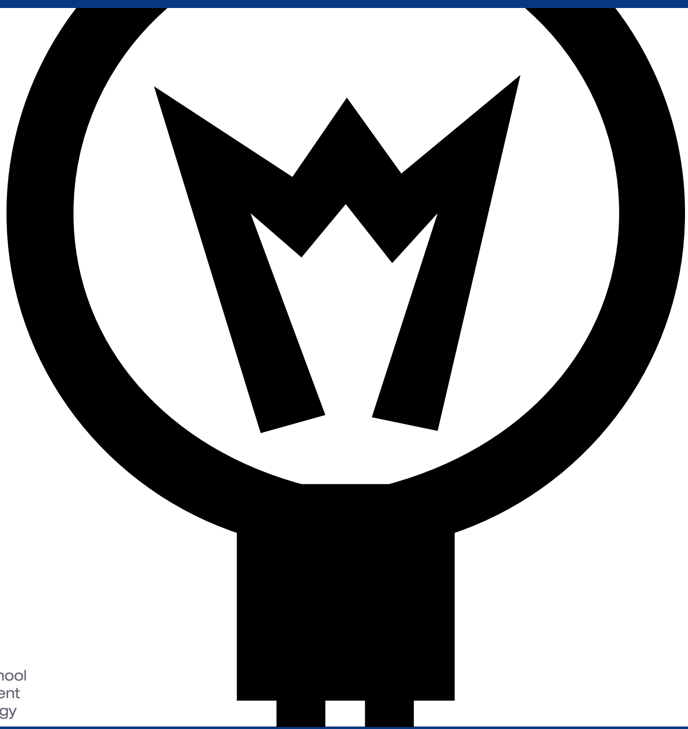
Energy: Choices for Europe

BY LARS-HENDRIK RÖLLER, JUAN DELGADO AND
HANS W. FRIEDERISZICK



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Energy: Choices for Europe

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Foreword

Energy policy in Europe is a worthy subject for the first of the new *Bruegel Blueprint Series* which, as its name indicates, aims at going beyond economic analyses to make detailed recommendations to policymakers.

This is not only because energy is currently a pressing issue which ranks high on the European agenda. More fundamentally, it is also a defining topic for the Europe of the next decades. Indeed, three of the major challenges all countries are confronted with – access to resources in a world that is rediscovering scarcity, endogenous change in what we used to call the state of nature, and competitiveness – converge to shape the energy discussion. This is why the issue is rightly regarded as a litmus test of the usefulness of the EU in the XXIst century.

However, the definition of a common energy policy is a very demanding mission and the Europeans should recall that although energy was present at the creation of the EU through the Coal and Steel Community and Euratom, it thereafter disappeared from the European agenda as each country embarked on a different course in the wake of the oil shocks of the 1970s.

Economists are used to looking at decisions to assign policy responsibility to the EU along two dimensions. The first is the diversity of preferences. The more heterogenous they are, the stronger the case for decentralisation. The second dimension is the extent of economies of scale. The larger they are, the stronger the case for centralisation. Yet as the report by Lars-Hendrik Röller, Juan Delgado and Hans Friederiszick makes clear, what characterises energy is a combination of high heterogeneity of situations (if not of preferences) and large economies of scale. Hence, the difficulty of the choice.

There is no hope, the report claims, to solve the issue by papering over trade-offs and differences. On the contrary, analysis should start with an identification of the trade-offs and evaluate to what extent a common approach has the potential to make choices less acute than at the national level. A common policy should also recognise national differences and make the best of them – exploit comparative advantage – instead of overlooking them. This is a fundamental requirement for a successful energy policy, however one that tends to be disregarded in the name of simple political messages.

'Energy: Choices for Europe' suggests a number of concrete ways in which the EU can confront hard choices and begin to forge the common energy policy which is vital for its future. Bruegel is happy to have collaborated on this project with the European School of Management and Technology (ESMT) in Berlin and especially with its president Lars-Hendrik Röller, who is also a non-resident senior fellow at Bruegel.

Jean Pisani-Ferry, Director, Bruegel
Brussels, March 2007

Executive summary

Energy policy is a make-or-break challenge for Europe – and a litmus test for the usefulness of the European Union as an institution.

The ongoing process of global economic integration has underlined the imperative of access to secure, reliable and cost-effective sources of energy. Declining international reserves of fossil fuels are gradually changing the world energy map. And, as the evidence for climate change hardens, it has become urgent for Europe to save energy and to promote lower-carbon energy sources.

Can Europe's nations go it alone in their quest for the triple crown of a secure, competitive and environmentally sustainable energy future? Or will this lead to dispersion of effort, even to mutually undercutting national policies? If a common energy policy is the way forward, can the European Union – and its agent the Commission – manage the necessary political arbitrage between 27+ different countries with very different energy histories and geographies?

The Commission's memorandum of January 2007 on a common European energy policy makes the case that the EU must stand united on energy – and assumes that the EU is capable of the necessary compromises to get there. This Bruegel Blueprint – the first in a new series of Bruegel publications – tests this case, finds it wanting and suggests a way forward.

We enquire about the nature of some key trade-offs involved in national energy policies. We scrutinise individual EU Member States' performance against three policy objectives – green, secure and competitive energy – in order to see these trade-offs at work. A cluster analysis reveals widely differing national trade-offs and policies.

The Energy Blueprint then analyses European policy in terms of persuading Member States to relax their national trade-offs and to adopt a common European approach. Five promising areas for European added value are suggested:

- The internal market: single market policies and competition rules provide a readily available framework for an EU-wide energy market. EU rules must be fully enforced in order to thwart suboptimal national solutions triggered by national trade-offs.

- A network of energy regulators: a pan-European network of energy regulators should be created. Regulators must cooperate closely and a strong EU agency must act as a regulator of last resort.

- Political framing: the EU must 'speak with one voice' to the outside world in order to reduce political interference in economic markets. Political framing will help EU firms gain access to third-country markets and facilitate full application of EU competition rules.

- The choice of energy mix: environmental targets must be set at EU level, burdens must be shared according to national circumstances and market-based incentives be set up. A system of tradable green certificates would be a suitable and efficient means of aligning national policies on common policy.

- A joint plan for developing new technologies: research should focus on the best national energy options but also be coordinated at EU level in order to exploit synergies where possible.

Finally, the Energy Blueprint sets out practical ways of getting to the goal of a common European energy policy.

1. Introduction

Energy is a central issue in the current European policy context. Europe faces a number of fundamental challenges. First, the ongoing process of global economic integration emphasises the importance of having access to secure, reliable and cost-effective sources of energy. Since energy is an important input for much economic activity, it contributes towards the competitiveness of the European economy as a whole. Second, declining international reserves of fossil fuels are changing the world energy map and have started to increase global competition for scarce resources. Whether European countries will follow common or national sourcing strategies is of profound political significance for the EU. Last but not least, climate change is an issue of great international concern. The need for stricter environmental standards has become apparent and the willingness of European leaders to spearhead this reform at a global level has resulted in calls to start optimising environmental policy instruments at EU level. Without a common policy the EU can hardly be a credible world player.

These challenges have been recognised by the European Commission in a recent Communication to the European Council and the European Parliament[1] and have been translated into three fundamental policy objectives: (i) sustainability, i.e. environmental objectives, (ii) security of supply and (iii) competitiveness.

However, an important question for Europe's energy policy choices is to what extent trade-offs exist between these objectives . The Commission appears to suggest that all objectives reinforce each other. In contrast, this report points out that there are important national trade-offs behind these various policy objectives which need to be recognised in order to arrive at a robust framework for analysing the benefits of – and convincing Member States of the need for – a European approach.

1. Communication from the Commission to the European Council and the European Parliament: An Energy Policy for Europe, January 10, 2007 (EC, 2007a).

In this report we provide evidence of individual Member States' performance in relation to the three objectives. We find that there is considerable heterogeneity in the accomplishment of each objective across Member States. This evidence is consistent with the existence of national trade-offs driving Member States towards different policy choices. Each Member State faces very different exogenous factors as regards geographical location and the availability of domestic primary energy resources, to say nothing of diverse national preferences, such as attitudes to nuclear energy. As a result of this considerable heterogeneity in energy markets, not all objectives can be achieved equally by all Member States. Or at least not at the same cost. National trade-offs exist, and to differing degrees, across Member States.

This report provides some direct examples and evidence of national trade-offs. It is important to emphasise that we are not providing a comprehensive list of all possible trade-offs inherent in the three possible objectives. Such a list would depend on precise definition of the objectives. For instance, the objective of 'competitiveness' may have several dimensions, which may not all involve the same trade-offs. As discussed below, this report concentrates on one aspect of competitiveness, namely competition. To the extent that competitiveness is a broader concept than competition, more trade-offs need to be taken into account.

We think that the correct way to analyse the costs and benefits of a European energy policy is to set the debate in terms of relaxing national trade-offs. Using this approach we identify five policy areas where national trade-offs could be significantly relaxed by the adoption of a common European approach: the internal market, a network of energy regulators, political framing, the choice of energy mix and a European plan for the development of new technologies. These five fields show that, despite national differences, a European policy can bring substantial added value.

Finally, the report asks how a European energy policy can be made acceptable to Member States. We emphasise five priorities: (1) implementing flexible (market-based) and harmonised incentive systems, (2) dealing with problem Member States, (3) focusing on energy objectives, (4) providing more rigorous impact assessments and (5) appealing to the special responsibility of France and Germany.

We conclude by underlining that, if a European approach is not successful, mutually incoherent national policies will prevail. This will have long-lasting negative effects on the global competitiveness of European industry and will be an obstacle to environmental adjustment. In other words, all three objectives identified by the European Commission are at stake.

2. The European energy landscape

This section describes some stylised facts about gas and electricity which make the economics of these sectors different from other commodities. The section also presents the main challenges facing energy policy which justify the need for new initiatives in this field: decline in global reserves of fossil fuels and concentration in unstable parts of the world, the link between energy and global competitiveness and the imperative of combating climate change.

2.1 Stylised facts

Gas and electricity are important input products for industrialised countries. Gas and electricity markets share several features, one of which is their reliance on a physical network, which distinguishes the economics of these products from that of standard commodity products or other natural resources, like coal and oil. Gas and electricity markets are also strongly interdependent due to the fact that gas is one of the major inputs for electricity generation. In this subsection we described some of the main economic features of those two markets.

First of all the markets for both products have a tendency towards regional fragmentation and a concentration of market power. This is due to several characteristics of the two products, namely the reliance on a physical network and low demand elasticity, together with product homogeneity and high entry cost. Both energy sources depend on a physical network structure – a pipeline system in case of gas, a grid of power supply lines in the case of electricity – which adds some technical complexity (in particular in the case of the power grid) in the operation of markets. The need for a physical network adds a geographical dimension in the sense that markets can only develop in reasonably well-interconnected regions. This implies some inherent tendency of both markets – gas and electricity markets – for regional fragmentation.

The regional fragmentation of markets, the low elasticity of demand and the high entry costs translate into the emergence of significant market power. Consumers cannot easily switch to alternative energy sources and supply is constrained by long lead times for planning and construction or access to network infrastructure.

Due to the fact that gas is an important input for electricity production, existence of market power in one market – gas or electricity – might be leveraged into the other market. For instance market entry may become more difficult in an environment where gas and electricity supply are controlled by vertically integrated firms.

Due to the homogeneous nature of both products, markets can easily be created in both industries as long as the appropriate market rules are in place and access to networks is guaranteed. However, due to low elasticity of demand (consumers cannot easily switch to alternative sources of energy in the short term), high prices might arise in peak periods in particular in the electricity market. This phenomenon is part of the normal workings of competition and necessary to provide the right investment incentives. Given the high investment cost these rents are necessary to make the investment profitable and, thereby, to provide incentives to invest in future capacity.

Finally, electricity markets feature some characteristics which distinguish them significantly from gas markets and make market design for electricity markets an even bigger challenge. Electricity is non-storable and transportation[2] is economically feasible only over limited distances. Non-storability of electricity on the one hand strengthens the above-described tendency towards regional fragmentation. More importantly, it even creates a strong interdependency between regions with respect to the operation of the network.

The limited transportability of electricity implies that it is barely traded with non-EU countries, limiting the potential direct effects of external political risks. In contrast, gas is a natural resource which requires significant investment in exploration and development of natural gas fields, which often lie outside the jurisdiction of consuming countries. Accordingly the 'politics' of the two energy products differ significantly: electricity production is mainly driven by national and EU policies and gains an international dimension only through the effects of electricity prices on the com-

2. Transport of electricity and gas does not necessarily take place physically. Within a common network the amount of electricity/gas imported into the network and the amount exported from the network must be balanced. The non-storability of electricity adds technical complexity to the requirement of local balance.

petitiveness of downstream industries active on global markets (for example the aluminum industry) or through exporting power plant technology. Gas production is, given the low availability of natural gas in Europe, inevitably linked to international markets and is more comparable to other natural resources like coal or oil. This implies that the notion of security of supply has a different meaning for these two industries. While for electricity it is linked to proper management of the grid and to an adequate level of investment in generation and transmission assets, for gas the foreign dimension and, in particular, the fact that most reserves are located in politically unstable countries is a key issue. Table 1 provides an overview on the main characteristics of the two products.

