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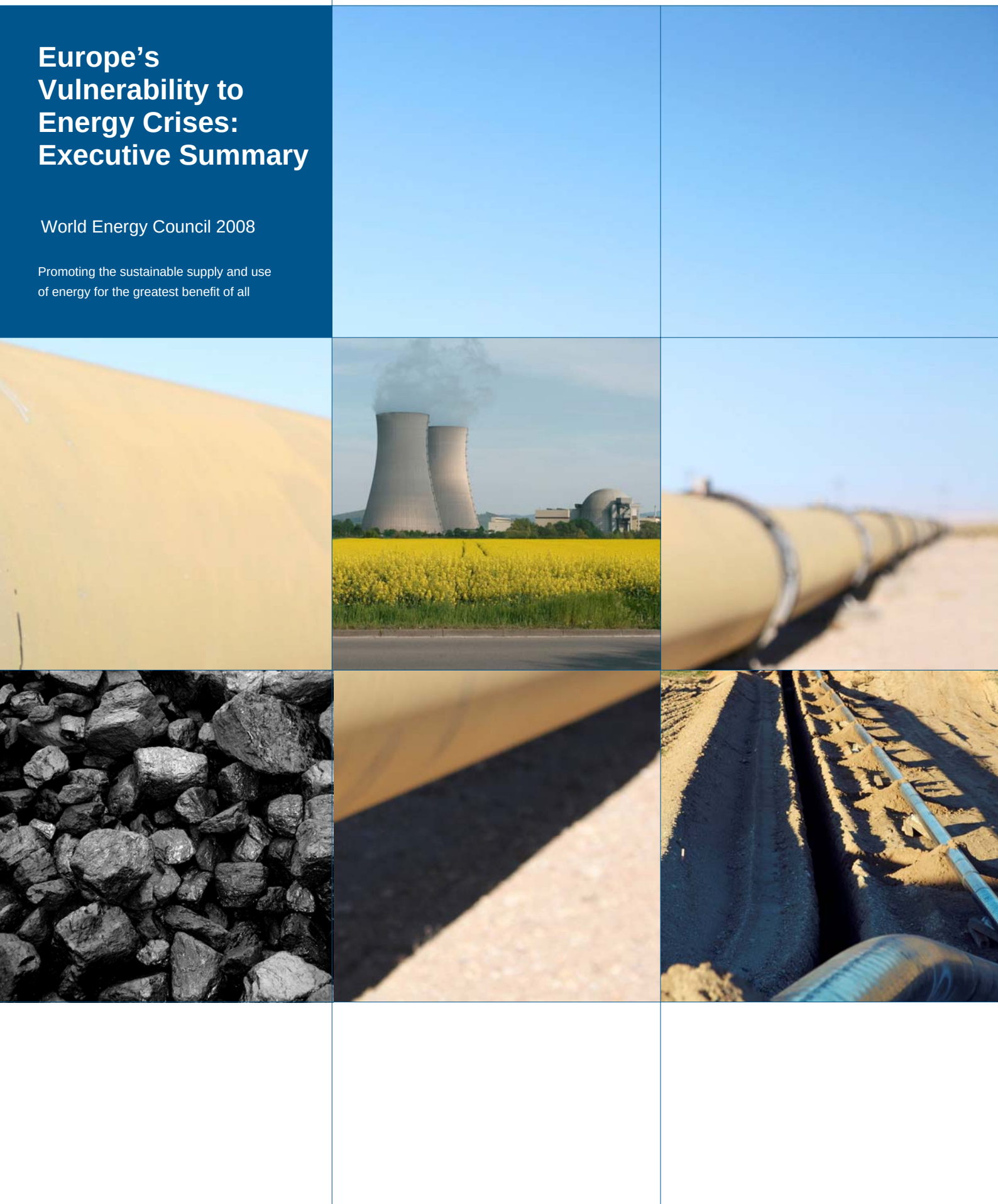
Europe's Vulnerability to Energy Crises: Executive Summary

World Energy Council 2008

Promoting the sustainable supply and use of energy for the greatest benefit of all



Europe’s Vulnerability to Energy Crises: Executive Summary

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European policy makers and market players should act **together** to secure energy supply and mitigate current and future vulnerabilities and risks.

The growing dependency of Europe on energy imports and anticipated further increases in energy prices reinforce the concerns about meeting the energy demand in the future. It is well recognised that ensuring secure and reliable energy supplies at affordable, stable prices is vital to economic and social development and should constitute an integral part of a sound and consistent energy policy.

The recent rapid changes in the economic environment in Europe require the energy sector to develop new concepts and policies to respond better to the security requirements of energy supply. While in the past security of energy supplies has traditionally been considered primarily the responsibility of governments, the current status of the European energy market requires market forces to play a complimentary role. In a liberalised market, security and competitiveness come at a cost.

