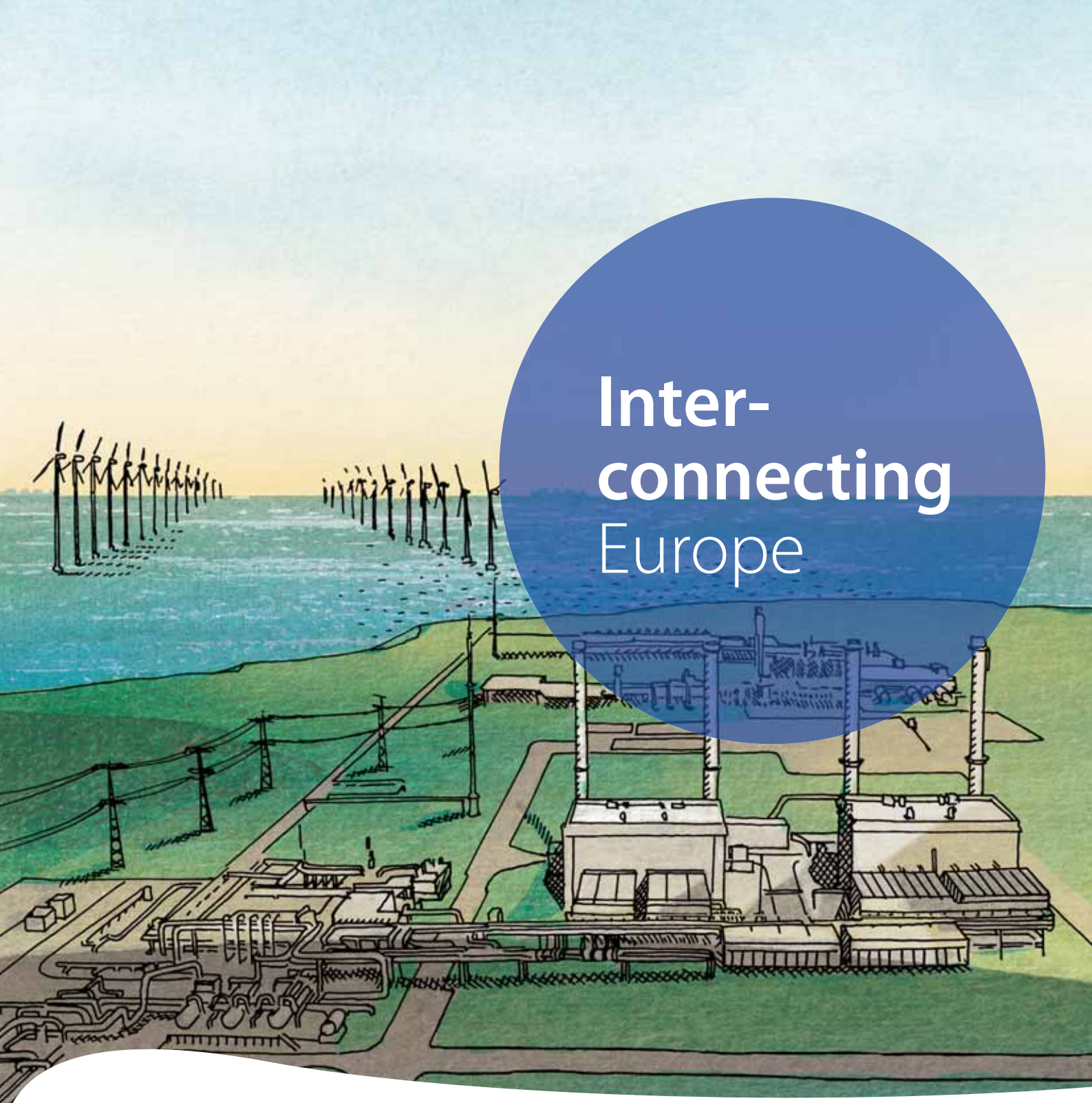


Inter-connecting Europe

Directorate-General for Energy and Transport

EUROPEAN COMMISSION

NEW PERSPECTIVES
FOR TRANS-EUROPEAN ENERGY NETWORKS

Europe Direct is a service to help you find answers to your questions about the European Union

Freephone number (*):

00 800 6 7 8 9 10 11

(*) Certain mobile telephone operators do not allow access to 00 800 numbers or these calls may be billed.