Table 1: Main features of gas and electricity

Characteristics	Gas	Electricity
Product homogeneity	High	High but little intertemporal substitutability due to non-storability
Demand elasticity	Short term: low/medium Long term: medium Main substitute: other natural resources	Short term: low Long term: medium Main substitute: more efficient use/other energy sources
Storability	Yes, but costly	Not feasible
Investment	Costly and sunk	Costly and sunk
Transportation	Long distance: feasible, mainly dependent on physical network (exception LNG)	Medium distance: feasible, always dependent on physical network
Network	Limited technical requirements to guarantee network stability	High technical requirements to guarantee network stability
Foreign dimension	Important	Of relevance only indirectly

2.2 Main Challenges

Energy policies face three main challenges:

- An accelerating decline in global reserves of fossil fuels concentrated in few producing countries, often under unstable political regimes.
- The ongoing process of globalisation.
- Climate change.

We now address each of these challenges in turn in more detail.

Declining international energy reserves and political risk

World demand for and supply of fossil fuels are characterised by three fundamental trends:

i. Fossil fuel reserves are depleting. The most optimistic forecasts estimate that existing world gas reserves will last for around 65 years, with oil reserves lasting 40 years[3]. Even if new technologies can exploit reserves which are at present technically inaccessible and economically unviable, the current heavy dependence on fossil fuels is not sustainable in the long run. Therefore, rationalisation of current energy consumption, together with more reliance on alternative energy sources, seem unavoidable.

ii. Energy demand is increasing. Energy demand is expected to increase at an annual rate of 1.6 percent. Developing countries account for over 70 percent of this increase. By 2030 more than 50 percent of total world demand for energy will come from developing countries, up from 40 percent today[4]. Industrialisation and economic growth imply increasing demand for energy. At world level there is already increasing competition at world level for energy resources, with countries positioning themselves to gain preferential access[5].

iii. Fossil fuel resources are concentrated in few countries, often with unstable political regimes. Over 85 percent of oil reserves are concentrated in ten countries. For gas, nearly 80 percent of current reserves are concentrated in ten countries[6]. Limited transport possibilities make gas markets more fragmented and less liquid than oil markets since not all reserves are accessible to all countries. For example, more than 90 percent of current EU gas imports come from Russia, Norway and Algeria (see Table 2).

Gas- and oil-producing countries therefore enjoy market power that allows them to influence the market price. Moreover, the majority of oil- and gas-producing compa-

3. See Annex II of the Communication from the Commission to the European Council and the European Parliament: An Energy Policy for Europe (EC, 2007a).
4. See OECD/IEA (2006).
5. For example, in anticipation of future demand growth, China has recently been especially active in acquiring interests in exploration and production and reaching cooperation agreements with countries like Kazakhstan, Russia, Venezuela, Sudan, West Africa, Iran, Saudi Arabia and Canada.
6. See EIA (2005).

nies are state-owned. Decisions may therefore be influenced by political objectives, and not based on strictly economic considerations.

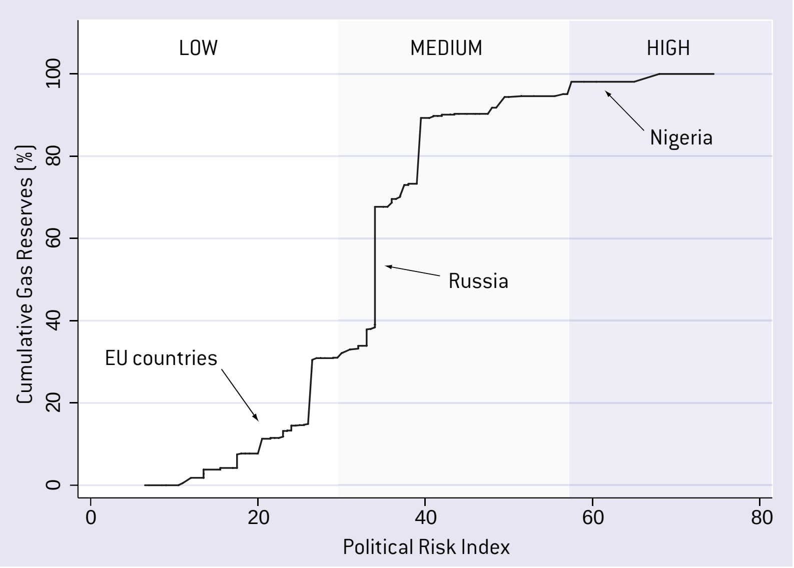
Table 2: Main gas exporters to the EU, 2004

	%	Main exporting company	Status	State ownership (%)
EU own production	37			
Norway	17	Statoil	Monopoly	70
Russian Federation	29	OAO Gazprom	Monopoly	>50
Algeria	13	SONATRACH	Monopoly	100
Nigeria	1	BBOC	Monopoly	100
Qatar	1	Qatargas	Monopoly	65

Sources: DG TREN and company webpages

Moreover, the instability of governments in some resource-rich countries may increase the uncertainty of physical supply of energy and the risk of temporary disruptions. As shown in Figure 1, 70 percent of world gas reserves are concentrated in medium-high political risk countries.

Figure 1: Location of main gas reserves and political risk



Sources: EIA (2005) and International Country Risk Guide, the PRS Group (2005).

As a consequence of the above factors, prices for fossil fuels are likely to rise[7] and be more volatile in the coming decades. This will have a negative impact on the European economy.

The ongoing process of globalisation

Energy is an essential input for any economic activity. The existence of an efficient and stable energy sector is essential for the economy and fundamental to sustaining the competitiveness of European companies. Markets are increasingly global and firms compete more and more in these global markets.

Making EU firms more competitive at global level implies access to reliable energy sources at minimum cost. An important factor is the role of the EU in the internationalisation of environmental policies. For example, as the US and China have not signed the Kyoto Protocol, the EU will increasingly face the challenge of maintaining and strengthening its competitiveness.

Climate change

According to the Stern Review[8], if no action is taken to reduce carbon dioxide (CO2) and other greenhouse gas emissions, temperatures will rise by two degrees Celsius by 2035. But global warming will imply not only temperature changes, but also changes in wind patterns and precipitation, and more frequent weather extremes[9]. This could have a dramatic impact on the economic geography of our planet and on human life.

Because energy production and consumption emit more than 80 percent of all CO2 emissions[10], the energy sector has a special responsibility for reducing these emissions.

The reduction of greenhouse gas emissions will also represent a challenge to the energy mix: cutting the share of carbon-based fuels in the mix and increasing the share of less carbon-intensive energy sources.

These challenges require the participation of the international community, as CO2 emissions in Europe constitute a small fraction of world emissions. Europe will not achieve the desired outcome on its own. A successful approach to the environmental challenge requires appropriate design of policies at world level and the implementation of a suitable system of governance.

7. Oil prices are expected to increase constantly in real terms for the next twenty years (OECD/IEA, 2006).
8. See Stern (2006).
9. IPCC (2007).
10. Source: EEA, European Environment Agency.

3. Objectives of energy policy

In its recent Communication on a European energy policy the Commission sets three major policy objectives: environmental sustainability, security of supply and competitiveness. The Commission develops these policy objectives and proposes policy instruments to deal with them. However, an important question for Europe's energy policy choices not addressed by the Commission is to what extent trade-offs between these objectives exist. This section defines the objectives of energy policy and identifies potential trade-offs between such objectives. The Commission paper does not identify trade-offs. On the contrary, it appears to suggest that all three objectives reinforce each other. In addition, the Commission's reasoning on how to achieve these objectives is rather tautological: a well-functioning market achieves all three objectives simultaneously if it functions well. This line of argument is unlikely to trigger fruitful debate.

More fundamentally, we argue that the existence or not of trade-offs between policy objectives depends largely on how they are defined. In particular, if the competitiveness objective is defined in terms of overall long-run economic efficiency, there are no trade-offs. If, however, competitiveness is defined in terms of industry profitability, there are trade-offs. For example, environmental policy goals could increase costs for industry, thus decreasing its competitiveness on international markets. Likewise, if the competitiveness objective is defined in terms of consumer interest (after all, this is the standard for EU competition policy) there are likely to be trade-offs. For example, increasing the share of renewables might increase the average cost of energy, since renewables are currently more costly than conventional energy sources.

In other words, if the policy objective is defined widely enough, there cannot be – by definition – any trade-offs. All objectives collapse. But this is not very helpful, in particular if the policy objective is not in line with the current policy and the political debate. In a way, defining policy objectives in an excessively broad way just serves to duck discussion.

We believe that a framework for discussing the real trade-offs is needed in order to design the appropriate policies. In this way, the identified trade-offs can be relaxed. Let us begin by asking why trade-offs occur.

One fundamental reason is that many policy choices involve very difficult intertemporal trade-offs: should we pollute today and leave the consequences to our children and grandchildren? Should we invest more in biomass today in order to get more supply independence tomorrow? Many of these policy decisions involve a short-run sacrifice that pays off in the long run.

An important aspect of policy-making is the time horizon under consideration and how one values (trades off) today's sacrifices against tomorrow's gains. This intertemporal trade-off is inherent across the three objectives identified by the Commission. For example, to the extent that economic efficiency is associated with prices, internalising environmental costs will raise prices today in order to achieve sustainable growth in the long run. In other words, one is trading off short-run higher prices with long-run benefits.

The above example illustrates that, in the long run, all three objectives tend to converge. For example, long-run economic efficiency can perfectly well achieve environmental objectives, if markets work properly, that is if there are no market failures and the costs of polluting are priced in. Similarly, if supply security is defined as secure access to resources at low prices, then long-run economic efficiency will amount to the same objective. By contrast, in the short run, tough intertemporal choices have to be made, as there are real trade-offs.

A second reason why trade-offs are a reality is that the world is not perfect. There are market failures and government failures. As long as we observe market failures (such as foreign monopolies) and government failures (such as bad regulation or political interference for political goals) competition and supply security may be at odds.

Before discussing these potential trade-offs in more detail, let us briefly comment on the three objectives identified in the Commission's Communication, starting with the third one.

3.1 Competitiveness

The third objective referred to in the Communication is labeled 'competitiveness'. The term competitiveness has been criticised by many economists as being too vague and even misleading. Most economists prefer concepts such as 'productivity', 'economic efficiency' or 'consumer surplus'. The Communication describes what the term competitiveness entails[11]. It would encompass concern about high prices and the associated transfers, investment, jobs and innovation and the knowledge-based economy. Moreover, all these concerns are, or should be, consistent with the social dimension of Europe, at least in the long run.

We would like to submit that such an all-embracing definition of competitiveness is not very useful, as it conceals many difficult trade-offs that need to be addressed. Perhaps it is true that setting such broad-ranging objectives is institutionally necessary in order to garner political support from Member States. However, we would take issue with this Panglossian approach.

In order to illustrate this point, let us concentrate on one of the above aspects of competitiveness, namely competitive energy markets, which should lead to low prices and, in turn, to an increase in the 'competitiveness' of the European economy. Even if we just focus on competitive energy markets, we will argue that several important trade-offs exist. If competitiveness were defined as a broader issue than competitive energy markets, additional trade-offs would arise.

Competition is closely associated with – but not always identical to – economic efficiency, which is a well-defined concept. Economic efficiency (or total welfare maximisation) is a situation where externalities are priced in, where products in the economy are produced at the lowest cost and where the allocation of products between consumers is optimised. Defined statically, economic efficiency relates to a situation where current prices are close to current marginal costs. Moreover, if one focuses on consumers[12], short-run prices (plus

11. Communication from the Commission to the European Council and the European Parliament: An Energy Policy for Europe, January 10th 2007, (EC, 2007a, pages 4 and 5).

12. Note that economic efficiency involves both consumer surplus and producer surplus (profits). By concentrating on consumers as a standard for competition, industry profits are only taken into account if they are passed on to consumers. However, a consumer surplus standard has its advantages, even if one is interested in maximising a total welfare standard. The reason is that the antitrust agency may be subject to political influence. If so, it may be better to give the agency a consumer surplus standard in order to countervail political pressures. In the end, this will lead to a better outcome, in terms of total welfare (see Neven and Röller, 2005). Note that this political environment is a government failure, which shows again that there are trade-offs whenever there are market or government failures.

quality, product variety, etc.) are the relevant measures of economic efficiency. In this case, the trade-off with other objectives, such as sustainability, is very steep.

Dynamic efficiency relates to a situation where consumption and investment is optimised over time. The difference between static and dynamic efficiency is that dynamic efficiency involves an intertemporal trade-off. For example, lower prices in the short run may reduce the incentives of firms to invest in future capacities. Dynamic efficiency will trade off these two opposing effects optimally.