A discussion about security of supply requires a common understanding of the definition of this concept. As a principal issue, energy security is defined as an uninterruptible supply of energy, in terms of quantities required to meet demand at affordable prices.

However, there are several risks that could endanger the security of energy supply, e.g. exporting countries might use the threat of disruption to apply political pressure. Another risk is an energy price shock, followed by sustained higher prices and a negative impact on the economy. This situation could create a long-term supply/demand imbalance, with the probability of serious tensions in national and international markets.

Aware of all these pressing challenges, the WEC-European Member Committees have conducted a regional study entitled "*Europe's Vulnerability to energy crises."*

In this Study, the key issue relating to energy security is that of **vulnerability** considered in a broader concept, e.g. as a risk and its resilience. Many identify vulnerability with import dependency only. It is important to distinguish energy vulnerability from energy dependency, as it is possible to be dependent without being vulnerable. A country that imports the majority of its energy at a sustainable cost and ensures the security of its supply by means of well-diversified sources will be dependent but not vulnerable. While a country which produces the majority of its energy at a prohibitive cost or uses obsolete technologies will be vulnerable, even if independent of external suppliers.

The ultimate objective of the Study is to assess how the European economies could respond to a possible energy crisis provoked by above-mentioned events. The Study also attempts to develop a set of vulnerability indicators that could be used to evaluate the levels of vulnerability, both at the national and regional levels. These indicators may help to pinpoint areas where policy makers and market players need to act in order to mitigate the impact of a possible energy crisis.

Can vulnerability be quantitatively measured?

The answer is yes, by applying specific indicators that help to simplify the complex and diverse relations characterising energy economics in the wider context of Europe. At present there is no suitable methodology worldwide to assess and quantify energy vulnerability in a way that is factual, objective, unbiased and above all transparent and accessible. Vulnerability is multi-dimensional, and several indicators are needed when defining it. A number of indicators are suggested by this study but others associated with additional risks need to be further developed.

This Study can be best understood in terms of metrics: while using a single indicator for determining a particular threat, the application of a set of parameters and indicators is needed to assess a wide range of factors, which influence energy vulnerability.

The major vulnerability indicators in this study are identified at **macro-economic level** (energy dependence/energy independence; energy intensity; net energy import bill; carbon content of TPES; currency exchange rate); **at micro and technological level** (distribution, obsolete technology); at **social level** (fuel poverty and access to grid) but also at **geopolitical level**.

A few single indicators determining a particular risk have been already known well worldwide and are worth using (for example, the Hirschmann-Herfindahl Index, concerning energy import dependence), but much more is needed to define the **country's overall vulnerability** by using a set of appropriate indicators. This was the main objective of the study. It is rather difficult to synthesise different factors that might have a negative impact on the energy market and economy. In order to be able to draw on several indicators that facilitate comparisons and aggregations, the study recommended the use of a set of indicators, **expressed in the same units**. To do this, the various indicators can be presented as values between 0 and 1. For example, the formula below (0.9) could define the following vulnerability indicators:

$$I_j = \frac{X_j - \min_k (X_k)}{\max_k (X_k) - \min_k (X_k)} \quad k = 1, 2, \ldots, n$$

where X_k is the indicator considered for a country ***k*** among ***n*** countries. (See Figure 2-1)

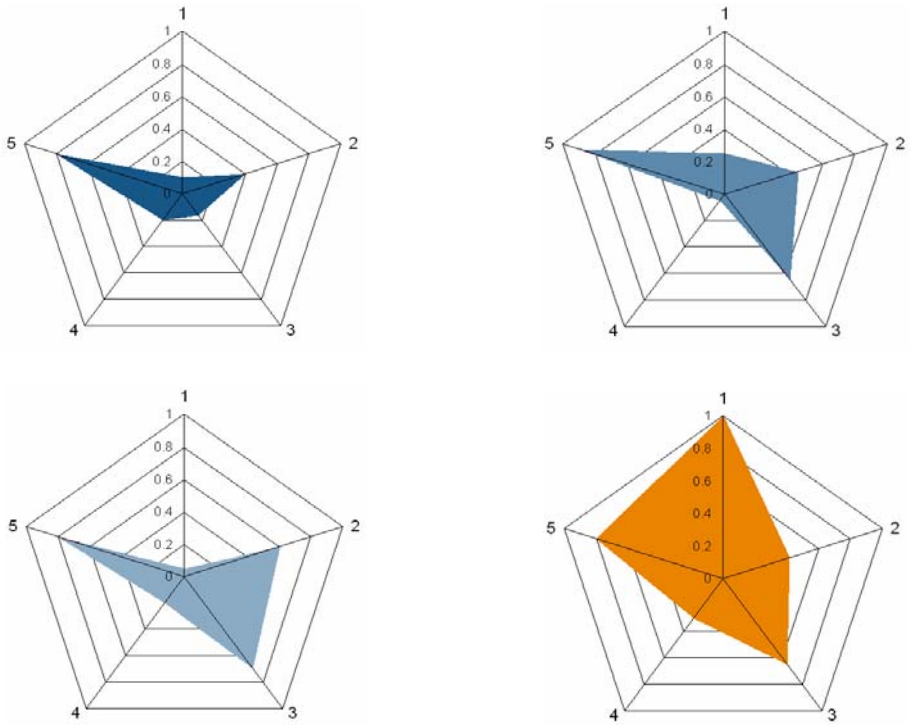
Thus, vulnerability can be calculated as a square mean of these five indices, represented graphically in the full version of the Study.