A great deal of additional information on the European Union is available on the Internet.
It can be accessed through the Europa server (http://europa.eu).

Cataloguing data can be found at the end of this publication.

Luxembourg: Office for Official Publications of the European Communities, 2008

ISBN 978-92-79-07295-6
doi: 10.2768/11498

Printed in Belgium
PRINTED ON WHITE CHLORINE-FREE BLEACHED PAPER

Manuscript completed on 17 October 2008

Foreword

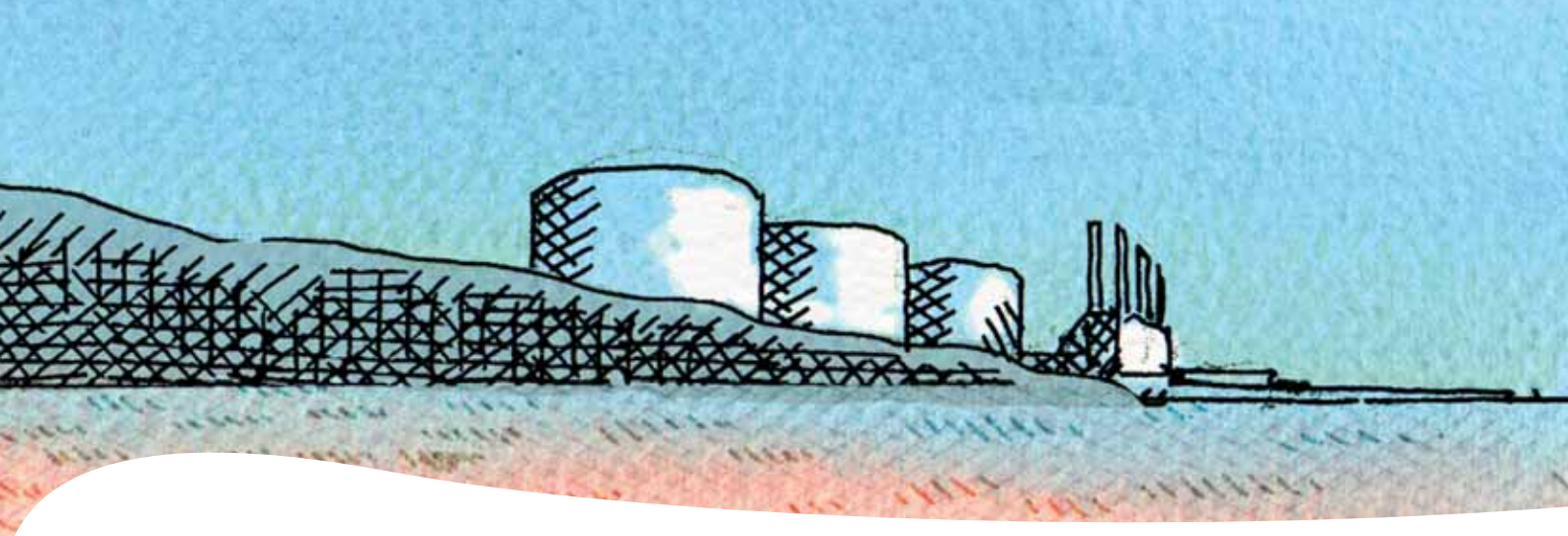
We are facing profound energy challenges that require both urgent and long-term action. Combating climate change is one such challenge. Another is to ensure the security of our energy supply, with world-wide energy demand set to rise and with uncertainty as to whether the oil and gas supply can keep pace. Facing these challenges means that we must leave our old energy ways behind us and develop a modern, sustainable energy system together with a fully integrated internal market. The European Union's trans-European energy network (TEN-E) policy is helping us to do just that.