In sum, we will use 'competition' as a key element of 'competitiveness' in order to illustrate that trade-offs exist.

3.2 Environmental sustainability

The aim of energy policy in the environmental field is to ensure sustainable development.

Environmental objectives have largely concentrated on the evolution of CO2 emissions (which is the focus of the Kyoto Protocol) as well as on acid emissions. A second related important objective is the share of renewables in the energy mix, such as the share of hydropower, combustible renewables, wind and solar energy. Other environmental concerns, such as radioactive waste management, are not explicitly included within the environmental objectives set by the European Commission.

3.3 Security of supply

In analysing supply security, we limit our attention to supply-side factors (such as limited resources, insufficient investment in infrastructure and new exploitation, blackouts, political blackmail, or terrorism). We divide supply security into operating reliability and resource adequacy (our definitions do not coincide with Joskow, 2005).

By 'operating reliability' we mean adequate investment in network infrastructure (and power generation in the case of electricity) and smooth operation of the existing network to balance supply and demand. The 2003 blackout in Italy or the recent blackout in Germany – which directly affected Germany but which also had consequences for Belgium, France, Italy and Spain – are examples of a lack of operating reliability.

'Resource adequacy' means reliable access to primary resources and is specifically linked to the external dimension of EU energy policy. As already mentioned, significant parts of the value chain are located outside the EU. In particular, producer countries are often characterised by unstable or undemocratic political regimes[13]. In such an environment, supply security will not only depend on the economic rationale of serving a specific region or group of customers, but on additional political objectives[14].

In an idealised world – that is one with competitive supply markets and private firms competing for access to resources – a competitive European market would maximise supply security by optimising investment in resource development and supply allocation. However, several market failures exist. First and foremost the monopolistic market structure in producing countries and the strong influence of political objectives on markets in both producing and consuming countries (for example China). Whether and when political influence is a problem is further discussed in Box 1, overleaf.

Abusing control over natural resources in order to advance political goals can lead to very damaging economic effects. Even though such tactics are not maximising economic profits, government-controlled foreign monopolists may restrict output beyond what a monopolist may do, in order to extract political concessions. In this case, supply security is a concern.

13. See Figure 1.
14. The recent conflicts between Russia and Ukraine and Belarus illustrate how conflicts between third countries can affect supply security in Europe.

BOX 1: THE ECONOMICS OF POLITICAL LEVERAGING

When is political influence a concern for supply security? In order to address this issue, it is useful to differentiate between various potential negotiation partners.

(a) competitive, private economy counterparts;
(b) monopolistic (considerable market power), private economy counterparts;
(c) government-backed or controlled counterparts.

Let us address these cases in turn.

(a) Whenever the trading partner is a privately-motivated agent in a competitive industry, the law of supply and demand applies. Dependence on trade is not a problem, even for products deemed to be vital inputs into the production process (for example, within the energy sector, dependence on foreign coal and uranium is not perceived as a problem). Free and competitive markets ensure that special interests – business or political – do not restrict supply.

However, whenever there is market power or political influence, the situation becomes more complex and supply security may be a concern.

(b) If a scarce resource is controlled by a foreign private monopolist, or a highly concentrated market structure, supply decisions are still based on profit considerations. A foreign private monopolist will have an incentive to restrict output (in order to raise prices), but will not have incentives to go further. In particular there will be no incentive to engage in involuntary rationing, since this does not raise profits. In situations of scarcity, supply will be directed towards those markets that are most profitable.

(c) Suppose the foreign monopolist (or highly concentrated industry) is government-controlled. Concentration of ownership is likely to be higher. Market power in the provision of natural resources is thus at its greatest. Furthermore, the foreign government's objectives are not necessarily solely economic. In such situations, energy policy might be used as one more tool available to the government to achieve its goals. In this sense, energy policy cannot be analysed in isolation from other government objectives. Therefore, given the possible multiple ends of energy policy, outcomes can be unpredictable.

4. The status quo of Europe's energy sector

In this section we investigate the status quo of Europe's energy policy, in terms of the three energy policy objectives: competitiveness, security of supply and environmental sustainability. In order to get a comparable measure across Member States, we construct an indicator – the Energy Policy Index – which provides the position of each country in relation to each of the objectives. On the basis of the Energy Policy Index, we perform a cluster analysis, which seeks to group countries according to the three objectives. From this analysis we notice that national starting-points vary considerably.

4.1 The Energy Policy Index (EPI)

The EPI (See Annex I for details) is designed to give an overview of the current state of energy policy in the EU. However, the relative simplicity of the index should be borne in mind, in particular when drawing policy conclusions[15].

For each objective the index ranks countries between zero and six: zero for 'bad' and six for 'good'[16]. In other words, the higher the value of a specific indicator, the better the performance of a country. The criteria for each of the indicators is as follows (see Annex I for a detailed description of the data and methodology):

Competitiveness

As discussed above, we focus on competition, which is related to competitiveness[17]. We measure competition by the degree of domestic competition and the exposure to foreign competition. In particular, we construct two indicators, as follows:

15. The EPI is not designed to provide a rigorous and comprehensive description of the energy sector in Europe but to provide a simple indicator of the status quo.
16. We follow a similar methodology to the one used by Conway and Nicoletti (2006) in their regulatory indices.
17. We do not directly measure productive efficiency or economies of scale.

- Domestic competition and liberalisation – this indicator measures the competitive situation in each country, in both gas and electricity industries, with reference to vertical integration in transmission and distribution networks, and to horizontal market structure at upstream and downstream levels.

- Intra-EU electricity trade – measures exposure to external competitive pressures. A well-interconnected country will be part of a larger market and therefore be subject to higher external competitive pressure. Intra-EU electricity trade is measured as the sum of imports and exports over domestic production.

Security of supply

Security of supply is measured by the degree of independence from foreign primary energy resources and by the extent to which current and future infrastructure will be sufficient to meet current and future demand. These two indicators proxy the international and domestic aspects of security of supply (that is, the existence of appropriate incentives for sufficient investment).

- Energy dependence – measures the share of net primary energy imports (imports minus exports) in gross energy consumption. We use energy dependence as a proxy for vulnerability to foreign supply disruptions[18].
- Generation adequacy – measures the extent to which the appropriate investment in electricity generation capacity is being made to respond to current and future electricity demand. It is defined as the excess of installed capacity over the expected peak load. The indicator is an average of the current adequacy margin and the adequacy margins for 2010 and 2015 (taking into account capacity investments already planned).

Environment

The environmental indicators are based on the share of renewables in the energy mix, on the level of carbon emissions and on the policies adopted to reduce them.

18. In the assessment of security of supply, it is not only relevant how much energy is imported but also from where it is imported: the risks of disruption are different depending on the exporting country. Most imports come nowadays from outside the EU (only Denmark is a net energy exporter) and, over the next decades, import dependence will increase and oil and gas production will become increasingly concentrated in fewer and fewer countries. Also, Norway, one of the main EU suppliers, is likely to reduce its exporting capacity (see OECD/IEA, 2006, p. 186). As a result, it seems appropriate to use import dependence as a proxy of vulnerability to disruptions in the provision of energy.

- Share of renewables in the energy mix – measures both the available resources (wind, sun, hydro) and the policies in place to encourage the use of renewables. It is based on the share of hydropower, combustible renewables, wind, solar energy and other renewables in the energy mix.
- CO_2 emissions
  - Level of CO_2 emissions – measures the level of CO_2 emissions for each country as total kilograms of CO_2 emissions divided by GDP at PPP values in 2004.
  - Evolution of CO_2 emissions – refers to the change in greenhouse gas emissions with respect to GDP at PPP values, from 1995 to 2004.
- Kyoto targets
  - Policies with quantified targets for reducing greenhouse gas emissions by 2010 – takes into account whether policies are being adopted to meet Kyoto targets, whether Kyoto mechanisms are being put in place and whether carbon sinks are being reduced.
  - Projected outcome with respect to the Kyoto target – zero if the Kyoto target is unlikely to be met, six otherwise.

Table 3 (overleaf) provides the Energy Policy Index for each country and for each of the three policy objectives: competitiveness, security of supply and environmental sustainability. The situation differs widely across Member States.

Such heterogeneity of policy choices is indicative of national trade-offs, which are attributable to different exogenous factors, such as geographical location (for example, central European countries are better interconnected with other countries), availability of domestic energy sources, as well as preferences and public opinion (for example, preferences for renewables or attitudes to nuclear energy).

4.2 Cluster analysis

In order to ascertain if countries can be grouped in accordance with their policy objectives, we perform a cluster analysis. It is important to underscore that the groupings which come out of this analysis are purely indicative and, of course, subject to qualitative assessment of the data gathered from several sources (see Annex II). We simply take these data as they stand and perform an exploratory analysis.

On the basis of the EPI, and using cluster analysis, we can classify Member States into five groups. A graphical interpretation of these five groups is given in Figure 2[19].

Table 3: Energy Policy Index

Country		Competitiveness	Security of supply	Environment sustainability
Austria	AT	2.7	3.0	3.7
Belgium	BE	2.0	1.2	1.8
Cyprus	CY	0.5	0.0	2.0
Czech Republic	CZ	2.8	3.1	2.8
Germany	DE	1.9	2.5	3.0
Denmark	DK	3.6	4.0	3.4
Estonia	EE	1.2	3.2	3.3
Spain	ES	1.9	1.9	2.4
Finland	FI	1.5	2.0	4.8
France	FR	0.8	2.6	3.8
Greece	GR	0.8	2.5	2.8
Hungary	HU	2.9	2.1	3.2
Ireland	IE	1.1	0.8	2.4
Italy	IT	2.4	1.9	2.7
Lithuania	LT	3.5	2.4	4.1
Luxembourg	LU	3.9	3.0	2.5
Latvia	LV	2.6	1.5	5.3
Malta	MT	0.0	0.0	1.3
Netherlands	NL	2.6	2.7	3.2
Poland	PL	1.8	4.6	2.6
Portugal	PT	2.3	1.5	3.3
Sweden	SE	2.3	2.7	5.0
Slovenia	SI	4.1	1.9	3.9
Slovakia	SK	2.5	1.7	3.0
United Kingdom	UK	2.9	3.5	3.1

Source: Bruegel based on several sources (see Annex I). Note: the higher the value of a specific indicator (0 to 6) the better the performance in terms of the criteria defined in the EPI.

Group 1 includes Austria, the Czech Republic, Denmark, Luxembourg, the Netherlands and the UK, which rank relatively well in terms of competition and security of supply.

The UK has the most competitive domestic energy markets but it is poorly interconnected with the rest of Europe and, therefore, not exposed to external competition. A similar situation pertains in the Netherlands. Denmark is well interconnected with the

19. The indices for Ireland, Malta and Cyprus are incomplete and biased by their geographical location and size. They are therefore excluded from the analysis.

Nordic countries and Germany, and has well-functioning markets, although the government has favoured the expansion of the state-owned company DONG, present both in electricity and gas markets, which could pose a danger to the further development of the market. Austria, the Czech Republic and Luxembourg are very exposed to electricity trade with their neighbours.

Most of the countries in this group have their own energy resources, such as gas (Netherlands and UK), oil (Denmark and UK), lignite and coal (Czech Republic) and nuclear (Czech Republic). Therefore, at present, they are not highly dependent on external sources. This situation will certainly change in the future, since demand is increasing faster than production. Companies in Austria and Luxembourg have planned sufficient investments to cope with future increasing demand.

Group 2 is composed of countries ranking low on the competition criteria, but having relatively secure supplies. Estonia, France, Greece, Germany and Poland are in this category.

This group is characterised by a low degree of domestic competition and limited exposure to competition from other EU countries, due to insufficient levels of interconnection with other markets.

German energy markets are characterised by a complex web of vertically-integrated and horizontally-related companies. In addition, most electricity companies also control import and production of primary energy sources (for example Eon-Ruhrgas for gas and RWE and Vattenfall for lignite).

In France, the electricity sector is dominated by EDF and the gas market by GDF. Both companies are vertically integrated.

Poland's electricity market is still in its infancy. The government is planning a far-reaching restructuring of the industry, which currently remains under government ownership. The gas market is still very small and is not liberalised. Given that Russia is currently Poland's only gas supplier, the government is wary of increasing its dependence on imported gas and has expressed its intention not to reduce its control over the gas industry. Currently, Poland relies heavily on domestic coal and lignite for power production.

Both France and Germany have a significant share of local primary energy sources in their energy mix (nuclear for France, coal and gas for Germany) and their import dependence is slightly below the European average. Planned investments in generation are sufficient to meet demand in the medium term but more investment is needed in the long term.

Group 3 includes countries which do well on environmental objectives but have average levels of security of supply and competition. Finland, Latvia and Sweden fall into this group.