To define vulnerability, the following indicators could be a part of the assessment:

- **Energy intensity**, of which the index is calculated using formula (0.9)
- An indicator of **dependency on oil and gas imports**, whichever is the smaller of the two values, the first being the actual dependency rate and the second an indicator of the geopolitical risk of supply disruption
- The index representing the **carbon content of total primary energy supply** (TPES) (formula 0.9)
- **Vulnerability of the electricity supply system**, involving the index of dependency on imports (0.9), via a square mean, a public acceptability indicator and an index of non-diversity for electric power generation of Shannon-Wiener type, the first index having twice the weight of the next two
- An indicator of **non-diversity of transport fuels** used for the Shannon Wiener type

N.B. The above five indicators denote the corresponding axes in Figure 2-1 overleaf

Figure 2-1: Energy Vulnerabilities of (clockwise from top left) Sweden, Croatia, Bulgaria, and Germany



The various indicators that have been examined could be useful in drawing up policies to mitigate vulnerability. It is only natural that the results of a policy will always be hard to assess using aggregate indicators. We have in fact observed a number of backlash effects. For example, a reliance on domestic energy production to limit dependency on imports can lead to costlier solutions, penalising certain industries. It is important to reinforce the interconnected grids that may help to address blackouts and other events.

Finally, this report suggests a number of analytical assessments and concludes that further research is needed to scrutinise certain issues.

Vulnerability of European Users to an Energy Crisis

When considering the vulnerability of European energy users to a crisis it is important to analyse the structure of the European economy and determine how energy resources and prices influence consumer choice and behaviour and how this affects economic development and growth. High-energy prices in Europe can lead to increases in energy import bills with adverse consequences for business, employment and social welfare.

Contributing factors affecting the separation of energy demand from economic growth can be observed in the further dematerialisation of European industry linked to structural changes within sectors. This is pronounced particularly strongly in Central and Eastern European countries where the recent macro-economic reforms led to shifting economy to less energy intensive activities.

The share of industrial value added in the European economy declines (Table 3-1), it indicates the increasing importance of new industrial activities with high value added, lower physical inputs, modern technology and the increase of services in economy (up to 70 - 71% by 2030). This growth in services in terms of GDP shares occurs to the detriment of others sectors of the economy, such as, agriculture, construction and energy.

Since 1972, energy intensity in Western European economies has been declining, and with the new EU-Green Paper (January 2007) a new decrease of 20% at average is expected for all EU-members, by 2020. Total energy demand is likely to decline in a number of industrial sectors, in the steel industry for example, the expected decline rate is 0.8% p/a over the next 25 years, despite a small increase in steel production.

Table 3-1 Evolution of European Economic Structure

		% Structure of Total Value Added				
		1990	2000	2010	2020	2030
Gross value added in industry	EU-15	21.5	20.8	19.8	19.8	19.8
	Recent members-10	26.4	25.4	25.8	25.1	23.4
	Bulgaria & Romania	31.0	30.0	29.3	28.8	28.7
	Norway & Switzerland	20.0	25.3	25.1	25.1	24.9
	EU-29	21.8	20.6	20.4	20.4	20.3
Gross value added in services	EU-15	66.2	68.8	70.2	70.9	71.5
	Recent members-10	51.3	57.4	59.8	62.3	65.2
	Bulgaria & Romania	36.2	43.7	50.3	52.2	53.0
	Norway & Switzerland	68.2	63.9	65.0	65.8	66.6
	EU-29	65.4	68.0	69.4	70.0	70.8

Source: Energy in Europe. European Union Energy Outlook, to 2020

However, this could also be associated with the fuel structure of energy demand: the continuous decline in solid fuel share will be compensated by increase of electricity as the steel technology is moving further to electric processing.

Energy prices and consumer vulnerability

The increase in world energy price has a negative economic impact: higher energy prices lead to higher costs and hence, to reduced competition of European industries, in the global market for goods and services.

The global price increase effect is generally led by the increase of oil prices followed closely by that of natural gas. The direct impact of oil price increases on European economy depends on a number of factors, among which the level and duration of the price increase; the response of oil markets; the proportion of energy in GDP; the flexibility of energy markets; and the exchange rate. The current high exchange rate of EURO against the US$ is favouring the European oil importers but penalising European exports of goods.

