies of energy, the rising global demand for energy and the increasingly urgent question of how to deal with climate change are all pushing this issue up the EU's agenda.

But this Issue Paper by EPC Senior Adviser Jørgen Henningsen argues that for all the intense political debate on this subject in the past year – most notably, at the EU's summits at Hampton Court in October 2005, Brussels in March 2006 and Lahti six months later – remarkably little has happened in terms of concrete policy development or action on the ground.

Key questions which need to be answered include: how can Europe best prepare itself to ensure secure supplies of energy and raw materials in the coming decades? What are the likely consequences of rising energy demand for the environment? How can Europe live up to its Kyoto climate change commitments and adopt new methods of production which are compatible with the sustainable development agenda? And is the EU doing enough to save energy both to reduce the pressure on supplies and to contribute to its efforts to cut carbon dioxide emissions?

The author of this paper, a former European Commission official with a wealth of experience in working on energy policy, provides a fresh and insightful analysis of the key problems and possible solutions. The paper clears up many of the misconceptions which often cloud the energy debate, provides a clear-cut examination of the current and likely future situation, and makes a number of policy recommendations.

This is an enormously complex issue, with a wide range of factors which have to be taken into account, from energy demand to geopolitical considerations. But this cannot be an excuse for inaction: Europe's energy situation in 2025 is already being decided today and politicians urgently need to match their rhetoric with concrete policy initiatives to tackle this issue.

This paper is published under the auspices of the EPC's Growth and Jobs Programme, which is run in conjunction with our two Strategic Partners – the King Baudouin Foundation and the Compagnia di San Paolo. It is intended as a modest contribution to the current energy debate, which will continue to be a focus of our work over the coming months and years.

Hans Martens is Chief Executive at the European Policy Centre.

Rising to the energy challenge: key elements for an effective EU strategy

By Jørgen Henningsen

Introduction

We live in challenging times. While it might be an exaggeration to claim that medium- to long-term energy supplies or the need to protect the global climate from the impact of energy use are the biggest challenges facing mankind, they are certainly among the top five.

This is partly because of energy's fundamental role in our economic activities and the functioning of society at large. But it is also because of its importance in addressing other challenges, such as poverty eradication or water supply. Energy, particularly oil, is also a potential source of regional or even global conflict, and a significant element of current global security concerns.

An important feature of the energy sector is the length of time it takes to achieve significant changes. High-cost infrastructure such as power plants and natural gas pipelines are built to last for up to 50 years or more, often with lead-times of five to ten years. Most of the energy sector infrastructure in operation today was built or at least being planned 20 years ago. Similarly, most of the new infrastructure needed to meet demand in 2025 is either already under construction or will be planned in the next few years.

This consideration is equally relevant to parts of the energy sector where there is a frequent turnover of products. For example, the vehicles needed to provide transport services in the future will, by and large, be different from those on our roads today – and changes cannot be introduced overnight. It is widely recognised that the significant efforts which several car manufacturers have made over the past five to ten years to develop hydrogen-driven cars will, at best, only have a marginal impact on the pattern of fuel consumption in the transport sector by 2020.

All this demonstrates that Europe's energy situation in 2025 is already being decided today.

Against this backdrop, energy policy should surely be high on the political agenda, but this is not the case. There is no shortage of political talk on this issue, and press coverage has definitely moved into a higher gear in recent years. However, when judged against the urgency of the situation, remarkably little is happening in terms of concrete policy development or action on the ground. There is a striking lack of even a basic analysis of the situation that might allow for an appropriate policy response. This paper offers a modest contribution to fill this gap.

It should also be borne in mind that technological innovation in the energy sector generally takes a long time to reach the market, and even then often only if supported by appropriate policies (as in the case of nuclear power, wind energy and alternative motor fuels). This implies that, within a 20-year time frame, policy innovation could well be more important than technological innovation. Using what we already have certainly has more medium-term potential than anything new we can hope to invent.

Existing technologies, if properly applied, would help the EU to meet its objectives of security of supply, reduced environmental impact and improved competitiveness to a much greater extent than is the case today. But without political courage and a readiness to challenge strong vested interests (and a few ideologically-driven 'conventional wisdoms'), this transition is not going to happen.

Over the next 20 years, a paradigm shift is likely to take place at the global level. In fact, this is already happening. Two decades ago, 75% of global oil consumption and global carbon dioxide (CO_2) emissions – the two most important constraints on future energy policy – resulted from activities in industrialised countries which cover less than 25% of the world's population. Today, rapid economic growth in many developing countries, most spectacularly in China, is broadening the range of countries which need to be involved in responding to this global challenge.

In recent years, it has become popular to point to China (or China and India) as the main source of existing or future problems, be they the rise in commodity prices, concerns about oil supplies or the threat to the global climate.

This 'China bashing' is both unjustified and counterproductive. It is only natural that the Chinese should want to raise their living standards closer to those in Organisation for Economic Co-operation and Development (OECD) countries. And it is hardly surprising that Beijing does not take kindly to suggestions that it should show more restraint in striving for higher *per capita* consumption levels because of the sheer size of the country's population. Even under the most optimistic economic growth forecasts, it will be decades before China's Gross Domestic Product, oil consumption or CO_2 emissions *per capita* reach 20% of those in the US.

It is imperative for the OECD countries to realise that, while it is true that future global challenges can only be effectively addressed if major developing countries participate, this will only happen if those with high *per capita* consumption rates or emissions demonstrate their readiness to change course now.

So far the OECD countries have not sent any such collective signal, and while the EU can claim steps in the right direction, they are still too small.

A new 'world order' will inevitably lead to new relationships between governments. It is entirely legitimate for Russia and China to agree long-term oil or gas deals. It is equally legitimate for Chinese companies to try to secure their supplies – be they oil, metal ores or soybeans – on the best possible terms, even if this challenges former European or American company strongholds.

This paper assumes that it is neither justified nor possible, in the long term, to maintain high living standards for only a minority of the world's population at the expense of efforts to improve conditions for the majority.

Technology can make an important contribution to addressing these challenges. The jury may still be out on whether technology is *the* long-term answer, or whether a more fundamental change in lifestyles will be necessary, but there is no doubt that the world already has a vast range of fully- or partly-developed technologies at its disposal which will allow for much more intelligent energy solutions than those being applied today.

This paper addresses a number of issues of crucial importance for EU energy policy development. It does not pretend to prescribe an overall energy policy, but it does identify a number of key elements for an effective strategy. It is the author's belief that these would benefit both EU citizens and enterprises, and make a useful contribution to building a broader global response to the energy challenge.

I. Energy supplies

I.1. The (non-existent) energy sector

In the context of energy policy development, it is commonplace to talk about the 'energy sector' as if it were a single entity. In fact, today's energy sector consists of two sectors which are only relatively weakly linked:

- *The oil/transport sector:* Since the 1970s' oil crisis, oil consumption outside the transport sector (i.e. in the production of electricity, in domestic heating and in industry) has gradually been replaced by other energy sources (gas, coal and nuclear). In OECD countries, very little oil is now used for purposes other than transport or as a raw material in the (petro)chemical industry (except for the modest amount of gas oil used for domestic heating and the small quantity used for peak-load or emergency electricity production). Since 1985, developing countries have been able to take advantage of low oil prices to a greater extent than before, but recent price increases are likely to push them towards alternative energy sources as well. The strong link between oil and transport has important implications: few alternatives exist and future transport growth will push oil demand still higher, even if the cost of oil rises.

- *The rest of the energy sector:* In areas such as electricity production, domestic heating and industry, natural gas, coal, nuclear, hydro and wind power are interchangeable to a great extent. In this context, electricity, which can comfortably be produced from all these sources, often serves as a universal energy carrier.