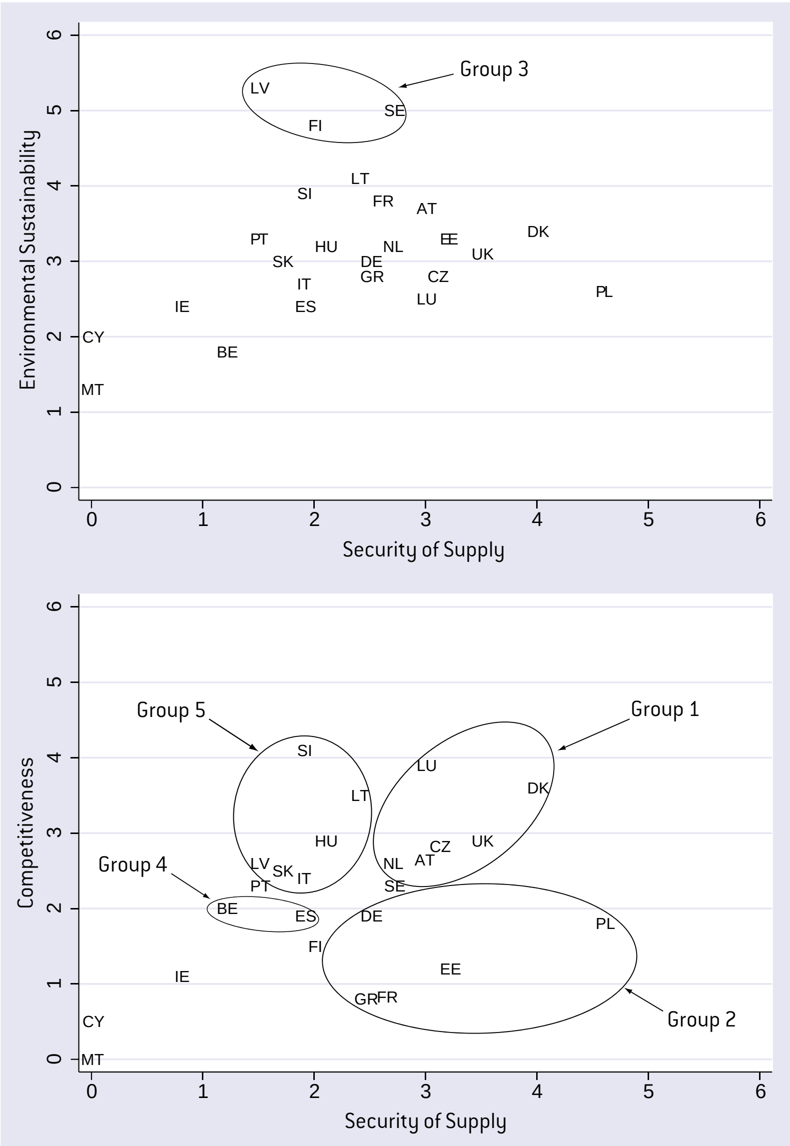
Renewable energy is a high priority for governments in Finland and Sweden. Finland, Latvia and Sweden have the largest share of renewables in their energy mix and the three of them have put in place the appropriate measures to meet Kyoto targets.

Group 4, which includes Belgium and Spain, does not rank well on any of the objectives.

Belgium and Spain perform slightly worse than the EU average on competitiveness and supply security. In the case of Belgium, domestic markets are still dominated by few companies. Spain is poorly interconnected with France, thus competitive pressure currently comes only from domestic competition. Both countries are highly dependent on foreign primary energy sources. In the case of Belgium there seems to be insufficient domestic investment in new generation capacity, though planned investment in interconnection capacity will compensate for a potential shortage of domestic generation capacity.

Finally, Group 5 is composed of countries such as Hungary, Italy, Lithuania, Portugal, Slovakia and Slovenia, which rank around the average against the three objectives.

Figure 2: the energy sector in Europe: cluster analysis



Source: Bruegel, based on several sources (see Annex I).
Note: the higher the value of a specific indicator (0 to 6) the better the performance in terms of the criteria, as defined in the EPI.

There are a number of different country groupings that can be identified from our cluster analysis. The clusters do not lend themselves to a simple geographical grouping (with the possible exception of Group 3, which could be labeled 'Nordic', although Denmark is not in this group). Group1 includes countries as diverse as Austria, the Czech Republic, Denmark, Luxembourg, the Netherlands and the UK.

The groupings appear to be largely determined by other exogenous factors that play a major role in energy policy, such as availability of natural resources and geography. National public preferences (such as attitudes towards nuclear power) vary. For example, it may be that a Nordic citizen derives sufficient benefit from an environmental objective to be willing to pay a higher price for energy. This evidence indicates that getting Member States to agree on an energy policy is likely to be a very complicated task.

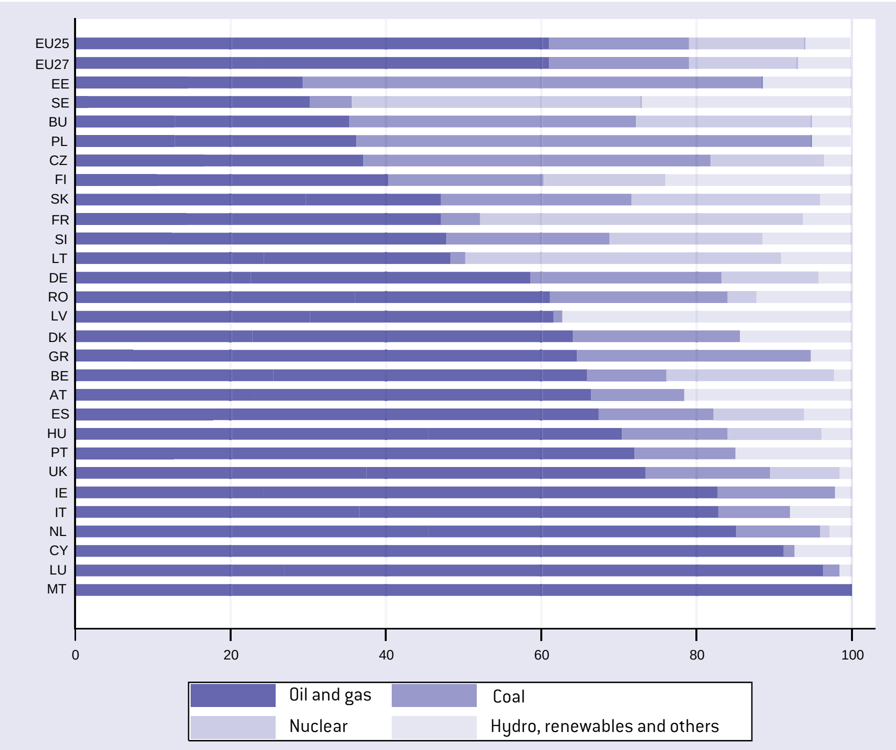
The analysis of this section suggests there is considerable heterogeneity in the achievement of the energy objectives identified by the European Commission. The EU's energy map is diverse. Countries face the energy challenge from different starting points, and with different needs and priorities. The potential costs of and benefits from a common energy policy are therefore not homogenously distributed across Europe. The adoption of some measures might imply higher costs for some countries than for others.

For example, small countries (say, central European countries and Baltic countries) find themselves in a weaker position when negotiating with foreign upstream suppliers, and might be more eager to face such negotiations under a European umbrella. On the other hand, large countries, or countries with relatively low foreign dependence (for example, France or Germany), might not derive significant benefits from giving a European dimension to their external policy. Countries with few domestic resources (for example, Austria, Greece, Latvia or Luxembourg) might see domestic competition as a danger to their security of supply. Finally, countries with a low share of renewables in their energy mix and limited sources of renewable energy (for example, the UK) might see renewables as an expensive option that might eventually endanger their security of supply.

In summary, the debate on a common European energy policy cannot simply ignore the current situation of each Member State, as well as the differing mix of costs and benefits of such a policy for each country. In fact, countries might find conflicts in pursuing all three objectives at the same time and, at least in the short term, may be confronted with a number of major trade-offs. Policies designed to increase efficiency, secure supply and protect the environment might not necessarily be complementary. Increasing the strength of one of them might require relaxing the pursuit of other objectives.

Finally, let us address the energy mix. Owing to a combination of factors discussed above, the energy mix is rather heterogeneous across the EU. As illustrated in Figure 3, there is considerable variety across Member States. The energy mix is not an objective in itself, but it crucially determines many of the national (as well as EU-wide) trade-offs.

Figure 3: Energy mix, total primary energy supply, 2004



Source: IEA, International Energy Agency.

The next section provides examples of policies where Member States face national trade-offs. The examples are intended to be illustrative of the type of trade-offs that may arise in pursuing all three objectives simultaneously.

5. Trade-offs: national choices

In this section we provide more detail and several examples of the trade-offs between policy objectives at Member State level. The list is not comprehensive but highlights that national trade-offs are a reality and cannot be ignored in formulating a common European policy. We note that environmental policies have a cost and that energy prices may rise, at least in the short term. Market mechanisms are the best way of distributing these costs.

5.1 The trade-off between competition and securing supply

As discussed above, security of supply has two dimensions: (1) operating reliability – setting the right incentives for operating the existing networks and investing in new infrastructure; and (2) resource adequacy – a political dimension related to securing access to primary energy.

As we stated above, efficient energy markets would contribute to both dimensions of supply security in an idealised first-best world, but may fail to secure supplies in a second-best world (one where market failures exist, see for example Box 1).

The operating reliability/competition trade-off

Competitive markets will only provide optimal incentives for private firms to operate the network, and to invest in new production capacity if market failures are absent and if market outcomes are not distorted by government intervention. Only properly regulated markets will provide the right incentives for the appropriate level of investment.

This line of argument is well documented and much debated (see for example Joskow, 2006). The fact that a trade-off between short-run competition and long-run investment might exist, and might affect supply security is not contested and not new. Focusing regulation on short-term competition might endanger the long-term sustainability of the industry. However, the appropriate level of regulatory intervention, as well as the 'right' kind of regulation is very much at the heart of the policy discussion.

Given the limited scope of this report, we do not provide further analysis of this issue.

The resource adequacy/competition trade-off

In an idealised world – with competitive supply markets and private firms competing for access to resources – a competitive European market would ensure supply security, by providing the right signals for investment in resource development and by allocating resources efficiently. However, as we have discussed above, when monopolistic markets in producing countries are coupled with political influence, supply security may be at risk.

Energy markets fit these facts at an increasing rate. Fossil fuel reserves are increasingly concentrated in fewer countries and the main producing companies are generally controlled by governments (see Table 2 and Figure 1). Moreover, energy supplies might also suffer from conflicts in, or with, transit countries[20]. Hence, it may not be assumed that functioning markets within the EU will suffice to ensure an optimal market outcome with respect to resource adequacy, or supply security in general.

A possible way to reduce political influence is to diversify the sources of supply and to reduce energy imports by switching into alternative energy sources or increasing energy efficiency. Clearly, these measures would reduce the scope for the exercise of political power as well as the extent to which energy can be used as a tool to achieve other policy objectives. However, the scope for reducing dependency from certain suppliers is limited. Especially, it would be hard to imagine that Europe could be completely independent from reliance on gas imports from Russia or on oil imports from the Middle East. Geographical proximity and the distribution of reserves limit the diversification possibilities.

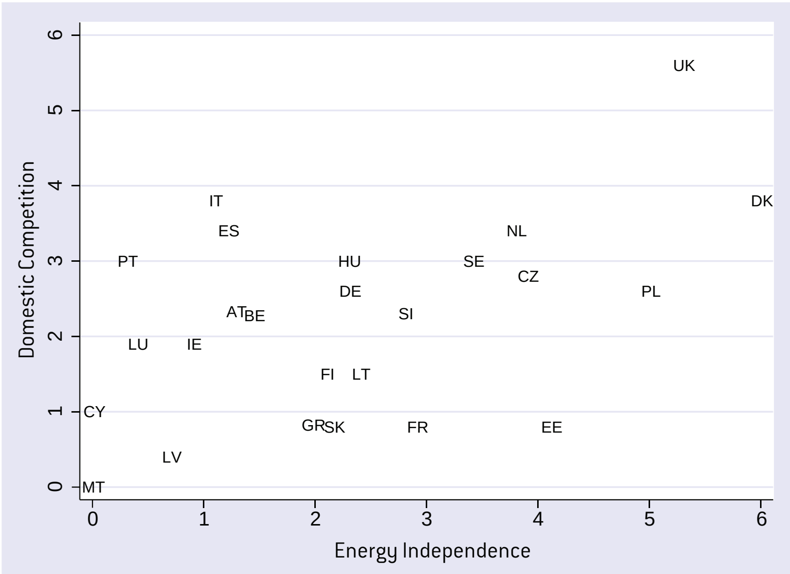
An alternative choice of action is the promotion of strong companies with market power – national champions – which could offset the political power upstream. This

20. The recent conflicts between Russia and Ukraine and Belarus are examples of conflicts between producing and transit countries which affected energy supply in Europe.

is conventional wisdom among many European policymakers and could explain, to a certain extent, the slow development of competition in some European markets.