In other words, an increase in the world fuel price has three major effects, namely:

- A direct effect on revenue by spending more on the energy bill;
- A financial effect through the rise of inflation and interest rates;
- A trade effect through the increase in import bill, which aggravates the trade balance.

How the European energy consumers react to energy price increase?

Energy consumers react with acute sensitivity to any price increases and adapt their behaviour to energy consumption accordingly:

- Generally, tertiary and domestic sectors are the most responsive to price changes, whereas both industry and transport sectors exhibit a more limited reaction to price increases; the latter have to contend with a rise in unit costs;
- In many European countries, gasoline consumption has decreased in 2005 and 2006. Given the very limited flexibility of transport to fuel alternatives, the future use of liquid fuel will depend on the trends in car making industry; consumers expect new competitive solutions, associated with technology development;
- The increase of electricity/steam price is less pronounced than that of oil and natural gas, at the final demand, making it a more cost-effective solution. The European consumers are aware of their vulnerability to external dependency, in terms of price volatility, and seek alternative solutions, including energy efficiency improvements, greater use of renewables and local solid fuels.

	Oil		Natural Gas		Coal	
EU-29	2005	2006	2005	2006	2005	2006
Reserves	1.3	1.2	3.5	3.3	6.1	6.1
Production	6.7	6.2	10.6	10.0	6.7	6.2
Consumption	18.9	18.8	18.1	17.5	10.9	10.6

Source: BP Statistical Review of World Energy, 2007 and World Oil & Gas Review, 2007

EU-29				Europe Total			
Imports		Exports		Imports		Exports	
2005	2006	2005	2006	2005	2006	2005	2006
19,370	19,200*	9,710	9,650*	21,100	20,000*	16,970	16,850

Source: World Oil and Gas Review, 2007; --*/ Estimates

EUROPE'S VULNERABILITY TO ENERGY SHORTAGES

Primary energy resources are unevenly distributed around the world. Europe is particularly poor in terms of energy resources and hence heavily dependent on imports.

Oil

Oil reserves in EU-29 as estimated at end 2006, represented only 1.2 % of world proven reserves against 1.6% in 2004 and 1.3% in 2005; a continuous downward trend due to the depletion of oil reserves in North Sea, while the world reserves were growing (1,215 billion barrels in 2005; and nearly the same end 2006) thanks to market price increases that led to new discoveries.

Oil production in EU-29 has also been falling from 7.6% of world production in 2004 to 6.7% in 2005 and 6.2% in 2006. Oil imports into EU-29 climbed up in 2005 by 1.2% reaching 21,100 bbl/day. Oil consumption slightly declined from 18.9% of world consumption in 2004 and 2005, to 18.8% in 2006; however, the consumption has been rising at an annual rate of around 1.5% over the last 10 years.

Natural Gas

Gas reserves of the EU-29 account for 3.5% of the world proved reserves in 2005 and 3.3% in 2006 (estimated at 181.5 trillion cubic metres -TCM, end 2006). Gas production level increased between 2004 and 2005 and slightly decreased in 2006 representing 10% of world production. Gas consumption in 2005 and 2006 was higher than the previous years.

The rate of expansion of the LNG industry is spectacular.

According to IEA estimates, over the past five years, LNG trade flows have increased by 29% (+40 billion cubic metre), the gas liquefaction capacity by 48 BCM/year and the LNG fleet has grown by 75%. By increasing LNG share the European energy markets may not only favourably diversify the present energy mix, but also their sources and routes of supply from more remote gas markets that would otherwise be inaccessible.

Oil and natural gas supplies to Europe: The Risk Factors

The vulnerability of European oil and gas markets is associated with a large number of risk factors and uncertainty, among which the most important are:

- **geopolitical risk factor**: this primary risk factor might cause physical disruption of supplies to consumers in Europe. Political instability and regional conflicts in major supplying countries have held back potentially

massive foreign investments in upstream sectors.

- **volatility** of oil prices is another factor hard to forecast. It is affected by political instability (the first mentioned factor) but also by recent imbalances between demand and supply, OPEC policy to dictate production levels, and shortages of extraction and refinery capacities. The social unrest in Nigeria and Iran's nuclear policy have raised the geopolitical risk factors with economic consequences to consumers, which partially explains the price increases observed in 2006 and 2007. And last but not least, the developments at the financial markets: today, oil prices are determined on spot and futures markets, not by the price lists issued by oil-producing countries;
- **delay** in investments in strategic projects;
- **terrorist attacks** on oil infrastructure should be also considered as a serious risk factor, the consequences of which might lead to temporary disruption of supply.
- **shortages** due to geological constrains: in EU-29, oil and gas fields are concentrated to Norway, United Kingdom and the Netherlands, where the first two already have sunset production plans.