While the physical link between the two energy sectors is weak, the fact that natural gas prices are often linked to oil prices (in Europe and the Far East, but not in North America) creates unfortunate confusion in the energy policy debate.

Relating gas prices to oil prices made sense in the 1980s, when gas was introduced on a large scale and replaced oil in certain uses. Today, however, gas is competing with coal, nuclear and renewables rather than with oil. It is only slowly becoming evident that gas finds it hard to compete with coal at the current price level within the EU.[1] It should therefore come as no surprise if German electricity generators decide to move to coal rather than gas to make up for the future loss of nuclear power, even if this is not consistent with the recognised need to achieve further reductions in CO_2 emissions.

The need to deal with the two energy sectors separately stems not only from the weak link between them, but also from their different characteristics.

Supplies of oil will be severely constrained in the near to medium term, while other energy sources are more plentiful. Proven global gas reserves stand at 65 times' annual consumption versus 40 for oil and, most importantly, much current or future gas consumption can be replaced relatively easily by other energy sources: renewables, coal (of which there are huge reserves and where CO_2 can be captured and stored) or nuclear. The non-oil energy sector is therefore characterised by a high level of competition between the different sources and this plays a key role in industrial competitiveness, particularly for energy-intensive industries. This does not apply to the oil sector.

'Fossil fuels' is another term now widely used in the energy policy debate – but it is, by and large, just as unjustified as the term 'energy sector'. Fossil fuels are well-defined: coal, oil, gas, peat, shale oil and tar sands, but apart from their common fossil origin, these energy sources have little in common. They all cause CO_2 emissions, but at very different levels (coal typically produces three times as many as natural gas in electricity production, and transport fuels derived from tar sands typically cause 50% more emissions than the same fuels derived from conventional crude oil).

A broad application of CO_2 capture and storage techniques would address the current concerns about the impact of coal and other fossil fuels on the environment, and therefore allow them to be used more

widely. This would clearly be beneficial given that most scenarios for the next 50 years see coal, oil and gas as the main sources of energy worldwide.

I.2. Why is there no EU oil policy?

Somewhat surprisingly, the European Commission's 2006 Green Paper on energy policy[2] says almost nothing about the oil/transport sector. It is not clear whether this is an accidental or deliberate omission.

What is clear, however, is that the future development of oil supply and demand is crucial for the EU. Oil is, without doubt, the energy source with the most critical supply perspectives. CO_2 emissions from transport, fuelled almost entirely by oil products, have increased most persistently since climate change became a political issue in the late 1980s, and the recent increase in oil prices has had the severest energy-related economic impact for decades – in developed and developing countries alike.

Future security of oil supply depends primarily on three factors:

- the size of global resources;
- the political, technical and economic possibilities of making the resources available to the market;
- the development (unrestricted or influenced by policies) of global demand.

It is important to stress that, in reality, all oil is supplied to and demanded from one global market on which everybody depends.

Whether the US moves its oil imports away from the Middle East, Venezuela decides to export its oil to China rather than to the US, or Russia sells its oil to the US rather than to Europe, is of virtually no importance for their respective national security of supply. It may have implications for the companies involved, and could mean higher transport costs, but these would still be small compared to the cost of the oil itself.

The world will not run out of oil any time soon. However, a continued annual increase in demand of 1.5-2% – as foreseen in most scenarios produced by governments, the International Energy Agency (IEA) and oil companies – would be highly problematic.

Officially reported recoverable oil reserves of around 1,200 billion barrels (around 40 times' current annual consumption) are, at best, uncertain.

The reason that proven resources have been relatively constant in recent years is not that new discoveries (less than 10 billion barrels per year) have kept pace with production (around 30 billion barrels per year), or that the application of new technologies has allowed for a better assessment of the reserves available. It is mainly because the system in most OPEC countries for reporting on reserves is politically motivated and is not adjusted to take account of the quantities of oil actually produced.

Obviously more oil will be found, but with annual discovery rates of less than 10 billion barrels (and falling), it seems dangerously optimistic to count on total global recoverable resources of conventional oil of 2,000 billion barrels or more, as regularly estimated by 'official' and commercial sources. Indeed, some experts claim that the officially reported figure of 1,200 billion barrels is already more than the world can reasonably expect to withdraw.

In view of the importance of oil for the global economy, and given that nobody knows how much oil we will ultimately have at our disposal, any responsible energy policy must err on the side of caution.

This approach is further supported by an often-ignored aspect of the future oil supply situation: the quantity of oil needed to meet current or future demand without disrupting the economy (even if consumption levels fall in the long term). The significant technical, economic, and social difficulties involved in finding substitutes

for oil in the transport and chemicals sectors mean that high quantities will be needed during the inevitably long period it will take to switch to other sources.

The Stone Age did not come to an end because of a lack of stones, but nothing today suggests that the oil age will come to an end for any other reason than a lack of oil.

It has been argued that unconventional oil sources (tar sands, extra heavy oil and shale oil) will be able to keep us afloat for decades more, but this optimism is not supported by real-life experience.

Attention is currently focusing on extracting oil from the Canadian tar sands, where there are plans to expand the level of production from one million barrels per day now to three million barrels per day by 2015. However, this will provide less than 10% of the new production required to meet the expected growth in demand and offset declining production from an increasing number of mature (post-peak production) fields.

This expansion will also put further pressure on the local community, which is already stressed to its limits, and this is likely to lead to a steep rise in the cost of increasing production and hence less glamorous profit perspectives. A further downside is that the CO_2 emissions which result from the production and upgrading of tar sand-based motor fuels are also much higher than those from the production of conventional crude oil.

Unfortunately, there is a risk that the short-term supply/demand balance could make the situation appear less critical than it actually is. If everything goes according to plan, production projects already under way (in the Middle East, off the coast of West Africa and in the Caspian Basin) could offer some relief from the current constrained supply situation over the next three to five years. This might lead to the conclusion that action is not all that urgent, but the medium-term cost of this scenario is likely to be high.

Oil carries by far the highest price-tag for consumers and society of all the sources of energy. It makes little sense to estimate the economic impact of current oil prices against the +/-€25 per barrel which was prevalent some years ago. However, it is generally recognised that oil prices have, by and large, been around $20 per barrel higher in 2005-2006 than can be justified by the medium-term supply and demand equilibrium. This is primarily because of the extraordinarily low spare capacity in the global oil sector, coupled with a number of geopolitical uncertainties that could lead to a real supply shortage.

An additional $20 (€16) per barrel increases the EU's oil bill of around €80 billion per year – and more if the impact of oil prices on natural gas prices is included (at least €100 billion extra for oil and gas imports combined).

This amount is not catastrophic, but it is big enough to call for action. And if nothing is done, it could well double.

I.3. How can the EU secure its future gas supplies and at what price?

Natural gas has become an important source of energy in the EU and virtually all scenarios foresee its share of the energy mix increasing in the coming decades.

The relatively cheap cost, until recently, of natural gas has allowed the EU to reduce its oil dependency and limit CO_2 emissions, preventing an otherwise inevitable increase in greenhouse gases. In some cases, most notably in the UK, switching from coal to natural gas has also offered big economic advantages.

However, recent increases in natural gas prices and the 'Ukraine incident' in January 2006 have raised questions about the virtues of natural gas and, in particular, concerns over the EU's relatively high dependence on imports of natural gas from Russia.