Figure 4 shows the EPIs for energy import independence and domestic competition.

Figure 4: EPI: energy independence vs. domestic competition, EU25



Source: Bruegel (see Annex I).
Note: 0 means low degree of competition and low import independence, respectively.

Interestingly, countries with a higher degree of domestic competition, such as Denmark, the Netherlands and the UK, have a low dependence on foreign sources of supply. Most European countries are characterised by both a relatively high level of energy dependence and a high level of industry concentration.

One interpretation of this finding is that dependence on foreign energy resources seems to lead Member States to create or support national champions. To offset the market power of upstream energy-producing countries, and to secure their energy supply, governments are tempted to support the creation of large horizontal and/or vertically-integrated energy companies. These companies typically combine import, production and distribution assets under the same ownership, in order to increase overall financial muscle[21].

National champion policies are more effective for large countries than for small countries. The larger the market size, the higher the bargaining power of the national champion[22]. Small countries are likely to suffer from such a policy, since their potential national champions will not be large enough to outweigh the bargaining power of the upstream monopolist. Moreover, the existence of national champions in larger countries might limit their access to resources. On the other hand, a national champion from a large economy like France, Germany or Italy can hope to have significant negotiating power.

There are several recent examples throughout Europe (see Box 2) where governments have promoted the creation of large national champions, thereby reducing competition, arguing that such mergers and takeovers promote supply security and investment.

However, it is not certain that a 'champion' will in times of crisis allocate supplies – or give preferential treatment – to the country where it is deemed 'national'. If the national champion is private, it will allocate resources according to where profits are highest, wherever it is headquartered and whatever the nationality of its shareholders. In other words, a profit-oriented national champion would not behave differently than a profit-oriented foreign supplier. In fact, a domestic monopoly may supply even less (at higher prices) to the domestic market compared to a more competitive foreign supplier.

This implies that a national champion, provided that it is motivated purely by profit, is no more reliable from a supply security standpoint then any other privately-motivated firm. To achieve supply security beyond what the market would provide, it is necessary to have influence over the national champion. As a result, a national champions policy implies that governments also need to keep substantial economic interests in energy companies, for example through the holding of significant shares or through holding a 'golden share'. As shown in Table 4, many European states hold substantial financial interests in energy companies that have strong positions on their domestic markets. State ownership of large energy companies is widespread and consistent with a national champions policy.

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21. Another rationale for national champions is rent-shifting towards national economies. By increasing its buying power, the downstream monopolist can negotiate lower prices with the upstream monopolist. This would imply a shift of rents from the upstream monopolist to the downstream firms. Since downstream firms are under the jurisdiction of domestic authorities, their rents/prices can always be controlled through price regulation, if they are considered excessive. In any case, potential higher profits will remain in national economies rather than accruing to upstream (foreign) monopolists.
22. In fact, 'national champion'-type behaviour is not a new development and has a long history in Europe.

BOX 2: RECENT EXAMPLES OF NATIONAL CHAMPION POLICIES IN THE ENERGY SECTOR: MERGERS

E.ON/Ruhrgas (2003):
Ruhrgas was the largest gas company in Germany, owning substantial parts of the gas grid and supplying around 60 percent of gas demand. Ruhrgas was also the largest importer – owning stakes in most pipelines supplying gas to Germany from different producing countries – and held important gas storage facilities. E.ON was one of the main players in the electricity market, owning generation, transmission and distribution assets. The German government approved the merger of E.on and Ruhrgas despite the negative opinion of the competition authorities. The decision was based on the argument that the merger enhanced security of supply by increasing the financial strength of Ruhrgas, which would be in a better bargaining position *vis-à-vis* gas producing countries, especially Russia. These considerations outweighed, in the German government's view, any restraints on competition.

Endesa/Gas Natural (2006-2007):
The Spanish government approved – subject to a number of conditions – the proposed takeover of the leading electricity company Endesa by the leading gas provider Gas Natural, despite the negative opinion of the competition authorities. A counteroffer by the German energy company E.ON led the Spanish government to increase the power of the national regulator, which in turn imposed a number of conditions on the takeover. The European Commission considered such conditions to be contrary to EU law. The takeover is still unresolved but Gas Natural has now decided to discontinue the takeover.

Gaz de France/Suez (2006):
In France, the recent proposal by Gaz de France for a takeover of Suez was perceived as a reaction to Enel trying to acquire Suez. If successful, the French state will become the largest shareholder in the newly-created company. The European Commission has approved this proposed takeover on competition grounds.

Table 4: Participation of the state in European energy companies

Country	Company	State ownership %	Market share %
France	EDF	85	87
France	GDF	80	95
Italy	ENEL	32.2	39
Sweden	Vattenfall	100	47
Finland	Fortum	51.5	23
Denmark	Dong	100	33
Hungary	MVM	100	39
Estonia	Eesti Energia	100	92
Latvia	Latvenegro	100	93

Source: European Commission Sector Inquiry (EC, 2007b) and companies' websites.

There is a rationale for the emergence of national champions policy as a response to supply security concerns. However, as a result, other policy objectives may suffer:

- Less competition could lead to less innovation and reduced European competitiveness, due to higher prices;
- The existence of (quasi)monopolies increases the need for regulation, in order to offset the market power of domestic companies (for example for vertically-integrated companies);
- In protecting their national markets, national champions would have little incentive to provide access to their infrastructures to other suppliers, which might in turn hamper the creation of an internal market.

In summary, some Member States seem to support the emergence of large horizontal and/or vertically-integrated national energy companies in order to secure investment and access to primary resources at the expense of domestic competition. This trade-off does not affect all Member States equally and seems rather to be a primary concern for countries with relatively high import dependence.

5.2 The trade-off between supply security and environment

The links between environmental objectives and supply security[23] are strongly related to the energy mix. On the one hand, different energy sources exhibit significantly

23. We will only address the resource adequacy aspect of supply security here. An example of a trade-off between operating reliability and environmental policies would be the risk that some green technologies impose on the reliability of power networks. For example, the current management system of wind farms in Germany might create risk of blackouts in Belgium and France.

different CO2 intensities. On the other hand, the energy mix reflects the diversification of energy suppliers and sources and the level of import dependency.

From a supply security perspective Member States have primarily three options in terms of energy mix:

- diversify their energy mix away from single sources;
- increase the share of domestic energy sources; or
- substitute energy sources which are controlled by monopolistic and/or politically-driven suppliers (such as oil and gas) for more widely available resources (such as coal, nuclear and renewables).

The trade-off between an optimal energy mix from a supply security perspective and an optimal energy mix that preserves environmental objectives, depends crucially on the energy endowment of individual Member States, as well as on attitudes to nuclear energy (provided that environmental objectives are solely defined in terms of CO2 emissions)[24]. For example, those Member States where the use of nuclear energy is widely accepted may reduce import dependence and CO2 emissions by relying on nuclear energy (for example, France and Finland). Other countries, in particular those with significant national coal reserves (such as Germany and Poland), might resort to coal as a way to reduce their import dependence, thereby facing a trade-off between security of supply and the reduction of CO2 emissions.

This trade-off is illustrated by Figure 5, which plots, for each Member State, the proposed CO2 allowances allocated to a standard existing coal-fired power plant[25] in the framework of the CO2 Emissions Trading Scheme (ETS)[26] against the share of coal in the power generation mix.

The figure shows that the same coal-fired power plant receives substantially different CO2 allowances depending on where it is located. Member States with a relatively large share of coal in their power generation mix (for example, Poland, Czech Republic and Germany) are reluctant to set incentives for moving away from this energy source and provide generous allowances to existing coal-fired power plants.

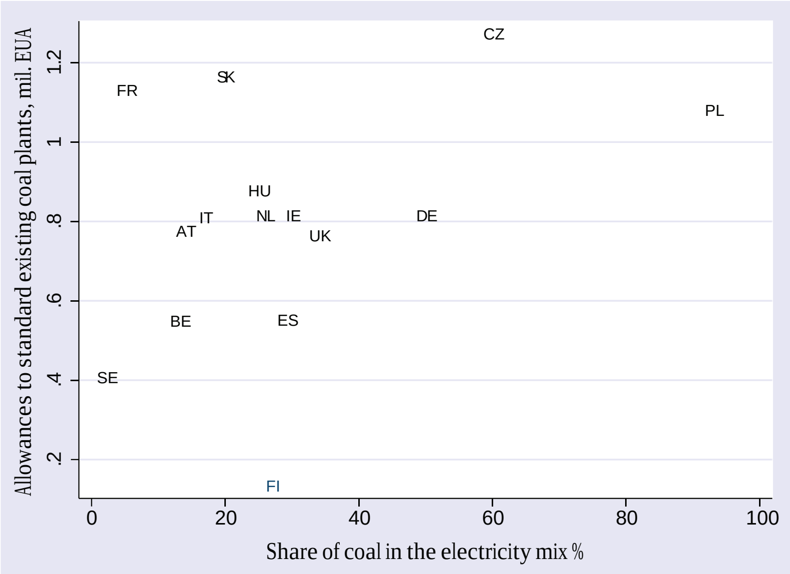
24. If, for example, radioactive waste is perceived as detrimental to environmental sustainability, the use of nuclear energy would itself imply a trade-off between security of supply and environmental sustainability.

25. A standard power plant refers to a power station of 200MW, assuming that it operates on average for 6,000 hours/year. See Neuhoff et al (2006) for more details.

26. The proposed National Allocation Plans for CO2 for 2008-2012 are currently being evaluated by the European Commission.

Although in some cases there might be employment considerations to support the demand for coal , there are also security-of-supply concerns behind this policy. Box 3 discusses this issue in more detail.

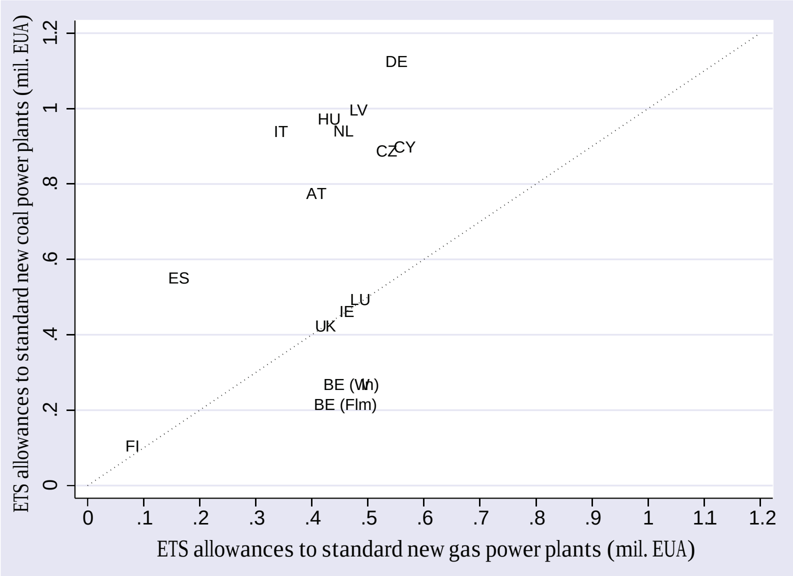
Figure 5: CO_2 allowances to coal-fired power plants



Source: International Energy Agency, Neuhoff et al. (2006)
Note: 'Standard power plants' is defined as power stations of 200MW, assuming that they operate on average for 6,000 hours/year.

Different approaches towards carbon-intensive technologies surface not only from support for existing fossil fuel power generation plants, but also from the allocation of allowances to new plants. Figure 6 shows the allowances granted to new gas-fired and coal-fired power plants.

Figure 6: CO2 allowances to new gas- and coal-fired power plants in ETS, 2008-2012



Source: International Energy Agency, Neuhoff et al. (2006)
Note: 'Standard power plants' refer to power stations of 200MW, assuming that they operate on average for 6,000 hours/year. Countries on the upward sloping line grant the same number of ETS allowances to coal and gas power plants.

Two main patterns emerge. First, some countries grant a larger number of allowances to fossil fuel generators than others, thereby discouraging investment in less carbon-intensive technologies (for example in the Czech Republic, Germany, Hungary and the Netherlands). Second, some countries favour investment in coal-fired generation plants vis-à-vis gas-fired generation plants (for example, Germany, Hungary, Italy, the Netherlands and Spain provide relatively more incentives to investment in coal-fired generation than to new investments in gas-fired generation)[27].

This evidence is indicative of certain objectives being given priority over environmental aims: environmental objectives are traded-off for more security of supply[28].

27. See Neuhoff et al (2006) for further details.
28. In addition, some countries have adopted other policies that encourage investment in coal-fired generation plants. For example, Germany has proposed to grant free CO2 allowances to all new power plants for 14 years no matter what technology they use. This means that, in the next decades, a significant amount of coal-fired capacity using carbon-intensive technologies will still be active, casting some doubt on the ability to comply with Kyoto targets. Some countries still keep special programmes to promote the use of national coal for social or employment reasons (for example Germany, Poland, Spain). The importance of such programmes is, however, declining.