The vulnerability of gas supply has become a primary concern to Europe, more than that of oil due to the higher vulnerability of supply infrastructure (pipelines). To mitigate this vulnerability, it is essential to develop more underground storage capacity and integrate energy businesses throughout the entire gas value chain. It is also essential to develop further LNG facilities in Europe, to diversify regions and routes of gas transport. The growing development of LNG capacities will change the gas market from local to global and mitigate tensions arising from the lack of alternative supply routes and fuel portfolios.

Coal

Coal reserves in Europe are predominantly lignite, and whereas expressed in metric tonnes they are considerable, measured in toe, they only slightly exceed 6% of the world reserves.

The world coal market continues to grow at a high rate: world consumption in 2005 and 2006 was up by 5.2% and 4.5% respectively. Coal has a much lower supply disruption risk compared to oil and gas. In addition, coal prices have been stable.

Uranium reserves are distributed among a limited number of countries worldwide. Unlike the fossil fuel market, for several years the uranium market has been characterised by a large gap between production and consumption. The gap was filled by stocks from civil and increasingly strategic (military) applications. Uranium reserves are substantive, and the current higher price of uranium is dictated by the lack of investment in mining (due to the low market price and low demand in the past years).

Renewable Resources

Renewable resources are fairly evenly distributed around the world and are more accessible than fossil or nuclear resources, although their widespread use continues to face mainly economic and technical constraints.

Further deployment of renewables will undoubtedly lead to reduced vulnerability, in particular to lower energy import dependence.

In the EU-29, **hydropower** potential has been nearly fully developed, in particular for large capacities. The total share of renewable energy, including large hydro, remains below 5% in the current total primary energy mix.

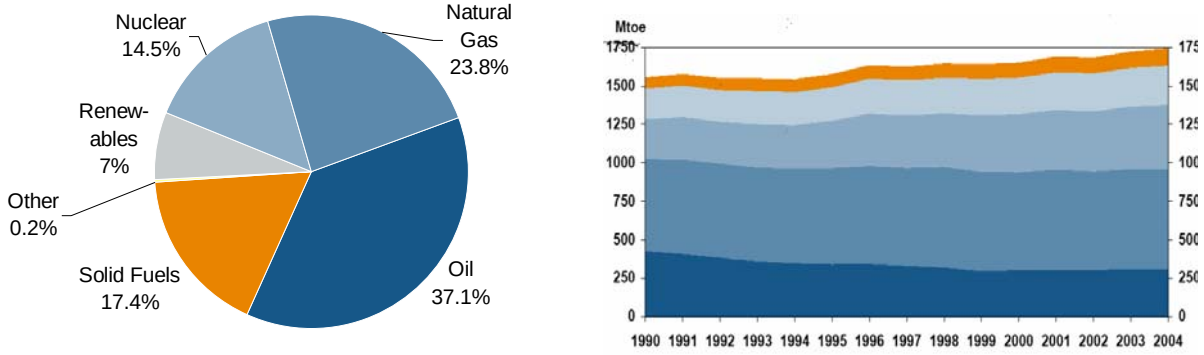
Since 1990, the gross primary energy consumption in the EU-29 has been rising at a rate of 0.7% per year. Oil, natural gas, solid fuels and nuclear have been the backbone of European energy mix while renewable energies showed the largest annual increases (3.0%) followed by natural gas (2.8%) and nuclear energy (1.8%). The European energy mix is characterised by considerable variation from one country to another.

In 2005, oil remained the main source of energy in the final consumption with a share of 43%. Natural gas saw strong consumption with a share of 24%, followed by electricity with 20%, while solids comprised 5%, renewable energies 4% and derived heat 4%. There were similar differences in the structure of energy consumption between countries.

The primary energy production in EU-29 fell by 3.2% during 2004 and by 4% for the total of EU-27 while net imports increased by 6.9% and 4.5% for EU-27 respectively. Europe produces less and less and imports more and more. Therefore, energy dependency climbed from 42% in 2004 to 45% in 2005 (E-29); and from 55% to 57% (EU-27) respectively. That is why the Import Dependency Indicator considered as a primary indicator for determining the vulnerability of a country or region to energy crises is generally defined as a ratio between the net imports and the gross domestic consumption.

DYNAMICS OF THE KEY ENERGY INDICATORS, 2005-OVERVIEW

Figure 4-9 Gross Inland Consumption of EU-29, 2005



Source: Energy and Transport in Figures, 2006

Energy consumption per capita in EU-29 was equivalent to roughly 3.5toe in 2005, compared to 7.8toe/capita for the USA and 4.1toe/capita in for Japan.