In order to properly assess the natural gas supply situation and the necessary policy initiatives, a few facts are helpful:

- Global natural gas reserves are, relatively speaking, larger than oil reserves (as mentioned above proven gas reserves are 65 times' annual consumption versus 40 times' for oil).
- Natural gas reserves are concentrated in a few countries (Russia, Iran and Qatar account for 65%), but many gas fields around the world remain untapped.
- Natural gas markets are highly regionalised and are likely to remain so over the next 20 years. Increasing liquefied natural gas (LNG) production and more LNG import terminals in Europe and North America are likely to increase price harmonisation between the different markets, but infrastructure constraints will set limits on a truly global gas market.
- Russia is clearly more dependant on gas exports to the EU (which account for close to 100% of its income from such exports) than the EU is dependant on imports from Russia (25% of total consumption). Concerns that Russia might decide to reorient its gas exports towards China or Japan are unjustified. East Siberian gas will find markets in the Far East, but West Siberian gas (the source of current exports to EU) will only become a commercially attractive alternative once East Siberian gas has been fully exploited. Exporting West Siberian gas to China would require huge investments in new pipelines and China does not appear ready to pay the prices that EU gas companies currently pay – not a threatening perspective from an EU point of view.
- Natural gas faces strong medium-to-long-term competition from other energy sources (coal, nuclear, wind and biomass), particularly in electricity generation. As mentioned earlier, the current price of EU gas imports (over €200 per 1,000m^3) is already making natural gas uncompetitive for future base-load electricity generation, probably even compared to coal with CO_2 capture and storage.
- The EU is geographically well-situated as a natural gas importer. There is no more attractive market for the big gas deposits in Russia, Middle East, and North Africa. Gas imports (LNG) from West Africa (Nigeria) might go to the EU as well as to North America.

Against this backdrop, it is justified to conclude that even if EU natural gas production slows down over the next 20 years from the current level of 250 billion cubic meters (bcm) a year to some 125 bcm, and consumption rises from the current 500 bcm to 650 bcm, the gas required will be available within a reasonable distance of the EU's main centres of consumption.

On the top of this, there is a big hidden gas reserve in Russia, where gas use has been remarkably inefficient to date. As long as the EU demand for gas can be met through existing production capacity, any improvement in energy savings in Russia will have little economic value. This will only change when domestic savings of natural gas mean that there is more available for export.

However, even if the EU has no reason to fear a medium-term shortage of natural gas, there are serious grounds for concern over short-term security of supply and the commercial conditions under which gas supplies will be available.

Short-term security of supply is, in fact, the least important issue, but the one most likely to attract high levels of media and political attention. In short, we cannot afford to have our gas supplies cut off, even for limited periods.

Measures to combat sudden (but short-lived) disruptions are simple and relatively cheap. A certain amount of buffer storage is useful, both to cope with disruptions to imports and to cover failures in domestic production systems. A natural gas emergency storage system would not only be useful in genuine crises, but also to deal with fake emergency situations like the 'Ukrainian incident'.

From this perspective, it would make sense to maintain existing, but only partly-used, coal-fired power plants as this would allow for cuts in gas consumption without affecting electricity supply, as well as introducing measures to counteract periods of excessively high electricity prices. Other users could be paid for accepting a reduction in supplies during emergencies – which will, in all likelihood, be an extremely rare phenomenon.

The only real problem in organising a proper emergency response policy is that it is not in the interest of the energy companies, which would have to carry the cost and lose out on the extra income to be derived from high prices when shortages occur. Without political action, short-term security of supply will therefore remain a problem.

The economic aspects of security of supply appear much more important. If the EU wants future natural gas imports at competitive prices, two elements are crucial: supply diversification and spare capacity.

Recent increases in gas prices have little, if anything, to do with the balance between supply and demand in the gas market. They are simply the result of contractual links to oil prices – a methodology which was invented in the 1980s when oil and gas were competing as energy sources, but is no longer justified when they are used in almost entirely different markets.

The fact that gas, unlike oil, can be priced out of the market because of competition with other energy sources means that the EU and its gas suppliers have a shared interest in keeping gas prices within a reasonable range. Current price levels of around €200 per 1,000 cubic metre are very attractive for gas exporters in the short term, but are not good for longer-term demand. Coal, wind and nuclear are much more attractive for electricity generation than they were two or three years ago. This issue should be addressed explicitly in the EU-Russia energy dialogue.

II. Diversifying energy supply

II.1. Energy source diversification in electricity production

The importance of electricity for all sorts of economic activities and for the population at large is beyond dispute.

The EU-wide cost of producing electricity is less than 2% of GDP, but the cost of power is far more important for the competitiveness of a number of energy-intensive industries than it is from a macroeconomic point of view. For this reason and for long-term security of supply, a diversified mix of energy sources in electricity production is crucial.

The current energy mix in EU electricity generation is good: one-third coal, one-third nuclear, 20% natural gas, 10% hydro and 3% wind (rising to around 5% by 2010). Apart from the associated CO_2 emissions (around 80% from coal), it is difficult to justify calls for further improvements.

Future energy source diversification is, however, a concern. Many existing coal-fired power plants are expected to be closed down over the coming decade in response to demands for a reduction in emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_X) from large combustion installations. Until recently, these coal-fired plants were expected to be replaced by natural gas turbines (CCGT). Even if natural gas prices moved back towards previous levels, making gas competitive again, a significant move from coal to natural gas would reduce security of supply both in the medium and long term.

There are similar concerns about nuclear energy. Without a clear strategy for developing alternative capacity, phasing out nuclear power through natural ageing (as in the UK) or a political decision (as in Germany and Belgium) is likely to leave the electricity sector uncomfortably dependant on natural gas.

In the medium term, this is not a problem from a resource availability point of view. There is enough gas around, and energy efficiency improvements in Russia, if implemented, could add significantly to what is in the ground. However, the long lead-time for establishing natural gas infrastructure does pose a risk. As experience in North America and the UK has shown, in a liberalised market the necessary infrastructure will not necessarily be provided quickly enough to meet the rapid increases in demand for gas.

Renewable electricity (wind, biomass and, in future, solar) has been suggested as the replacement for nuclear. However, this would mean a radically new commitment to generating electricity from renewables. EU electricity demand is currently growing by around 2% per year, equivalent to around 50 terawatt-hours (TWh). The annual increase in electricity from renewables is in the order of 10-15 TWh. Neither the EU, nor any of its Member States except Denmark, are at a stage where the quantity of electricity produced from renewables is anywhere close to allowing them to reduce the overall amount of electricity generated from fossil fuels and nuclear, which together currently account for well over 2,000 TWh annually.

However, electricity savings have the potential to become an important factor. Cutting consumption by 20% relative to the baseline scenario (which is seen as possible by many experts) would make it much easier to maintain a healthy diversification of energy sources in the power sector, while at the same time delivering a much-needed reduction in CO_2 emissions.

In conclusion, a roadmap for security of supply of energy sources in the electricity sector would include:

- accepting the present level of diversification;
- moving full speed ahead with electricity savings and efficiency improvements;
- accelerating electricity generation from renewables;
- keeping existing nuclear power plants running where possible until sustainable alternatives are put in place;
- moving full speed ahead with carbon capture and storage to allow continued use of coal in electricity (see section II.3).

II.2. A liberalised electricity market – driven by ideology or reality?

Energy market liberalisation has been a cornerstone of EU energy policy in recent years. It is a natural continuation of the single market created in the late 1980s and early 1990s, and is driven by the belief that open markets and competition offer a higher level of efficiency than the often inefficient, protected public monopolies of the past, which had no incentives to cut costs. This should lead to lower prices for consumers and businesses, and society as a whole should gain.