BOX 3: RETURN OF COAL - A DIRTY APPROACH TO SECURITY OF SUPPLY

Coal consumption in Europe has been decreasing since 1990 (coal consumption decreased 32 percent from 1990 to 2003). Coal has been progressively replaced by gas in the electricity generation mix. Most new power plants constructed in the last few years have been gas-fired generation units[29]. Nevertheless, Germany, Greece and most eastern European countries still rely heavily on coal and lignite.

However, the increasing demand for energy, the increasing price and increasing price volatility of oil and gas and the decision by some countries to phase out their nuclear programmes have made many countries revert to coal as a realistic alternative to guarantee their energy supplies. Moreover coal, which is abundant within the EU and relatively cheap (even adding the extra CO2 cost), is seen as a good option to reduce energy import dependence from politically unstable countries. The current price of CO2 does not act as sufficient incentive to switch to cleaner technologies.

Many companies (in the Czech Republic, France, Germany, Italy, Poland, Slovakia and Spain)[30] have plans to invest in new coal-fired power generation plants, replacing and increasing the capacity of old ones. For example, in Germany new coal-fired projects represent nearly two thirds of total forecast new capacity[31].

In some countries such as Germany and Spain coal constitutes a reliable replacement for nuclear energy (since other alternatives are either not cost effective or able to meet baseload demand). In other countries with limited options for diversifying their sources of supply, such as Poland, coal is perceived as a means of not increasing their dependence on Russian gas[32].

In the absence of cheap and reliable technologies to capture CO2 emissions, this move is incompatible with the aim of environmental policy, namely the objective of switching to cleaner less carbon-intensive technologies. Member States seem to be relaxing their environmental policies in order to promote new investment in existing technologies and to increase future security of supply, at the expense of not reducing their CO2 emissions.

29. Gas-fired generation capacity constituted sixty percent of the new generation capacity between 1990 and 2004 (Source: IEA).

30. "German Generators Turn to Coal as Gas Prices Soar" (Reuters, February 6, 2006), website http://today.reuters.com

In summary, there are strong trade-offs between environmental objectives and supply security. Again, and perhaps more than in any other area, the severity of this trade-off differs greatly across Member States.

5.3 The trade-off between competition and environment

The internalisation of externalities implies an increase in prices in a static sense, and induces a fundamental tension between short-term consumer interest (lower prices) and long-term consumer interest (living in a sustainable environment). In fact, despite the significant price increases over the last years for non-renewable resources, renewable resources cannot yet compete in economic terms with traditional sources of energy. The investment needed to produce a unit of energy using clean technologies (for example solar, wind, biomass) is much higher than the required investment in conventional technologies for a comparable energy output[33].

Accordingly, most Member States have put in place mechanisms to support new investments in renewable sources of energy. This is organised mostly through green certificates (where generators obtain the market price for electricity plus the market price for the green certificate, which is marketable in organised markets) and feed-in tariffs (which are fixed out-of-market prices or fixed mark-ups over the market prices). In addition, the CO2 ETS is a market-based mechanism directed at reducing CO2 emissions and at providing incentives to use less carbon-intensive sources of energy. It is, however, naïve to believe that such mechanisms will not affect the final price of energy (or the tax-payer burden if feed-in prices are paid through public budgets). This potential price increase could even be desirable in order to promote investment in carbon-efficient technologies.

Environmental policies impose an economic cost in the short run though they may well bear fruit in the longer term. Thus, environmental policies might imply higher prices today. As a result the environment/competitive markets (low prices) trade-off is fundamentally an intertemporal trade off. Limiting the extent to which environmental

31. http://www.euractiv.com/en/energy/co2-quota-plan-shows-germany-craving-coal/article-156642

32. In Finland and Poland, gas plays a limited role in the energy mix. Increasing the use of gas is perceived as an increase in the vulnerability of their energy supplies. In order to keep their energy independence, these two countries have adopted different approaches. Poland has persisted with coal and lignite, which still constitutes an extraordinary share of its energy mix, while Finland has decided to follow the nuclear path building the first nuclear power plant in Europe since the 1980s.

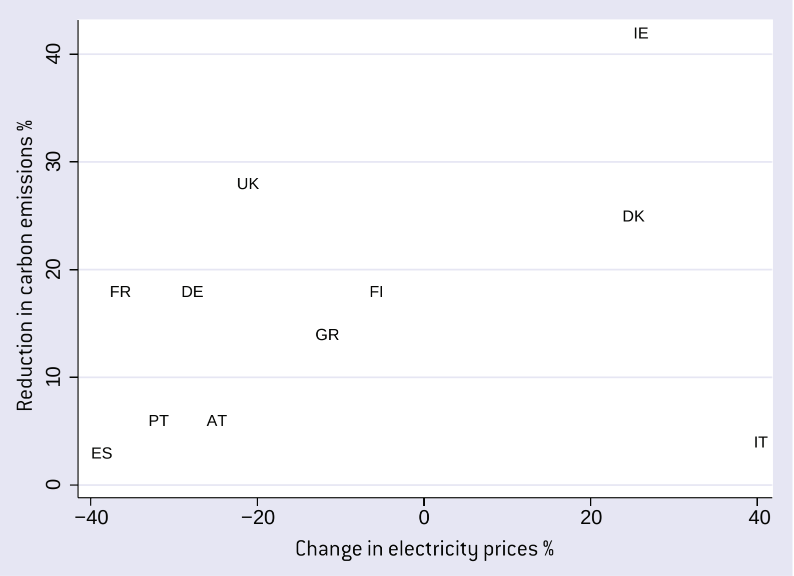
33. However, significant cost reductions are anticipated for many technologies, including relatively conventional ones, and especially in some of the frontier technologies of today, such as offshore wind, hydrogen fuel cells and Generation 4 nuclear plants (see EC, 2006)

costs can be passed on in final prices might lessen the effectiveness of environmental policies in the future.

The CO2 ETS is an example where environmental objectives are achieved through a market-based mechanism. Despite the potential to achieve long-run efficiency, the ETS is still subject to an intertemporal tradeoff: energy prices will tend to go up in the short run (see also Box 4).

Through a simple illustration Figure 7 shows that, in general, those countries that have been more successful in reducing their CO2 intensity in the last decade have also registered the largest increases in electricity prices. There is obviously no clear causality between both variables but one of the reasons might be that reducing CO2 emissions comes at a price, as it narrows policy options in other fields (such as competition policies or the choice of a more cost-efficient energy mix).

Figure 7: Changes in industrial electricity prices and carbon intensity (CO2 emissions over GDP), 1995-2004



Sources: Eurostat, EEA (2006).

In addition to the intertemporal trade-off just discussed (dynamic trade- off), there is also an important static trade off in this policy arena that needs to be addressed.

When the ETS affects certain firms more than others, either in the same segment or downstream, distortions of competition emerge. For example, if the allocation of allowances varies across Member States, or European firms are competing with non-European firms that are not subject to an ETS standard, then environmental objectives would still be served, but competition would be distorted[34]. In such a situation, a trade-off between environmental objectives and competition would appear.

In summary, environmental policies have a cost and, as a result, energy prices might increase in the short term. This should not be interpreted as a failure of markets but, on the contrary, as a necessary step to achieve long-term goals (a cleaner environment). Market mechanisms such as the ETS are the most efficient way of distributing such costs. However, for them to work properly, it is necessary that the allocation of rights is sufficiently harmonised. Otherwise, the environmental costs will be asymmetrically distributed across countries, with unequal effects on competing firms located in different countries.

BOX 4: ETS - THE PRICE OF CLEAN ENERGY

The ETS is a market-based mechanism designed to reduce CO2 emissions at the minimum cost and with the minimum level of distortions. The ETS is based on the 'polluter-pays' principle: each polluting agent is assigned a number of CO2 allowances which they can offset against their own production or sell. If they want to produce more than allocated, they need to buy more allowances on the market.

Independently of the allocation mechanism (auctioning or grandfathering – giving allowances for free), polluters (and especially power companies) seem to be passing on the cost of the allowances to the final consumer. The logic is simple: an emission permit holder has two options, either to sell it or to keep it. If the holder decides to keep the allowance, it will incur opportunity costs which will be reflected in the final price. The more inelastic the final demand, the higher the share of the cost that can be passed on to final consumers. Therefore, independently of the allocation mechanism, the (real or opportunity) cost will be partially passed on to final consumers. The only difference between auctioning and grandfathering relates to who gets the rents: the state or the companies.

Continued on page 37.

34. Concerns about distortions of competition are very much at the centre of the debate when Member States decide on their national allocation plans, as well as on the mechanism to distribute them (such as how many to allocate and how to distribute them).

BOX 4: *CONTINUED*

The increase in final prices as a result of the ETS helps achieve environmental objectives. It acts as an incentive to invest in cleaner technologies. On the other hand, governments fear that being too strict in their environmental regulation can affect the competitiveness of their national industry, in particular if other trading partners do not apply equally such strict rules. Given this trade-off, governments have reacted differently, adopted two main types of policy.

Governments are tempted to reduce the environmental burden on national companies by oversupplying CO2 allowances[35]. This is what seems to have happened in the EU, where the price of CO2 is now below €1 after having reached a peak of €30, in April 2006. The price has continued to decrease to the point that the effect of the ETS as a carbon deterrent is now negligible. At current prices, in most countries, it is cheaper to produce power by using coal than by using cleaner gas.

In some countries (for example Germany), governments and regulators have expressed their concern about passing on CO2 costs to final prices, especially in the energy sector. The German competition authority is investigating whether this could be an infringement of competition law. Capping energy prices would imply a market intervention that would distort the incentives which the ETS is designed to create in the first place.

This section has identified some trade-offs between the three objectives of energy policy[36]:

- Countries might be tempted to promote the emergence of large integrated energy national champions and relax competition in order to guarantee sufficient investment and secure access to primary energy resources. That is, the objective of security of supply is prioritised over competitive markets.

- In order to guarantee security of supply, countries might be tempted to promote conventional energy sources and to relax environmental policy. Allocating generous CO2 allowances to conventional energy sources is a way of pursuing this objective. That is, countries sacrifice their environmental goals in favour of reliable energy supplies.

35. In May 2006 the European Commission reported that some countries had emitted less carbon dioxide than expected, which implied that there was an oversupply of emission allowances in the market.
36. The list is, however, not comprehensive and depends crucially on the definition of the objectives.

- Finally, environmental policy has a cost that is likely to be translated into higher energy prices, which might in turn affect the competitiveness of national industry. Member States are therefore tempted to relax their environmental policies (or to limit the extent to which environmental costs are priced into energy) in order not to place their domestic firms at a competitive disadvantage. That is, environmental sustainability might be relaxed in order not to affect industrial competitiveness.

Can a European approach resolve, or at least relax, some of these trade-offs? Obviously most of these trade-offs will continue to exist at European level, for example, the conflict between short-run prices and long-run investments. A common approach to energy policy is not the panacea to all the national conflicts. However, the 'European dimension', by increasing the range of alternative solutions, can relax and reduce the costs of the different trade-offs.

The next section analyses how, and to what extent, European policies can reconcile the three objectives of energy policy.

6. Common policy: relaxing national trade-offs

In this section we investigate how a European approach can relax national trade-offs. As discussed earlier, national trade-offs are resolved differently by Member States, as they face different exogenous factors (such as geography and natural resources) and have different preferences (such as towards nuclear energy or renewables). Europe's advantage is that it is capable of relaxing the national trade-offs by enlarging the range of alternative solutions. In other words, more of everything is possible, *potentially* leading to an improvement for all the players.

What are the advantages of a European approach in terms of relaxing national trade-offs? Fundamentally, there are three ways in which the European dimension can help.

- Size/scale – the size of Europe increases its strength in both political ('speaking with one voice') and economic markets. This will help relax the supply security/competition trade-off.
- Heterogeneity/comparative advantages – Europe's heterogeneity can be exploited in order to benefit from comparative advantages that will in turn help relax the trade-off between all three objectives.
- Coordination – European countries can coordinate their policies, thereby relaxing national trade-offs.

How do the above factors help to relax trade-offs?

The competition/security of supply trade-off

Whereas the conflict between short-run competition and long-run operating reliability remains at European level, consistent and adequate market regulation across Europe can contribute to reducing regulatory uncertainty and to providing the appropriate environment for long-term investment.

By increasing the size of the market, Europe allows European companies to grow without compromising competition. Equally, a well-interconnected internal European market allows for diversification of sources of supply, thus reducing the power of upstream monopolists.

The security of supply/environmental sustainability trade-off
Certainly, the extent to which renewables will be a reliable alternative to conventional sources of energy, and will guarantee supply security, will not be changed by a European approach. However, Europe can provide flexibility as to how these objectives are achieved. Setting environmental objectives at European level with flexible implementation instruments can help to achieve environmental goals without risking supply security. At a European level, countries could exploit their comparative advantages and would not have to rely exclusively on their domestic investments and resources to pursue both security of supply and environmental sustainability at the same time.