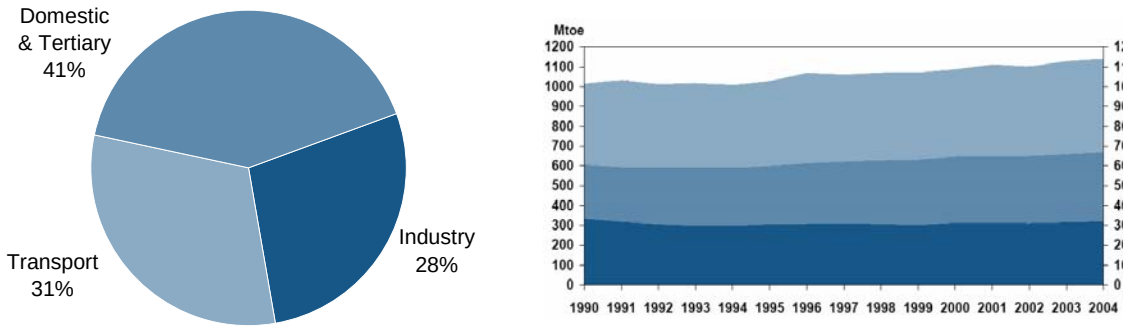
Security of electricity supply may be defined as the ability of the electrical power system to provide end-users with a specific level of continuity and quality in a sustainable manner, relating to the existing standards and contracted agreements.

single liberalised market. The implementation of the first liberalisation Directive (96/92/EC) has resulted in a fully completion of most EU-member states. However, there are still a few markets where not all the liberalisation aspects are in place.

Secure reserve capacities level should be maintained

The age structure of the existing thermal power plants in Europe–29 is shown in Figure 5-1. It is

Figure 4-11 Final Energy Consumption by Sector of EU-29, 2005



Source: EU Energy and Transport in Figures, 2006.

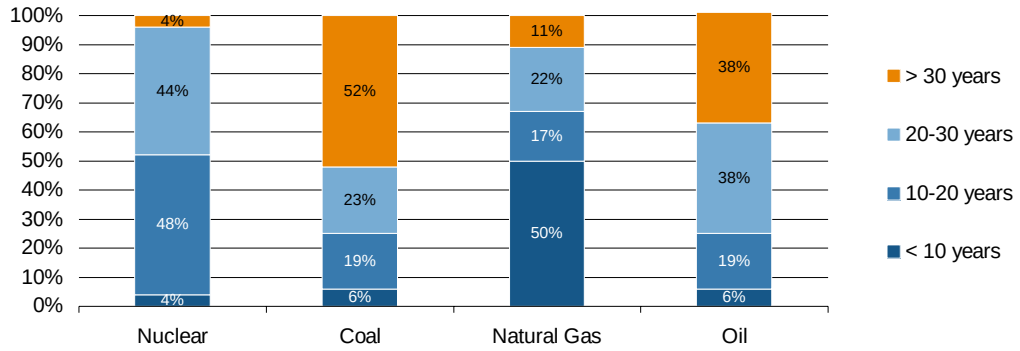
To ensure a regular supply of electricity in the foreseeable future, there are three prerequisites, namely: (a) sufficient generation to meet demand; (b) an adequate infrastructure, to deliver the power, and finally (c) robust technical and administrative operational procedures.

In the present liberalised structure of European electricity markets, investments are triggered by market decisions in a competitive framework but transmission investments are still triggered by regulatory action or incentives. European countries are in the process of changing their electricity markets from many more or less separate monopolistic markets with national supply, into one

seen that only the share of new TPP on natural gas is significant–about 50%. All other types of thermal power plants are too old–10-20 years and more. They need vast rehabilitation to increase their efficiency.

Considering the age of the existing power plants in the EU-29 and the expected growth of electricity consumption in the period 2006-2030 (1.5% per year), the maximum net installed capacity needs of the interconnected European systems will be 843 GW in 2030, assuming a normal reserve margin and availability.

Figure 5-1 Age Structure of Installed Capacity in EU-29, 2005



Source: Eurelectric

The increase in installed capacity by 265 GW requires major investment in the new power plants.

The real need for investment is perhaps roughly double, as many older power plants will be retired by 2030 or will have to close because of stricter environmental rules, political decisions, higher costs due to the emission trading system or lower profits because of low efficiency. According to EURELECTRIC's estimates, around 520 GW of new generation capacities must be installed by 2030.

The internal electricity market should be well designed to work smoothly

There is no contradiction between a well functioning liberalised electricity market and secure supply of electricity. As a matter of fact, the liberalisation of electricity market could play a positive role, if well managed, in managing these two challenges, sometimes considered as opposed each to other.

The price of electricity is the most important signal for investors in a deregulated market

The competition authorities must be strong in promoting fair competition so that the price of electricity reflects the true marginal cost of the whole supply system. Otherwise, newcomers are unable to participate in investing in new capacity.

Environmental and social policies must be as market orientated as possible, in order to achieve reliability

In this context, the most important environmental regulation in Europe is the Emission Trading System (ETS) introduced in 2005. Unless ETS or s similar system is introduced globally, the European energy market will be at a considerable disadvantage compared to other external competitors. A global ETS would also provide the market with effective prices on emissions allowances that reflect the true marginal cost of reducing CO2.