Numerous examples support this hypothesis. Hardly anyone would argue for a return to pre-liberalisation airfares or telephone bills. Likewise, the liberalisation of the electricity sector in the UK in the early 1990s demonstrated the virtues of this approach, with prices in the UK moving from the top of the EU league table to the bottom. The European Commission therefore found it easy to argue its case when it proposed opening EU gas and electricity markets ten years ago.

However, in the euphoria over the prospect of lower electricity prices, one element of the equation seems to have been ignored. Price-setting in a liberalised market is fundamentally dependant on two factors: production capacity relative to demand, and the availability of cheap additional production. Had it not been for the Ryanairs of this world and the avalanche of new low-cost technology in telecoms, airfares and international phone calls would not be available as cheaply as they are today.

Most of the EU electricity market was liberalised at a time when there was significant spare capacity. This allowed prices to move towards marginal variable cost levels which, coupled with low energy prices until recently, allowed the Commission and others to stress the consumer-friendly development of electricity prices as liberalisation moved ahead.

It appears to have come as a surprise to many professionals that electricity prices have suddenly risen sharply in the middle of the process. The Commission has responded by searching for evidence of a lack of competition because of insufficient unbundling, insufficient interconnections between the Member States, and for cases of market dominance by a few large companies.

These aspects deserve attention, but they miss the key point: electricity prices have increased and will increase further not because of insufficient market opening, but because of liberalisation itself.

A closer look at the electricity sector easily explains why. While established companies in the air transport and telecoms sector now face competition from cheaper alternatives provided by new market entrants, exactly the opposite happens in today's EU electricity sector because of the high cost of building new power stations. All the cheap production (often at less than €20 per megawatt-hour (MWh)) is 'inside' the existing system, and (almost) all perceivable new capacity will lead to production costs of €60/Mwh or more.

The big differences in production costs at existing power plants with low capital costs (because the original investment has largely been amortised) and low operating costs (as is the case for hydro, nuclear and coal) make it virtually impossible for newcomers to make inroads into the electricity sector.

Contrary to what most textbooks say, the liberalisation of the electricity market provides almost perfect protection for the incumbents – and with market prices vastly exceeding production costs for much of their production.

The EU CO_2 emissions trading scheme and increased natural gas prices have usually been largely blamed for the recent increases in the price of electricity, together with market dominance. However, power companies' balance sheets show that electricity is being traded today in the EU at prices which are increasingly decoupled from costs.

Even though the inflated price of emission allowances has increased prices, the cost of limiting CO_2 emissions so far has been, at most, very modest.

Increased natural gas prices offer a rare example of how higher 'raw material' costs can be of huge benefit to the buyers of those materials: at times when natural gas is needed to meet overall electricity demand, natural gas-based electricity becomes the price-setter, even though it usually only accounts for a minor part of total production. Higher gas prices thus allow lower-cost nuclear, hydro or coal-based electricity to be sold at the high natural gas-based electricity price. Market prices three times higher than production costs or more are not exceptional.

It would be useful for the debate on the future of the EU electricity market to carry out a proper analysis of the links between liberalisation, energy prices, CO_2 abatement costs and investment needs.

Until now, ideology (market liberalisation is good, full market liberalisation is better) has prevailed over realities. It may be that the high prices currently being paid by private consumers (beyond what is justified by added costs) are of little concern to governments and the Commission, but it is harder to see how they can ignore their impact on energy-intensive industries at a time where industrial competitiveness is high on the agenda.

The barrier to bringing this debate into the open appears to be that those who would normally be the natural defenders of the legitimate interests of the respective industries (UNICE, national industry federations, national economy or industry ministries and the Commission's Directorate-General for Enterprise) have traditionally been the champions of maximum market liberalisation.

The observation that a liberalised electricity market does not offer the advantages suggested does not imply that there should be a return to the old national monopolies. It does, however, imply that a number of measures are needed to keep prices within reasonable ranges, and to ensure a reliable and adequate electricity supply. Unless the true character of the electricity market, as described above, is recognised, the necessary policy adjustments are unlikely to be made.

The most important of these is to insist that electricity suppliers maintain a certain level of spare capacity in the system. This would be useful from a security of supply point of view and to ensure that electricity prices are subject to a marginal variable cost ceiling.

The necessary level of spare capacity is unlikely to materialise unless the regulators make it a requirement, as it is not in the economic interest of the producers in a liberalised system. However, it would correspond well to the objective of promoting competitiveness in the industry and to the social dimension of energy policy, by reducing the transfer of wealth from consumers at large to shareholders in power companies.

Other measures include agreeing a ceiling on CO_2 prices in order to lower the marginal cost of coal and natural gas-based electricity – generally the price-setter for the whole electricity market – and working politically to decouple gas from oil prices. Both measures might face opposition from the electricity industry. If so, this would prove that they were justified.

II.3. Coal – potentially much better than its reputation

The share of coal in the overall EU energy mix has been in steady decline since World War II. Today, it is virtually only used in electricity generation and a few industrial sectors.

Coal delivers the energy required for roughly one-third of EU electricity production, and makes an important contribution to fuel diversification in the electricity sector. However, it causes CO_2 emissions of roughly 1 kg CO_2 per kilo-watt hour (KWh) – accounting for approximately 80% of total power plant emissions – posing a problem for future efforts to reduce emissions. Natural gas emits around 300g per KWh, while the rest – nuclear, hydro and wind – are virtually CO_2-free.

However, coal is a much better energy source than its reputation suggests. It is not only cheap, but – unlike natural gas – its price is (and is likely to remain) unaffected by oil prices. International coal prices are

currently in the range of 25% of EU natural gas prices per energy unit. World reserves of coal are much larger than oil and gas reserves, and much more evenly distributed. It is difficult to imagine coal prices being subject to international price-fixing or production quotas.

Furthermore, pollution from coal burning need no longer be a concern, as emissions of particulates, sulphur dioxide or nitrogen oxide in modern (clean) coal-fired plants are well in line with other fuels and, thanks to technological advances, can be reduced to virtually any level required.

However, coal's relatively high CO_2 emissions per energy unit remain a potentially serious drawback for its use as a future energy source, particularly in electricity production.

Carbon capture and storage appear to offer the answer. Neither the capture of CO_2 from a mixture of gases nor the underground storage of CO_2 is anything new. However, for CO_2 capture to be economically feasible, it appears necessary to change combustion technology from today's direct coal combustion to coal gasification with subsequent CO_2 removal (pre-combustion capture) and final burning of the gas, mostly hydrogen, in a gas turbine.

The technology to do this already exists, but there is a need to demonstrate how the different processes will work together in this particular constellation. This has to be done urgently to prevent the building of new conventional coal-fired power plants which are ill-suited for carbon capture and storage, and which have an expected lifetime of 40-50 years.

There is also an urgent need to clarify the conditions under which CO_2 can be stored underground, to protect people living close to storage facilities and to ensure that CO_2 does not slowly leak into the atmosphere. This work should have started years ago, and as large-scale emissions of pure CO_2 already occur in Europe (connected to hydrogen production), practical experience of CO_2 storage can be obtained straight away, without waiting for future coal-gasification power plants to become operational.

Technology is usually a slow driver of policy, but policy can be a very strong driver of technology. An EU-wide decision not to build any new coal-fired power plants without CO_2 capture would deliver precisely the policy most likely to push CO_2 capture and storage the last step towards full commercialisation.

The need to reduce CO_2 emissions provides the justification for this policy, the gap between coal and gas prices will make it happen; and a policy which demonstrates the EU's determination to maintain coal as a significant source of energy in electricity generation is most likely to have a dampening effect on future natural gas prices.