The environmental sustainability/competition trade-off
A European approach to the financing of renewables, and to a more consistent allocation of CO2 allowances, would reduce the current distortions (caused by the heterogeneous mechanisms in place) and would improve the proper distribution of environmental costs across Europe. However, the fact that environmental burdens could place EU firms at a competitive disadvantage with respect to firms located outside Europe would still be a problem and would require a more active role on the part of the EU in extending a consistent approach to environmental policies beyond its borders.

In the remainder of this section we identify five policy instruments where a European approach would help relax national trade-offs and would bring significant benefits to the energy sector in Europe. We also discuss the implications of the trade-offs for policy.

6.1 European energy markets – economies of size/scale

As we discussed above, some Member States create or protect national champions in order to increase market power in the hope of ensuring supply security[37]. As a result there are significant national trade-offs between supply security and competition, so that a national champions policy comes at a very high cost (the trade-off at the national level is 'steep'). Even though the same trade-offs still exist at the European level, they are much less restrictive.

37. We will again concentrate on the resource adequacy aspect of supply security here.

A European market implies increasing the size of the market, which provides companies with the necessary size to increase their bargaining power in upstream markets while maintaining a sufficiently high level of competition.

In order to create a true European energy market, a number of ingredients are necessary:

- Access to existing network infrastructure is essential for the liquidity and proper operation of markets. An internal market for energy is not feasible if market players do not have access to transport and distribution networks. The alternative ways of granting effective access to networks (the alternative degrees of vertical separation) should be carefully analysed and compared on the basis of rigorous impact analysis.

- The creation of an integrated market requires large investments in transnational interconnections and the design of an appropriate network architecture that allows for trade (for example, creation of hubs for the trading of gas). The current network architecture is not designed for trade but for the delivery of gas from end to end. The roles of a pan-European regulator and of a European system operator are crucial in this field.

- Investment in LNG terminals is key to the development of gas markets. The development of LNG will multiply the entry points into the EU for gas and will increase the sources of gas supply to Europe[38], creating greater market liquidity. Expanding EU gas networks and cross-border interconnections will mean that wider markets can be reached from each entry point, thus providing incentives to invest in LNG terminals.

A national champions policy can therefore be trumped by a large European internal market[39]. However, given the national trade-offs and the rather different starting positions, the costs and the benefits of a European market are not equal in all Member States.

As in other policy areas, national trade-offs make it more difficult to agree on a

38. Currently, gas imports from Russia account for almost two thirds of the European imports from outside Europe. By 2030, the IEA estimates that this share will be reduced to one third (see OECD/IEA, 2006, p. 119).
39. To the extent that national champions are based on the objective of 'rent shifting', it is also unclear that this objective will be accomplished. Given the heterogeneity in the nationality of shareholders and the increasing internationalisation of firms, it is not obvious that higher profits in a domestic market will be reinvested at home (see Veron, 2006). In addition, upstream monopolists are increasingly getting more involved in downstream markets (for example, Gazprom's attempt to acquire Centrica or the exchange of shares between Gazprom and E.on). Therefore, some of the downstream rents would still be captured by the upstream monopolist.

European approach that does not take national differences into account. However, unlike other policy areas, the internal market and the competition policy rules have been agreed upon by Member States as part of the Treaty of Rome. New Member States also accept these rules upon accession to the EU. As a result, there is a set of rules already in operation which clearly holds benefits for Europe as a whole and which has been agreed upon by all governments.

Given that competition policy rules in Europe have already been established, they should be fully enforced, as their beneficial effects are well-proven. There is also no need to apply special rules to energy markets, beyond the usual case-by-case empirical approach conducted in competition policy investigations. We are not aware of any theory of harm that cannot properly be sanctioned under current competition policy rules.

Finally, if political framing at the EU level is done (see section 6.3) there is no need to compromise any of the competition rules.

Proposal 1: Single market policies and competition rules provide a readily available framework for an EU-wide energy market. They do not need to be changed in response to the energy challenge. On the contrary, they should be fully enforced at the European level in order to avoid suboptimal national solutions triggered by national trade-offs.

6.2 Pan-European architecture of energy regulators: increased coordination

One obvious area where Europe helps to improve the incentives for adequate investment and efficient use of existing infrastructure is through an effective and efficient regulatory framework. In this context the question of an EU-wide regulator is proposed by the Commission Communication. Specifically, the issue arises as to what extent a network of national regulators is a useful governance structure or whether a new single European regulator at EU level is needed.

The experience in other fields (see Box 5) shows that a strong pan-European architecture of energy regulators with the involvement of the Commission is a powerful tool to guarantee the consistency of energy policy across Europe. Besides the principles of best-placed agency and the ability to refer cases, it seems vital that the EU-wide body can take binding decisions and act as a last resort in cases with an EU dimension.

In order to be fully effective, such a network of regulators should have real power to implement binding decisions on Member States and market players, at least on those aspects that have EU relevance. Given the heterogeneity of the energy sector across Europe, it seems more appropriate to set up a network of energy regulators rather than an independent European body.

The role of the pan-European architecture of energy regulators should recognise the EU dimension when it comes to:

- coordination of transnational interconnection;
- common technical standards to facilitate transnational trade; and
- coordination of network design to optimise European goals and not purely national goals.

Finally, further coordination between transmission system operators is also necessary to guarantee the smooth operation and liquidity of markets. A Europe-wide energy market cannot possibly work properly if rules governing markets and access to networks differ substantially across Europe.

Proposal 2: A pan-European network of energy regulators should be created. Regulators must cooperate closely and the system must involve a strong EU agency to act as a regulator of last resort.

6.3 Political Framing – 'speaking with one voice'

As mentioned above, natural resources are increasingly concentrated in certain regions outside the EU and are more and more controlled by political stakeholders, not economic ones. In such circumstances, market power can be used to leverage political influence. The concern for such abuse of market power through leveraging is indeed highest when a dominant position is controlled by politicians. The conditions for leveraging market power into 'political markets' are very relevant in the field of energy, as the recent Russian-Belarus gas negotiations have shown.

The risk of political leveraging is one more reason to design an external European energy policy in order to increase Europe's role in countervailing this phenomenon. Moreover, it is important to arrive at a policy that will allow Europe to 'speak with one voice'. But what does speaking with one voice mean in this context?

BOX 5: A NETWORK OF REGULATORS: THE EXAMPLE OF COMPETITION AUTHORITIES

One approach, which is in place and working well, is the European Competition Network (ECN). This was created in 2004 and has since been operating very successfully. One of the main principles is that case allocation within the EU is done according to the 'best-placed agency' principle. This ensures that decisions with purely local implications are taken at the local level.

To the extent that cross-border issues are a concern (where there is an 'effect on trade') EU law applies, and jurisdiction is given to the European Commission. In addition, there is a referral system by which cases can be allocated, on request, either from the Member State to the Commission or vice versa.

Besides the legal implications, the ECN has provided a forum for discussion on a number of important competition issues, such as how markets evolve and how competition policy affects consumers across Europe. This is important for citizens' understanding of the purpose of Europe. In the field of competition, the ECN has contributed towards a culture which is part of Europe's comparative advantage. This competition culture is very much needed in order for policy to converge and to ensure that the benefits of European policies are shared. With enlargement, Europe and its values are now shared by more and more countries.

Moreover, the success of the ECN crucially hinges on the fact that the EU institution in charge of competition policy, the Directorate-General for Competition, is equipped with considerable powers. As already mentioned, if trade between Member States is affected, it is the Commission that has ultimate jurisdiction. It may decide to allocate the case to a Member State, but it is the Commission that is the reference of last resort.

Speaking with one voice certainly cannot mean that one European political leader should negotiate energy contracts. After all, it should not be a government – national or EU – that makes private business decisions about where to buy what resources at what price. Nor does it mean that markets should be monopolised. We propose instead that speaking with one voice should be achieved by a policy of 'political framing' and that this is an appropriate role for EU policy.

In particular, two aspects seem important. First, political framing is a means of obtaining non-discriminatory access for EU firms to resources and trading partners in those third countries where scarce energy resources are located. However, given that the trade-offs are so different at Member States level, this will not be easy to achieve. The benefits of political framing will affect Members States differently. As a result, speaking with one voice cannot be accomplished if it is a requirement that all Member States are equally represented in the European voice. As with trade policy, a European external energy policy needs to take into account that not all Memberr States are equal.

Second, political framing is a means of providing a framework for European business to trade. It is directed at countervailing political power and intervenes in the political market only, not in economic markets. If political support in the form of framing is provided to European businesses, the case for excessive (private) market power to countervail political power is weakened. As a result, the existing competition policy rules can be allowed to do their job properly. As stated by European Competition Commissioner Neelie Kroes in a recent speech, 'Supply security should not translate into incumbency security'.

Proposal 3: Significant political framing is necessary in order to reduce the interference of political markets in economic markets. The EU should speak with one voice and provide an umbrella of external supply security for all Member States. The weight of individual Member States in conducting this policy must necessarily differ.

6.4 The choice of energy mix: comparative advantages

As already discussed, the energy mix is a reflection of the trade-off between all three objectives. For example, oil and gas are subject to price volatility and political leveraging, coal is relatively cheap but dirty, nuclear energy is reliable and does not produce CO2 but requires large sunk investments, renewables have a lower capacity factor and are less reliable as a constant source of energy supply.

Deciding on the incentives for the energy mix (for example, for renewables) at the European level is an obvious way to exploit national comparative advantages and thus beat national trade-offs. Given the enormous heterogeneity across Member States in terms of natural resources, location and past investments, this is obviously a case where both supply security and environmental objectives would potentially benefit from an EU-wide approach.

We have seen that a trade-off exists between environmental objectives and competition when the allocation of ETS allowances varies across Member States, or when European firms are competing with non-European firms not subject to an ETS standard. The obvious solution to this problem is to harmonise the trading system at European (if not at world) level. Note that where there are no asymmetries, the national trade-off would disappear at the European level.

The previous discussion suggests that the benefits of Europe (stemming from heterogeneity) can be flexibly shared by a market-based system, provided that it is harmonised.

Take now the European environmental objectives agreed by the EU Energy Council in its conclusions of 15 February 2007. They specify 'a target of a 20 percent share of renewable energies in overall EU energy consumption by 2020', as well as 'a 10 percent binding target to be achieved by all Member States for the share of biofuels in overall EU transport and diesel consumption by 2020.'

The previous analysis suggests that strict national quotas are not a good idea, because this approach fails to exploit the potential benefits of comparative advantage within the EU. In contrast, a harmonised system at EU level that is based on tradable certificates (such as green certificates) could more effectively exploit Member States' comparative advantages and will relax national trade-offs. As a result, it will also tend to be politically more acceptable.

This is clearly a case where the fruit of European cooperation is potentially very sweet. The design of appropriately flexible mechanisms which allow achievement of EU-level environmental goals at minimum cost becomes essential both for ensuring that such objectives are realistic, and for gaining political support for them.

Proposal 4: Instead of symmetric national quotas, which are economically inefficient and difficult to implement, environmental targets should be set at EU level, and burdens shared according to national circumstances. Incentives to comply with the targets should be market based. A system of tradeable green certificates would be an appropriate and economically efficient mechanism to ensure that national policies are aligned with the common objective.

6.5. New technologies

The development of new technologies is essential to relax practically all trade-offs. Research into alternative sources of energy and more efficient use of existing ones may reduce energy dependence, increase security of supply and reduce carbon emissions. Equally, cheaper renewable technologies and less costly carbon sequestration technologies would reconcile competitiveness, security of supply and environmental sustainability.

Investment in R&D is therefore crucial for the achievement of all three objectives. A recent report by the Commission[40] suggests that while Europe as a whole dedicates more public resources to non-nuclear energy research than the US and Japan, research in Europe seems to be very wide in scope and fragmented, delivering fewer results in return. Research projects are basically national in scope and are not able to achieve the appropriate scale to develop demonstration projects[41].

The report also highlights that the structure of research is substantially different in Europe and the US. Whereas the US concentrates largely on hydrogen, fuel cells and energy-efficient technologies (75 percent), Europe spends almost half of its budget on renewable energy research (Japan about 35 percent).

Although it is important to maintain a certain degree of flexibility, so that national and regional research can focus on the development of domestic energy sources, it is also important that research is coordinated at EU level, allowing similar projects to feed off each other and avoiding duplication of research. Also, EU coordination could provide projects with sufficient scale to go beyond the experimental phase. Finally, a European approach to R&D in energy technologies would permit diversification of the costs of risky innovation, which would not otherwise be pursued by individual Member States.

Proposal 5: Research should focus on development of the most promising domestic energy sources but should also be coordinated at EU level in order to exploit synergies and combine efforts in similar projects.