Another important environmental regulation concerns the different support systems for renewable energy.

Strategies to mitigate vulnerability

In January 2007, the European Union issued the Green Paper on a "Secure, Competitive and Sustainable Energy Policy for Europe". This document has stipulated how Europe should respond to the major challenges including those with specific provisions to security of energy supply and climate change; and among others, how to face the treats of continuous oil and natural gas price increases; Europe's energy dependency on the Middle East and Russia; new uncertainties concerning long-term availability of fossil fuels and the urgent need of policy to fight again the global warming. The new Green Paper advocated for greater integration and cooperation of EU energy

policies, and identifies the priority areas that policy should focus on it.

To reduce dependency and mitigate vulnerability of European energy markets, a number of priority policy actions need to be contemplated, among which a confident legislation to attract investments; regulations to ease cross border electricity exchange between countries; supportive provisions to enhance the functioning of internal gas and electricity market; regulations needed to guarantee fuel emergency reserves and reserve capacity in electricity sector.

Cooperative policy efforts to ensure security of energy supply

The liberalisation of gas and electricity markets has changed the political relations between EU Members States and non-European producer countries. Unlike the oil sector, the gas and electricity sectors have functioned largely through long-term relationships, both at the domestic level (monopolies) and at an international level (long-term contracts with producer countries). Consequently, energy security has mainly been considered vulnerable to supplies coming from the Middle East and to a lesser extent from Russia.

If the EU-member states truly embraced the notion that their own interests are best served by a stable world market, the process of opening the producer countries to foreign companies could be advanced through co-operation that would bring about more balanced economic development in these countries. This was one objective of the dialogue initiated between the European Union and external suppliers.

A need for colossal investments to ensure supplies: what policy can support it?

At present, markets are opening up to competition, but this could be successful only if there is sufficient infrastructure to ensure market liquidity and flexibility, while ensuring greater security of energy supplies. For example, in the gas sector: the main requirement is to ensure satisfactory conditions for the transportation of additional 200BCM needed to meet the natural gas demand over the next 20 years. This would require around €350 billion investment in the production and gas infrastructure. The reality of today's investment trends poses serious concerns: between 1998 and 2005, European operators reduced their investments in production and transmission infrastructures for natural gas. During that time, the investment/revenue ratio fell from 10.3% to 5.5% and maintenance spending from 10% to 7%. A similar situation has developed in electricity markets. Three conditions must be met if the need for new infrastructure is to be fully satisfied:

- The regulatory framework must nurture confidence among both, European and non-European operators and investors. Profitability must be commensurate with the perceived risks if investors are to provide the required financing; this will require sufficiently high returns on investments, efficient financing mechanisms and favourable investment conditions;
- The market liberalisation must allow, within the rules of EU directives, the active presence of operators-traders of sufficient size and credibility, able to make responsible commitments, such as long-term supply contracts, with "take or pay" clause and long-term provision of transport infrastructure capacities.
- Several operators must participate in the infrastructure projects for two reasons: (a) to reduce the risks that each assumes individually; and (b) to avoid a situation in which two or three operators dominate a strategic infrastructure.

These conditions, specifically pertinent to the natural gas industry, are likely to encourage essential investment in the sustained and efficient

operation of the European network because there is a long-term focus.

Market policies: assessing uncertainty risk, which tools for operators?

Today European operators must make their strategic decisions in an environment of multiple risks. They should have adequate tools for analysing and managing these risks. Uncertainty in the energy sector is one of the major risk that has an increasing impact on the strategies and investment decisions of European operators. The use of net present value (NPV) as a decision-making tool for market operators is pertinent as it is based on data gathered on prices and costs; when companies attempt to develop a sustainable business plan, the objective of reducing uncertainty by managing risks becomes as complex as it is essential.

More numerous and complex risks have an impact on long-term investment and, therefore, on security of supply. In this regard, it seems that a clarification of government policy and the wholesale-market framework would send satisfactory financial signals to players and investors.

In the current liberalised market, the application of theoretical models for assessing uncertainty (industrial, strategic and financial) is more complex, despite excellent methods of acquiring data. By reducing uncertainty, a stable and clear regulatory framework should make risk management easier and investment safer; as a result, it should help ensure a sustainable security of supply.

Overall Conclusions and Recommendations

Europe is one of the largest energy consuming regions in the world and the current energy production of the European countries is insufficient to cover their energy demand. As a result, the dependency on energy imports is growing and on current trends is forecast to reach almost 70% by 2030 if no adequate policy measures are taken in response.

Constitutionally, the EU is the only international body with a legal mandate and the power to design energy policy and monitor its implementation in 27 member states. The EU Green Paper (2007) should certainly bring improvements and advance a single European energy market.