Carbon capture and storage can be an important part of EU energy research, but should not be seen primarily as a technical development issue. Discussions in the EU have so far tended to regard this as a long-term goal, similar to hydrogen technology for road transport. A failure to push for the rapid deployment of carbon capture and storage would mean missing one of the significant opportunities in energy/environment policy development.

II.4. Do we really want to close existing nuclear plants?

Few issues have divided the EU more, and for so long, as nuclear power. Any effort to move towards a shared view (either favourable or negative) on this subject so far has failed. This situation is unlikely to change any time soon and, in the years to come, nuclear power is likely to play a key role in some Member States and none at all in others.

However, the particular situation of nuclear energy should not be exaggerated, and the wisdom of the Commission's extrapolation of this in its Green Paper to state that the choice of energy mix is an entirely national competence is highly questionable. Could a Member State decide to ban natural gas or wind energy in general? Probably not under existing EU legislation. It is important that the particular problems

posed by nuclear energy be contained rather than expanded, and it is especially important that the debate respects the facts.

Nuclear power, like coal, provides the energy for roughly one-third of EU electricity production. Again like coal, it does so with a historically-demonstrated high security of supply and at a very attractive cost, even when nuclear waste storage and decommissioning are taken into account. Unlike coal, it provides electricity without any CO_2 emissions. One could debate forever whether this represents a saving of 1 kg of CO_2 per KWh (compared with the emissions generated by producing electricity from coal) or 300g per KWh (compared with using gas) – or any other number in between – but to suggest that the electricity produced by nuclear power today could be produced by renewables instead is wholly unrealistic.

Although there is little hope of real movement in the debate over new nuclear power plants, there are more grounds for optimism over the timing of the closure of existing plants.

The early closure of existing plants would not provide the answer to the concerns raised, be they waste management, decommissioning challenges or the proliferation of nuclear material. Until sufficient CO_2-free alternatives are available, the disadvantage in terms of CO_2 emissions is obvious. In today's electricity market, the impact of this on prices is likely to vastly exceed the forecasts made when the decisions on nuclear phase-outs were taken in different countries.

It goes without saying that these arguments can never be used to prolong the operating life of nuclear power plants which do not meet the highest security standards.

Many of the factors behind widespread negative attitudes towards nuclear power over the last 30 years were well founded. However, this does not justify paralysing an important part of the energy policy debate for decades on predominantly ideological grounds.

A non-ideological debate could well take as its starting point the situation in relation to existing nuclear plants. This debate should not ignore the fact that reducing existing power plant capacity through forced closures could well be extremely profitable for the electricity industry – and very expensive for consumers.

III. Sustainability in energy policy

III.1. Energy efficiency – the obvious but ignored first priority

Numerous studies and reports have highlighted energy efficiency and energy saving as the most cost-effective means to achieve the triple objective of security of supply, environment protection and competitiveness in energy policy.

The fact that even countries which have pursued a strong energy efficiency policy, such as Denmark, still believe there is a great deal of potential for further savings is a strong indication of the broad possibilities for efficiency improvements and savings in energy policy.

Energy waste is a truly global problem. In relative terms, more is wasted in developing countries; in absolute terms, industrialised countries waste the most. Russia, Ukraine and, to a lesser extent, the new Baltic, Central and Eastern European EU members, still have very wasteful energy sectors. Several oil- and gas-exporting countries have allowed their energy sectors to develop with virtually no concern for energy efficiency and on the basis of very low energy prices.

Energy efficiency and energy savings are genuine cross-cutting issues. Every sector has the potential to make improvements: transport, electricity generation, lighting, domestic heating, industrial processes, appliances etc. However, this is also part of the problem. Given the big differences in the sectors' technical and economic characteristics, there is no one single approach that will allow all this potential to be exploited fully.

Despite its indisputable virtues, improving energy efficiency is an uphill struggle. To start with, it is unglamorous: it does not have the high profile of big projects, nor the visibility of small projects such as solar panels or biofuels, and it offers few opportunities to cut ribbons.

It also requires money upfront, but delivers benefits only a long way in the future. Most consumers pay more attention to the price of the goods they buy (such as cars, appliances and light bulbs) than to the overall cost of using them. And the collective benefits – be they lower emissions or less pressure on the oil, gas or electricity markets – do not form part of the individual consumer's cost-benefit analysis.

The measures required to improve energy efficiency will necessarily be different in each sector. However, experience over many years has already demonstrated clearly that market forces alone will not do the job. A combination of subsidies and taxation can be effective (for example, in the domestic heating sector) and negotiated agreements have delivered some improvements in car-fuel efficiency. However, in order to achieve significant results, regulation appears necessary even in areas where there is strong competition between economic operators.

EU-wide solutions are the only way forward in sectors which operate at the EU level, such as electricity generation, transport or appliances. In other areas, such as domestic heating or energy efficiency in the service sector and in most industries, action at national level is crucial.

This is of particular importance in the new Member States, where the energy efficiency potential is greater, and it would make sense for the Commission to launch a separate initiative to push for improvements in the new Member States as part of an overall EU energy efficiency strategy.

The Commission's recently published action plan does not deliver the necessary answer to the energy efficiency challenge. Although its efforts to make progress in this area since the 2000 Communication on the issue must be recognised, the new action plan adds little to what should result from already agreed targets and actions.

The situation in three crucial areas demonstrates why this is the case:

1. In the transport sector, the only concrete action proposed is a mandate to develop a European norm for road vehicle tyres. The rest is just a description of the problems and promises of further Communications. Efforts to boost energy efficiency in road transport are still limited to passenger cars, even though it is already clear that the current approach will not deliver efficiency corresponding to 120g CO_2 per kilometre by 2012, as originally envisaged – and it is already too late to make much difference to 2012 emission levels via the legislative process. Both the urgency of the situation and the need for action in the rest of the transport sector are largely ignored. Neither energy consumption in heavy-duty vehicles nor the ongoing invasion of SUVs are even mentioned. Furthermore, the impact assessment focuses mainly on energy savings from measures not included in the action plan – and is still not delivering anything close to overall target of energy savings of 20%.

2. Domestic heating offers the biggest potential for energy savings, particularly in existing buildings and especially in the new Member States. This is not even properly recognised in the action plan. Furthermore, the impact assessment, which gives a somewhat over-optimistic view of the likely achievements of the existing Buildings Directive, is not part of the current action plan. The sad truth is that Member States have been unwilling to let the EU play a major role in energy efficiency in this area and most of them, old and new alike, have done disappointingly little to reduce energy consumption in existing buildings. The action plan will not change this, and the Commission would have been justified in highlighting this.

3. The action plan correctly highlights the energy losses in electricity generation (hidden under the title of energy transformation), but then immediately excludes all of these losses from the scope of the action plan by praising the Emissions Trading Scheme (ETS) as an effective means to address losses in power plants above 20 MW. Neither the experience from the present phase of the ETS (2005-07), nor realistic expectations for 2008-12 justify this (see section III.4). Again, in the impact assessment, the expected savings of 20 million tons are overwhelmingly due to savings in plants not covered by the action plan (new power plants above 20 MW). The Commission is right to make energy efficiency a priority, but it is wrong to claim that the action plan is likely to make a significant contribution towards meeting its 20% energy savings target.

III.2. Carbon-dioxide free electricity – much more is needed

If CO_2 emissions in the electricity sector over the last 15 or 20 years were the only factor, both the 'old' target of stabilising CO_2 emissions at the 1990 level by 2000 and the 8% reduction envisaged in the first Kyoto period (2008-12) would be met comfortably. The power industry has missed no opportunity to point this out and has argued that other sectors should deliver relatively stronger contributions to CO_2 emission reductions in the future.