40. See EC (2007d).
41. The report mentions the case of CO2 capture and sequestration 'where efforts carried out by three major Member States and Norway are each superior or at least at the level of the ones carried out at EC level, while each of them is still not sufficient to engage in demonstration projects such as the Futuregen project supported by the US Department of Energy with a budget of 1 billion dollars.'

7. Getting to the goal: Sweet, but not low-hanging fruit

In this section we examine how a common energy policy might be implemented in practice. While it is precisely the heterogeneity of Member States' starting points that promises the fruit of substantial benefits at the European level (coordination, size and comparative advantage), it is this same asymmetry which will make a common policy difficult to implement. In other words, the fruit of a common European energy policy is very sweet, but not low hanging.

How might a common European energy policy be achieved in practice? In particular, given that Member States have such heterogeneous positions, how can one make it incentive compatible for all to agree to a common energy policy? The different trade-offs at Member State level imply that the relative costs and benefits of moving from today's situation (position 'A') to a common market and a common energy policy tomorrow (position 'B') vary substantially between Member States. Since the Commission's Communication does not identify any trade-offs, it cannot form the basis for a proper assessment of this central question.

We mentioned earlier how national trade-offs affect policy in particular areas, and we proposed five policy instruments which could help to relax these trade-offs. In this section, we mention five practical considerations which will determine whether a transition from 'A' to 'B' is possible in reality.

First, as mentioned above in the context of environmental objectives, European policies can only beat national trade-offs if they are, on the one hand, flexible (market-based) but, on the other hand, harmonised. Flexibility would allow all Member States to benefit, while harmonisation would guard against abuse (such as distorting competition).

Second, Europe is likely to face a significant hold-up problem. This is a result of its extreme heterogeneities, as well as of the recent enlargement. An example of this is the recent Polish veto of a new EU-Russia energy partnership agreement. Agreement was not reached because a single Member State blocked it. A solution to the hold-up problem is to strengthen Europe-wide commitments (or solidarity). For example, in the event of a crisis or shortages, guarantees between Member States could be given. Such contracts – properly designed – could eliminate the hold-up problem. A potential alternative is side payments between Member States. However, these are often difficult to implement in practice and it is hard to imagine how this option could be politically feasible.

A third element is to focus negotiation, as much as possible, on energy objectives and not on other policy objectives (such as food). One reason already mentioned is that multi-objective talks increase the potential for hold-up problems. Recall that the recent Polish veto was apparently motivated by the Russian ban on Polish food imports[42]. Given how multidimensional energy markets are, it is important to separate energy objectives from other objectives, such that hold-ups do not occur.

A fourth element is the need to provide more evidence of the impact of policies at Member State level[43]. In other words, a careful cost-benefit analysis at the Member State level, taking trade-offs into account, is needed. This analysis would not only shed light on the relative trade-offs that would need to be overcome, but would also generate more political support for a common policy by providing an empirical basis to demonstrate how sweet the fruit is. Also, by showing how suboptimal today's energy markets are, and how this situation could get worse, again more support for common policy would emerge.

Finally, as we have discussed above, the benefits of a common European energy market are largely related to size: economies of size/scale in economic and political markets, as well as coordination. This implies that the relative position of countries like France and Germany is very different from that of smaller Member States.

All this means that countries like France and Germany have a special responsibility in the process of moving Europe forward. If a European approach is not successful, there is a danger that national policies will prevail. For example, by failing to provide

42. The fact that Poland does not rely heavily on energy imports from Russia undoubtedly contributes to this hold-up problem.
43. An impact assessment would need to compare point A to point B, taking note of the relevant counterfactual.

an umbrella of external supply security for all EU countries, fragmentation of the European internal energy market will become likely. This could have long-lasting negative effects on the global competitiveness of European industry and could increase the cost of environmental adjustment. In other words, all three objectives identified by the Commission are at stake.

8. Conclusions

In summary, there are significant trade-offs between the three objectives of energy policy: competitiveness, sustainability and security of supply. Identifying such trade-offs is necessary in order to understand the relative positions of Member States and to suggest a framework for moving forward. This report proposes five areas where the European dimension can help in relaxing current national trade-offs. However, implementing such measures is not easy - policies should not only focus on setting targets but, most importantly, should trace the path towards such targets.

This report argues that the advantage of a European energy policy is to relax the national trade-offs inherent in the three objectives, and discusses five policy areas where this is likely to be the case. These are the internal market, a pan-European architecture of energy regulators, political framing, the energy mix, and research and innovation.

Specifically, we propose:

PROPOSAL 1:
Single market policies and competition rules provide a readily available framework for an EU-wide energy market. They do not need to be changed in response to the energy challenge. On the contrary, they should be fully enforced at the European level in order to avoid suboptimal national solutions triggered by national trade-offs.

PROPOSAL 2:
A pan-European network of energy regulators should be created. Regulators must cooperate closely and the system must involve a strong EU agency to act as a regulator of last resort.

PROPOSAL 3:
Significant political framing is necessary in order to reduce the interference of political markets in economic markets. The EU should speak with one voice and provide an umbrella of external supply security for all Member States. The weight of individual Member States in conducting this policy must necessarily differ.

PROPOSAL 4:
Instead of symmetric national quotas, which are economically inefficient and difficult to implement, environmental targets should be set at EU level, and burdens shared according to national circumstances. Incentives to comply with the targets should be market based. A system of tradeable green certificates would be an appropriate and economically efficient mechanism to ensure that national policies are aligned with the common objective.

PROPOSAL 5:
Research should focus on development of the most promising domestic energy sources but should also be coordinated at EU level in order to exploit synergies and combine efforts in similar projects.

We then investigate a strategy for achieving a common European energy policy and emphasise five aspects: implement flexible (market-based) and harmonised incentive systems; eliminate the hold-up problem; focus on *energy objectives*; provide more evidence about impact assessment; and appeal to the special responsibility of France and Germany.

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ANNEX I

The Energy Policy Index (EPI): Data Sources and Methodology

In this annex we describe each of the indicators used to calculate the Energy Policy Index. For the three policy objectives (competitiveness, security of supply and environmental protection) we define indicators using the variables described below. Each variable is ranked from zero to six, six meaning the best performance and zero the worst performance. The number in brackets is the weight each variable has in the determination of the indicator (e.g. vertical separation accounts for half of the electricity sub-indicator which determines half of the value of the competition and liberalisation indicator).

The complete dataset is available on www.bruegel.org.

1. Competitiveness:

- Competition and liberalisation (1/2)

    - Electricity (1/2)
        - Vertical separation (1/2): Ownership, legal or no unbundling in transmission (1/2) and distribution (1/2) networks. Year: 2006; Source: EC (2006, 2007c).
        - Market structure (1/2): Number of companies with a market share higher than 5 percent in generation (1/2) and supply (1/2). Year: 2004. Source: EC (2006, 2007c).
    - Gas (1/2)
        - Vertical separation (1/2): Ownership, legal or no unbundling in transportation (1/2) and distribution (1/2) networks. Year: 2006. Source: EC (2006, 2007c).
        - Market structure (1/2): Number of companies with a market share higher than 5 percent in production and import (1/2) and supply (1/2). Year: 2004. Source: EC (2006, 2007c).

- Intra-EU electricity trade (1/2): Sum of imports plus exports over domestic production. Year: 2004; Source: IEA (2006).

2. Security of supply:

- Energy dependence (1/2): Energy net imports divided by gross energy consumption. Year: 2005; Source: EUROSTAT.
- Generation adequacy (1/2): Percentage of installed capacity (RAC) in excess of peak load demand for 2007, 2010 and 2015. Reliably Available Capacity' includes all available generation capacity known with certainty (existing capacity that will still be available in the relevant year plus capacity that is projected with certainty). Generation adequacy for each year is ranked between 0 and 6 and the indicator is calculated as an average of the three years. Year: 2005; Source: ETSO (2006), UCTE (2006).

3. Environment

- Share of renewables in the energy mix: Share of hydropower, combustible renewables, wind and solar energy and other renewables in the energy mix. Year: 2004; Source: IEA (2006).
- CO2 emissions
    - CO2 emissions: Kg CO2 over 2000 US$ PPP GDP. Year: 2004; Source: IEA (2006).
    - Evolution of CO2 emissions: Percentage change in greenhouse gas emissions with respect to GDP at PPP values, from 1995 to 2004. Source: EEA (2006).
- Kyoto targets
    - Policy measures with quantified 2010 reductions projections in greenhouse gas emissions: This indicator takes a discrete value depending on whether or not countries have in place policies and measures to reduce greenhouse emissions, whether or not additional policies are planned, whether or not countries use Kyoto mechanisms and whether or not there have been net removals from carbon sinks. Year: 2006. Source: EC (2007e).
    - Projected outcome with respect to the Kyoto target: The indicator takes value 6 if the Kyoto target is projected to be reached and 0 otherwise. Year: 2006. Source: EC (2007e).

ANNEX II

Cluster analysis

Cluster analysis is an exploratory data analysis technique which attempts to identify natural groupings (clusters). We perform a cluster analysis using kmeans partitions in two steps. First, we consider only EU15 countries and determine the main features and means of the identified groups. Second, we perform a new cluster analysis with all EU25 countries using as seed values (for the iteration process) the averages of the groups determined by the first cluster analysis[44].

The groups determined by the first step are shown in table A1 and the group characteristics are shown in table A2. In the second step, we add the new Member States keeping the group averages determined in step one. New groups are shown in table A3 and group characteristics in table A4.

44. We use only EU15 countries to determine the initial groups because they have a more stable energy mix not subject to major recent changes as is the case for most new Member States. Including the new Member States in the initial analysis could lead to less robust and less significant groups.

Table A1: EU15

Groups	1	2	3	4	5
AT			1		
BE	1				
DE				1	
DK			1		
ES				1	
FI		1			
FR		1			
GR				1	
IE					1
IT				1	
LU			1		
NL				1	
PT				1	
SE		1			
UK			1		
Sum by group	1	3	4	6	1

Sources: Bruegel (see Annex I).

Table A2: Group characteristics, EU15

Groups		Competitiveness	Supply security	Environment
1	Min	2.0	1.2	1.8
	Average	2.0	1.2	1.8
	Max	2.0	1.2	1.8
2	Min	0.8	2.0	3.8
	Average	1.5	2.4	4.5
	Max	2.3	2.7	5.0
3	Min	2.7	3.2	2.5
	Average	3.3	3.7	3.2
	Max	3.9	4.3	3.7
4	Min	0.8	1.8	2.4
	Average	2.0	2.4	2.9
	Max	2.6	2.8	3.3
5	Min	1.1	0.8	2.4
	Average	1.1	0.8	2.4
	Max	1.1	0.8	2.4
Total	Min	0.8	0.8	1.8
	Average	2.2	2.5	3.2
	Max	3.9	4.3	5.0

Sources: Bruegel (see Annex I).

Table A3: EU25

Groups	1	2	3	4	5	6
AT	1					
BE				1		
CY						1
CZ	1					
DE		1				
DK	1					
EE		1				
ES				1		
FI			1			
FR		1				
GR		1				
HU					1	
IE						1
IT					1	
LT					1	
LU	1					
LV			1			
MT						1
NL	1					
PL		1				
PT					1	
SE			1			
SI					1	
SK					1	
UK	1					
Sum by group	6	5	3	2	6	3

Sources: Bruegel (see Annex I).

Table A4: Group characteristics, EU25

Groups		Competitiveness	Supply security	Environment
1	Min	2.6	2.7	2.5
	Average	3.1	3.2	3.1
	Max	3.9	4.0	3.7
2	Min	0.8	2.5	2.6
	Average	1.3	3.1	3.1
	Max	1.9	4.6	3.8
3	Min	1.5	1.5	4.8
	Average	2.1	2.1	5.0
	Max	2.6	2.7	5.3
4	Min	1.9	1.2	1.8
	Average	2.0	1.6	2.1
	Max	2.0	1.9	2.4
5	Min	2.3	1.5	2.7
	Average	3.0	1.9	3.4
	Max	4.1	2.4	4.1
6	Min	0.0	0.0	1.3
	Average	0.5	0.3	1.9
	Max	1.1	0.8	2.4
Total	Min	0.0	0.0	1.3
	Average	2.2	2.3	3.2
	Max	4.1	4.6	5.3

Sources: Bruegel (see Annex I).

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Bruegel is a European think tank devoted to international economics. It started operations in Brussels in 2005 as a Belgian non-profit international organisation supported by European governments and leading corporations. Bruegel seeks to contribute to the quality of economic policymaking in Europe through open, facts-based and policy-relevant research, analysis and discussion.

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Energy: Choices for Europe

Can Europe's nations go it alone in their quest for the triple crown of a secure, competitive and environmentally-sustainable energy future? Or will this lead to a dispersion of effort, even to mutually undercutting national policies? If a common energy policy is the way forward, can the European Union – and its agent the European Commission – manage the necessary political arbitrage between 27+ different countries with very different energy histories and geographies?

This report – the first of the Bruegel Blueprint Series – seeks to answer these questions and suggests a way forward.

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