Assessing Vulnerability

The vulnerability of an energy system is generally perceived as "the degree to which that system is able to cope with selected adverse events". The degree of vulnerability is a combination of different factors; among which is energy intensity, flexibility in modifying the energy mix, quick response and adaptation to energy price increases and the ability to manage disruptions of the energy supply.

The WEC Study Group attempted to define the concept of vulnerability and establish a set of quantitative indicators, both at macroeconomic and microeconomic level, that would help determine the level of vulnerability of a country or a region.

Vulnerability indicators defined at macroeconomic level are: price volatility, exchange rate, rate of energy dependency, rate of energy diversity, import concentration index, rate of energy bill and level of technology performance. Those defined at microeconomic level vary depending on the type of energy consumer and supplier.

It is important to emphasise that while energy vulnerability is linked to energy dependency it is quite different. For example, a country could be dependent on imports without being vulnerable if the import portfolio is diverse and suppliers reliable.

The Study Group made the following recommendations for policy making:

Setting up and implementing a common EU-energy policy, with the emphasis on security of supply, is highly desirable, as it will undoubtedly provide strong support in reducing the European vulnerability to energy crises and sustain long-term development of European energy market. European countries should speak with one voice when maintaining a policy dialogue with strategic external suppliers.

More Pragmatism in Policy Implementation

The policy should ease market integration and enhance its attractiveness to investors, by providing a more transparent, stable and predictable long-term regulatory frameworks (legislative & fiscal). This would inspire confidence among operators & investors and urge long-term commitments. In addition, but in this context, the borders should be opened to cross-investment (upstream for European consumers, downstream for suppliers).

Enhance the Promotion of Energy Efficiency and a Market for Renewable Energies

Energy efficiency improvements in all areas of the economy should become a priority issue for policy making in Europe.

Energy efficiency regulations and standards should be **mandatory** in all sectors of national economy with **enforcement** in the Central and Eastern European economies, where the potential in making energy savings is still much higher than in Western Europe. The construction norms/standards in households and buildings must be considered and upgraded.

Mitigate Tensions and Vulnerability Level in Electricity and Gas Markets

In the case of electricity, the EU member states should be required to develop the internal market, thus attracting investment in constructing new generating and transmission capacities. At regional level, there is an urgent need for (1) harmonising cross-border tariffs, and (2) developing methods for defining a common price formation, with the proviso that the price of electricity is the primary signal to investors in a deregulated market. In addition, an emission-trading scheme beyond 2012 is a necessary development to encourage investment in power generation for the future.

In the case of natural gas, to create a surveillance mechanism at regulatory level, with a mandate to control and co-ordinate functions on the construction and access to infrastructure facilities (LNG terminals, pipelines, underground storage), with a view to easing, instead of impeding, development. The Council of European Energy Regulators could integrate such a mechanism. In addition, the EC may consider elaborating a **security supply standard** defining the level of gas volumes demanded by non-interruptible customers under the conditions of a single gas market.

Encourage Further Diversification of Each National Energy Mix

Given the current circumstances of intensity and commitment to Kyoto Protocol targets, the re-evaluation of **each domestic energy mix** is strongly recommended. The purpose would be to reduce the dependence on imports by any country and expand the supply pattern by promoting the use of domestic energy resources, including renewables. It should take into account economics, technical fundamentals and local circumstances in promoting each energy alternative, supplement policy measures, use additional regulations, especially for renewable options and preserve market rules for fair competition.

Re-integrate the Nuclear Option into Policy and Public Debate

Nuclear power is a promising alternative for both reducing dependency on imports and fulfilling the commitment of all European countries to the Kyoto Protocol. The EU and neighbouring European countries should seriously consider including the nuclear option in their public debate and energy policies. The European Union should take a firm position about option of nuclear re-integration, a source that already provides a 1/3 of the electricity supply.

Achieve more Consistent and Targeted Research and Development

Budgets, including that of the EU, allocated for R&D on future technologies should be distributed among energy carriers in proportion to their expected share in the future energy mix and keep a healthier balance between supporting other forms and technologies of low carbon generation (carbon capture, SO_2 sequestration, nuclear).

It is important to develop joint public and private sector R&D programmes with the aim of promoting commerce and competition in the market.

Promote a "Fact-Based" Debate on Energy Issues

A new approach should be established - regular dialogue between all stakeholders involved in energy policymaking and implementation, including the public. Civil society should be more informed, consulted and integrated into policymaking.

Encourage the European Countries to Assess their Vulnerability Level by Applying the Indicators Proposed by this Study

The Study Group encourages all European countries to use the vulnerability indicators developed in this Study. They should assess their level of vulnerability at macroeconomic and microeconomic level, e.g. on energy dependence, import concentration, energy intensity, the national energy bill, carbon content of primary energy supply, price volatility, exchange rates and on technology. This would help to develop national and regional energy policies based on facts and realities facing the European countries today and in future.

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