While this is justified, there is no reason for self-congratulation in the energy industry.

The overwhelming proportion of the CO_2 emission reductions in the electricity sector result from changes in production patterns entirely driven by commercial factors: the improved performance of existing nuclear plants, a few new plants, and a switch from expensive (subsidised) coal to cheaper and more efficient natural gas (particularly in the UK). In the one area where there have been calls for action (to promote the use of renewable energies in electricity production), the sector as a whole has been dragging its feet.

It is also probably optimistic to hope that the EU will succeed in achieving even half of the seven percentage point increase in the share of renewables in electricity production aimed for by 2010 (as laid down in the 2001 directive[3]).

There are two very strong reasons why the electricity sector should be required to do more rather than less in the years to come.

The first is cost effectiveness. It would be unwise to let policy be guided by the idea that every sector should be required to make comparable reductions. For the individual citizen, the overall cost of measures to reduce CO_2 emissions is more important than the cost of any of the specific elements. However, fuel-switching, CO_2 capture and storage, and a number of other measures are in fact easier and cheaper to apply in electricity generation than in the transport sector.

The other compelling argument for pursuing ambitious CO_2 reduction policies in the electricity sector is that most scenarios foresee an increase in CO_2 emissions from electricity generation over the next 20 years. Declining nuclear production, high gas prices relative to coal and insufficient generation of renewables could well lead to bigger increases in CO_2 emissions in the power sector than in the transport industry – a totally unacceptable development at a time when significant overall reductions are needed.

The liberalisation of the electricity market does not make it easier to address this challenge. In principle, the CO_2 Emissions Trading Scheme was established to deliver the necessary cuts. However, there are serious doubts that the existing scheme will do this (see section III.4). A much longer time-horizon and a much stricter allocation process – harmonised at EU level to a high degree (if not carried out entirely at EU level) – are essential for the scheme to produce the required results.

In this situation, national plans for the further development of CO_2-free electricity appear to be necessary. It must also be recognised that the potential for nuclear, biomass and wind energy or carbon capture and storage is very different in different Member States.

A CO_2 policy for the electricity sector which reflects those differences would allow for a much more ambitious reduction strategy than a common policy which has to reflect individual Member States' concerns about specific energy sources. However, such a strategy will only be able to succeed if all Member States are ready to recognise the contributions which all sources of energy (including nuclear) can make to reducing emissions.

It is currently too easy to hide behind the lack of an overall policy and do nothing or very little.

Ireland is a stark example of this. In the face of nationwide opposition to nuclear energy and a remarkably unambitious policy on the use of renewables to produce electricity (in spite of very favourable wind resources), Ireland's CO_2 emissions have been allowed to grow without restrictions during one of the most successful examples of economic development ever seen in the EU.

This lack of action has to be seen against the generally-accepted view that it is easier to mitigate environmental problems in a growing economy than in a stagnating one. Ireland's economic development has been supported by generous EU funding, yet there has been hardly any serious EU criticism of the lack of an Irish CO_2 policy.

III.3. Fighting climate change or pushing the Kyoto Protocol? An important choice to be made

Meeting the EU's Kyoto target of an 8% reduction in greenhouse gas emissions between 2008 and 2012 (relative to the 1990 figure) has been the strongest single driver behind EU energy policy for almost a decade, only recently challenged by energy market liberalisation.

The competitiveness and security of supply debates have produced a great deal of talk, but little concrete action. In the public's mind, and in most discussions among experts, 'Kyoto' has simply become synonymous with 'climate change' (or to be precise, reducing climate change). This development is understandable, but unfortunate.

When it was adopted in 1997, the Kyoto Protocol was celebrated far more than its content justified. The collective 5% reduction in greenhouse gas emissions relative to 1990 required from industrial countries

amounted to no more than a stabilisation of the 1997 levels because of the fall in emissions in former communist countries between the base year and 1997.

The fact that the targets given to these countries allowed them to produce emissions at a level way above what they actually required (in the order of one billion tons CO_2 equivalent per year for Russia alone), coupled with the possibility for parties to trade emissions rights, meant that the OECD countries could meet their reduction targets through a combination of increasing emissions domestically and buying up the difference. Indeed, during the negotiations, US delegation members made no secret of the fact that Washington had no intention of reducing emissions at home to the levels agreed.

The Kyoto Protocol was negotiated on the basis of a mandate which recognised that the commitments made in the 1992 Climate Convention were insufficient to achieve long-term global climate protection. However, if the parties had implemented the commitments made in article 4.2[4] of the convention properly, it would have paved the way for at least as great a reduction in greenhouse gas emissions as the Kyoto Protocol could have been expected to offer when it was agreed in 1997.

Washington's withdrawal from the Protocol has made the situation much worse. The excessive emission rights given to Russia, Ukraine and, to a lesser extent, most of the new EU Member States under the Protocol amount to quantities of 'hot air' that far exceed what the remaining parties would ever need, even if they decided today not to launch any further emission reduction policies.

For this reason, real progress on this issue will not be driven by the Protocol, but by the individual parties deciding to go beyond simply taking the easiest way out – and this sort of engagement is not widespread. While the EU is still collectively struggling to meet its minus 8% target mostly through domestic reductions, few other parties have done much more than would have occurred anyway. The same is true of a number of individual EU Member States.

While recognising that the contribution made during the first Kyoto commitment period to limiting global emissions will, at best, be modest, supporters of the Protocol often point to the fact that 2008-12 is only a first step, and argue that the real merit lies in the 'architecture' it provides. However, a reality check does not support this optimism, at least not for the subsequent five-year commitment period from 2013-17.

One of the problems with the targets' approach is the timing. The Kyoto negotiations started in 1995, and agreement on a skeleton Protocol was reached two years later, but it took a further four years to produce an international agreement that was sufficiently developed to be sent for ratification.

This delay was fatal. Not only did emissions continue to increase for another four years, but, more importantly, the timeframe for meeting the targets was critically shortened.

For many parties, this doubled the annual emission reductions required, compared with what would have been needed if the Protocol had been 'ratifiable' in 1997. If 2001 was too late for a commitment period beginning in 2008, we are already past the point of achieving a realistic agreement for a 2013-17, with no sign of agreement yet in sight.

Recognising that Kyoto without the US makes no sense (and is politically impossible), the most optimistic scenario is one in which there is a more forthcoming post-Bush administration. This could in principle allow negotiations to begin in 2009, but this would be way too late for anything but business-as-usual commitments for 2013-17 – and probably also too late to agree anything sufficiently ambitious for 2018-22.

All this means that Kyoto will certainly not be able to deliver any contribution to emission reductions before 2018 and, at best, little between 2018 and 2022. This is more – or rather less – than we can afford if the idea of an international effort to protect the global climate is to make any sense.

The longer EU policy sticks to the illusion that Kyoto offers the main vehicle for global or EU climate policy, the more precious time will be wasted. It is a choice between climate protection and Kyoto.

One justified objection to suggestions that Kyoto should be put on the back-burner is the need for an alternative. Without pretending to offer a fully-fledged alternative, there is at least one which is often ignored but is still better than Kyoto: the 1992 United Nations Framework Convention on Climate Change (UNFCCC) mentioned above.

This convention includes a clear commitment for industrialised countries to adopt policies and introduce measures to reverse the previous trend towards increasing greenhouse gas emissions. Even though it does not include quantified targets and there is no doubt that most parties have failed to meet their commitments under the agreement, strict enforcement of these commitments would have a much bigger impact on emissions over the next 15 years than is possible under the Kyoto regime.

Refocusing on the UNFCCC would have two other advantages. Firstly, there would be no need for further ratifications since it has already been ratified by all the signatories (including Australia and the US – the latter on the initiative of President Bush Senior in 1992). Secondly, it offers a much better opportunity to gradually pull (or push) developing countries into the process of protecting the global climate.

III.4. Emissions trading: what will it take to make the system work?

The EU's CO_2 Emissions Trading Scheme (ETS) has attracted much attention as the proclaimed flagship of its climate policy and the first international scheme to put a price-tag on CO_2 emissions.

In the political context, it was argued that the system would provide for cost-effective emission reductions. More than half-way through the first trading period (2005-07), it is imperative to start drawing conclusions, however preliminary, as to whether it has lived up to expectations.

A preliminary assessment leads to the conclusion that the system has failed, if measured against expectations; and, unfortunately, the second trading period will operate under largely similar conditions to the first, with many of the existing problems likely to continue.

From a climate point of view, the most important problem is that the system is unlikely to provide significant emission reductions. This was to be expected following the Commission's 2001 proposal to let the allocation of emission allowances take place at national level, with allowances tradeable EU-wide between companies operating at EU or global level.

This was asking for trouble. Which government would like to see its companies among the buyers rather than sellers of allowances? Or resist the pressure from national companies to offer generous allowances to cover themselves against uncertainties?

Emissions in 2005 were between 100 and 200 million tons (more than 5%) below overall allocations. This is a clear signal that unless, as a minimum, the allocation criteria are tightened and subject to a much higher level of harmonisation, they will remain too high to encourage investments in emission reductions.

The basic idea – that some will invest in emission reductions at lower cost and sell to others who would otherwise face higher costs – remains attractive but, for the time being, entirely hypothetical. So far there are no indications that the system has led either to any significant investment or delivered the emission reductions aimed for.

This makes it difficult to examine the cost-effectiveness of such reductions. However, it does not mean that the experience so far does not allow for some assessment of the economic impact.

The fall in CO_2 trading prices in May 2006 (from around €30 to €15 per ton), when it became evident that the collective emissions in 2005 had been solidly below the allowances allocated, was widely described as a "collapse" of the system. That may well be the way traders saw it, but the real surprise was that prices were ever allowed to move towards €30 per ton when it was already clear in 2005 that most governments had been very generous in their allocations and that, even after this over-allocation became evident, CO_2 prices remained as high as €15 per ton.

On the positive side, unrealistically high CO_2 trading prices may have tempered the tendency to move towards a greater use of coal in electricity production as a response to higher natural gas prices. However, the high CO_2 prices are widely accused of inflating electricity prices. This issue demands closer analysis.

The first observation is that since there have been virtually no investments, no added net costs have been incurred as a result of CO_2 abatement. The fact that the CO_2 emission allowances have a real value explains why, as might be expected, they have an impact on prices.

This is independent of whether allowances are being paid for or given for free to the power producers and, in a liberalised market, it has a knock-on impact on the price of all electricity, including the almost 50% of total production which is CO_2-free (nuclear, hydro and other renewables). Exactly the same happens with increasing gas prices. The liberalised market allows producers to charge the price of the most expensive type of production at any time for all production and thus generate high profits at the expense of consumers.

It would obviously be wrong to blame the ETS or climate policy for this. Under the traditional 'cost plus' pricing scheme, under which electricity monopolies were allowed to charge prices corresponding to production costs plus a modest surplus, power producers would only have been allowed to pass the actual cost – which would have been virtually zero – on to consumers.

Unfortunately, these aspects were never properly analysed when the emissions trading system was devised and decision-makers were probably not aware of them. And when it becomes increasingly clear over the next six to seven years that the scheme is not living up to expectations, this will tarnish its image in the eyes of the public.

In this context, similar attention must be given to the time horizon. It is only possible to promote investment in CO_2 reduction technology if there is a demand for cuts, but this alone is not sufficient. It is equally important to create expectations that this demand will continue for long enough to allow investors to recoup their money. Clear rules are needed on allocations for more than three to five years, and the link to an uncertain international regime like the Kyoto Protocol does not make the necessary investments attractive.

For the time being, the ETS is not delivering any significant reductions, while CO_2 prices are pushing up electricity prices, with big profits for electricity producers and costs for consumers way beyond those justified by the modest reductions achieved. This is the worst of both worlds.

It is more likely that, in future, there will be a fall in CO_2 prices and lower 'windfall' profits for electricity producers but still no investment in emission reductions, than that this will lead to investments in reductions and higher prices.

Neither of these alternatives is acceptable. Only when a truly European allocation scheme with a clear long-term framework to encourage investment becomes a reality will it be possible to have the best of both worlds. Without this, emissions trading is a less attractive way of reducing CO_2 emissions than other solutions.

Conclusions

In analysing the key issues facing energy policy-makers, certain common themes arise: the need for diversification and spare capacity, and the importance of energy efficiency and energy savings. On the individual issues, the main conclusions are:

Diversification

Energy diversification in transport is disastrously low, with oil covering around 98% of the total. Biofuels will help somewhat, but the potential of natural gas as a transport fuel has been ignored so far.

Energy source diversification in electricity is good, but at risk if coal and nuclear lose significant market share in future. Natural gas supply could become overly dependent on Russian deliveries.

Maintaining sufficient alternative natural gas capacity, particularly via LNG terminals, would make it possible to maintain a high share of Russian gas in the overall EU supply, as it would ensure a higher level of independence if supplies were interrupted. It would also strengthen European gas companies' hand in negotiations with dominant suppliers.

Spare capacity

Spare capacity is essential in liberalised markets in the absence of external alternatives to challenge existing producers. This has been demonstrated powerfully in the global oil market over the past three years, and it is about to be demonstrated in gas and electricity markets as well,

There is little the EU can do directly to provide spare capacity in the global oil market, but it can do something in the electricity market if the ideological belief in liberalised markets is put aside. It will, however, take more than talk to make incumbents invest in projects that are, seen in isolation, unprofitable and would remove the possibility to make extra profits from existing production. However, the alternative is a loss of competitiveness for the industry and significant extra costs for consumers, particularly for those who can ill afford them.

Energy savings and efficiency

Energy efficiency has long been recognised as the most cost-effective way of meeting CO_2 reduction targets and security-of-supply needs. What is missing is a recognition that it cannot be talked into happening and that market forces are unlikely to do the job.

There are several reasons for this. One is that the energy cost of many commercial or private activities is a relatively small share of the overall cost, which means that other factors prevail. Another is that most consumers pay more attention to the price of an appliance – be it a car or a refrigerator – than to the combined capital and operating cost of using it. Furthermore, the person who bears the initial investment cost may not be the one who benefits from the savings. In any case, the collective benefit (for example, less CO_2 emissions or lower pressure on oil demand) does not directly benefit whoever bears the possible cost.

A word of warning on energy efficiency: this is not an objective in itself. It is pursued because, in most cases, it supports the real goals of security of supply, CO_2 emission reductions or competitiveness. But there are exceptions to this rule.

Electricity generation based on nuclear or biomass is less efficient than that based on natural gas. However, it is better from a security of supply and CO_2 emissions point of view, and, depending on gas prices, may be better for competitiveness. Similarly, coal-based electricity with CO_2 capture and storage is not characterised by high efficiency, but again is better than natural gas on security of

supply and CO_2 emissions. Switching from gasoline or diesel to natural gas in road transport also improves security of supply and reduces CO_2 emissions, but does not offer greater overall efficiency.

It would, therefore, be a mistake to look at developments in gross energy consumption as the only criterion for success in an energy efficiency policy.

In addition to the general principles described above, a number of particularly important energy policy elements for the medium term (up to 2025) can be identified. These must be based on addressing, first and foremost, the two main global issues in a medium-term perspective:

- The indisputable need to gradually turn global increases in greenhouse gas emissions into reductions – and, in this context, to pursue continuous reductions in industrialised countries (at least 1% per year) urgently;
- the highly probable increasing difficulties in providing the quantities of oil demanded worldwide in virtually all scenarios.

Policy recommendations

1. Energy consumption in transport must be the highest priority since it is a serious problem in relation to both concerns. The 'EU CO_2 and cars' agreement with the motor industry of the late 1990s must be expanded to cover all types of road transport; reinforced to ensure ambitious reductions in the future (post-2008); and strengthened with an incentive scheme which makes it attractive for manufacturers to use existing technology and develop new technology for more efficient road transport.

   The European Commission's 2001 alternative motor fuels strategy must be reactivated. It is more than surprising that while an oil price increase to $30 per barrel prompted the Commission to propose an overall alternative motor fuel diversification strategy, a further increase to $70 per barrel has seen the strategy being shelved (except in the case of biofuels, from many points of view the least attractive alternative fuel but the one being most strongly lobbied for).

   On the other hand, the possible use of natural gas as a motor fuel has been virtually ignored, even though it is much cheaper than other alternatives, has the greatest medium-term substitution potential and offers significant CO_2 reduction possibilities (around 20%).

   Energy efficiency in transport and alternative motor fuels are strong candidates for broader international cooperation, both because such cooperation will multiply the benefits and because the car industry is one of the world's most globalised sectors.

2. A continued reduction in CO_2 emissions from electricity generation, whilst maintaining a diversified mix of energy sources, is another priority.

   This involves several elements. The use of renewables in electricity needs to be accelerated. The relatively impressive progress in wind energy in a few Member States is far from sufficient if measured at EU level.

   A master plan for the use of coal in electricity production is also needed, with two main elements: no new coal-fired capacity without carbon capture and storage, or – as a very minimum – without being prepared for carbon capture and storage after a certain time; for example, 2015. Older, less efficient plants will also have to be phased out. In addition, an overall policy at EU and Member State level is needed to ensure an increasing use of CO_2-free energy in electricity production.

   Such a policy could make a strong contribution to a continued reduction in CO_2 emissions from electricity generation and would make it possible to start bridging the gap between those who believe that either nuclear or renewables offer the only way ahead.

3. An overall strategy for future natural gas supply is also crucial.

   One element in such a strategy must be to draw up emergency measures to cope with sudden, unexpected interruptions in supply. A combination of emergency stocks, 'interruptible' consumers and spare capacity will have to be discussed and agreed at EU level. Such a strategy could be developed on the basis of national and company commitments. However, new EU legislation might also be needed.

   A medium-term supply strategy is no less important. As domestic gas production falls within the EU, import flexibility becomes increasingly important. It cannot be stressed enough that this is as much a question of commercial negotiating strength as of simple physical security of supply.

   In the light of an expected increase in natural gas consumption to over 600 billion cubic meters (bcm) annually and imports moving from 250 towards 500 bcm a year, the EU would be well advised to ensure spare capacity of at least 50 bcm within ten years (with most of this in LNG terminals) and well above that within 20 years (unless energy efficiency measures are successful enough to justify a lower level).

   Spare capacity at these levels would be higher than is likely to be generated by companies' needs. It is also more than would be profitable for individual companies, for whom a tight market is usually an advantage. But it would be hugely beneficial for EU gas and electricity consumers, be they energy-intensive industries or private consumers. Whether legislation would be necessary to achieve this remains to be seen. If sufficient agreement on the strategy can be achieved, it could be implemented by the gas companies themselves.

4. A real action plan for energy efficiency needs to be developed, covering transport, electricity generation, appliances and buildings. This plan must specifically address the question of how to reduce energy wastage in the new Member States, where both buildings and industries still suffer from the extravagances of the past, when energy was almost free.

   Public awareness campaigns are not going to do the job. Many of the measures needed will obviously have to be introduced at national level. But as long as the European Commission refrains from pursuing an ambitious policy in areas within the EU's competence (road transport, electricity generation and appliances), Member States cannot be expected to do their part of the job. A real road map is required.

Jørgen Henningsen is a Senior Adviser to the European Policy Centre on energy and the environment. **He would like to thank EPC Associate Policy Analyst Carlos Buhigas Schubert and Nicola Rega, who works in the Energy & Environment Unit of BluePrint Partners, for their insightful contributions to this paper.**

Endnotes

1. Gas prices of €200/1000m3, which is equivalent to an energy cost element of €40/Mwh in electricity generation, cannot compete with coal prices of €15-20/Mwh for the energy cost, even if adding €10/Mwh for the higher CO_2 emission from coal.
2. Green Paper: 'A European Strategy for Sustainable, Competitive and Secure Energy', Brussels, 8.3.2006 COM(2006) 105 final.
3. Directive 2001/77/EC,On the promotion of the electricity produced from renewable energy source in the internal electricity market.
4. United Nations Framework Convention on Climate Change, FCCC/INFORMAL/84 GE.05-62220 (E) 200705, 1992 United Nations. Article 4.2 states:
   2. The developed country Parties and other Parties included in Annex I commit themselves specifically as provided for in the following:
   (a) Each of these Parties shall adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Parties' starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective. These Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention and, in particular, that of this subparagraph;
   This includes policies and measures adopted by regional economic integration organizations.
   (b) In order to promote progress to this end, each of these Parties shall communicate, within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred to in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for the period referred to in subparagraph (a), with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol. This information will be reviewed by the Conference of the Parties, at its first session and periodically thereafter, in accordance with Article 7.

Executive summary

European energy supplies and the impact of energy use on the global climate are two of the biggest challenges facing mankind, and they are gradually rising up the EU's agenda – although not fast enough, given the urgency of the situation.

Against this backdrop, this Issue Paper assesses the EU's current energy policy and considers how Europe can best prepare itself to meet these challenges now and in the years to come.

The paper considers current and future management of the various energy sources, warns that decisions taken today will determine the EU's energy situation in 2025 and identifies a number of key elements for an effective strategy.

In particular, it emphasises the need to use a diversified mix of energy sources to produce electricity; argues that energy market liberalisation will not, of itself, bring down prices and a number of measures will therefore be needed to keep them within reasonable ranges and ensure a reliable and adequate electricity supply; and examines the role which two energy sources in particular – coal and nuclear – can play in responding to the challenges facing the sector. It argues that coal "is better than its reputation" and says the debate over nuclear energy should not be clouded by ideological concerns.

It also considers the increasingly urgent question of how to combat climate change and ensure sustainability in Europe's energy policy. It argues that the Emissions Trading Scheme set up by the EU to reduce carbon dioxide emissions is failing to live up to expectations, and warns against continuing to view the Kyoto Protocol as the main vehicle for EU or global climate change policy.

In analysing the key issues facing energy policy-makers, the paper concludes that certain common themes arise: the need for diversification and spare capacity; and the importance of energy efficiency and energy savings.

It recommends action in the following four key areas, in particular:

- prioritising the reduction of energy consumption in the transport sector;
- reducing CO_2 emissions from electricity generation, while maintaining a diversified mix of energy sources;
- developing an overall strategy for future natural gas supply to deal with unexpected interruptions and the expected increase in consumption;
- drawing up an energy efficiency action plan covering transport, electricity generation, appliances and buildings.