The EU is pursuing important energy and climate change initiatives, setting ambitious targets for reducing carbon dioxide emissions, promoting renewable energy sources and improving energy efficiency, as well as favouring low carbon fuels. These measures will require massive investments over the coming years and decades in Europe's energy infrastructure. Meeting the EU's emissions and renewables targets calls for a far-reaching restructuring of European energy networks. Harnessing renewable energy at optimal sites across Europe will depend on developing an appropriate and efficient transmission infrastructure. At the same time, energy networks must deliver the physical electricity interconnections and gas supply routes needed to ensure the smooth functioning of energy markets and the EU's security of energy supply.

Dating back to the mid-1990s, the TEN-E policy helps to achieve broader energy policy goals by identifying the missing links and the bottlenecks in the energy network as well as priority routes that are in need of upgrading. This brochure – which updates the brochure on TEN-E published in 2004 – highlights examples of key European energy infrastructure projects: an electricity interconnection between France and Spain; offshore wind power connections in the Baltic and North Sea areas; a power link in northern Europe between Germany, Poland and Lithuania; and the Nabucco gas pipeline to bring gas to Europe from the Caspian and the Middle East.

These and the other TEN-E projects are essential for the development of the EU's energy system. The European Commission will make sure that such projects reflect the very latest energy developments and needs by proposing updated TEN-E guidelines – comprising prioritisation and project specification – following the publication of a Green Paper. Meanwhile, as also highlighted in this brochure, EU-backed research is working to develop the technologies and the new breed of 'smart' networks that will make the EU's energy infrastructure fit for the future: energy research, and smart grids in particular, are important elements of the EU's seventh research framework programme for 2007-13.

Andris Piebalgs,
European Commissioner for Energy



Contents

Boosting sustainability, competitiveness and security of supply

The European Union (EU) is pursuing an energy policy with three core aims:

- increasing the security of the EU's energy supply;
- promoting sustainable energy consumption and production to reduce the environmental impact of energy and to combat climate change;
- ensuring the availability of affordable energy for the competitiveness of European economies.

The EU is taking an integrated approach to climate and energy policy and has set itself ambitious targets with this in mind. It is aiming for a 20 % reduction of greenhouse gas emissions by 2020 compared with 1990 levels, and says it will be ready to go further provided other countries make commensurate efforts.

The EU has also set itself a binding target of achieving a 20 % share of renewable energy in overall energy consumption by 2020. The European Commission issued in January 2008 a major package of proposed legislation to this end featuring national targets for emissions and renewables.

And the EU is looking to increase energy efficiency with the aim of saving 20 % of the EU's energy consumption compared with projections for 2020. For the industry of the future, energy intensity – that is, the units of energy consumed per unit of gross domestic product (GDP) – has to be decreased.

Meanwhile, efforts are being made to open up the EU's electricity and gas markets. All EU energy consumers have the freedom and the right since 1 July 2007 to choose their own supplier, and the Commission tabled in September 2007 a new package of proposals designed to complete a truly competitive, interconnected, Europe-wide internal energy market.

Energy networks are crucial in determining how energy is sourced and delivered to our households and industry: they are therefore central to the objective of ensuring sustainability, competitiveness and security of energy supply, and to efforts to transform Europe into an energy-efficient, low-emission economy.

The old national networks, once developed by a single State-owned company, have to be integrated to form one European grid, supporting exchanges of electricity and gas throughout Europe for the benefit of all consumers and their security of supply. This European grid should be seen as a key vehicle of solidarity between Member States.

The quality of energy networks and infrastructure interconnections is essential for Europeans' quality of life and for the performance of European businesses. Citizens and businesses alike depend on reliable and efficient energy supplies – and both can only benefit from the development of a stronger trans-European energy network.

The need for action

Energy networks in the EU have been formed on a territorial basis according to national rules. Natural barriers such as mountains and sea have also limited the interconnections between EU Member States. Europe-wide energy networks must be developed, in line with the progress made in building the EU internal market.

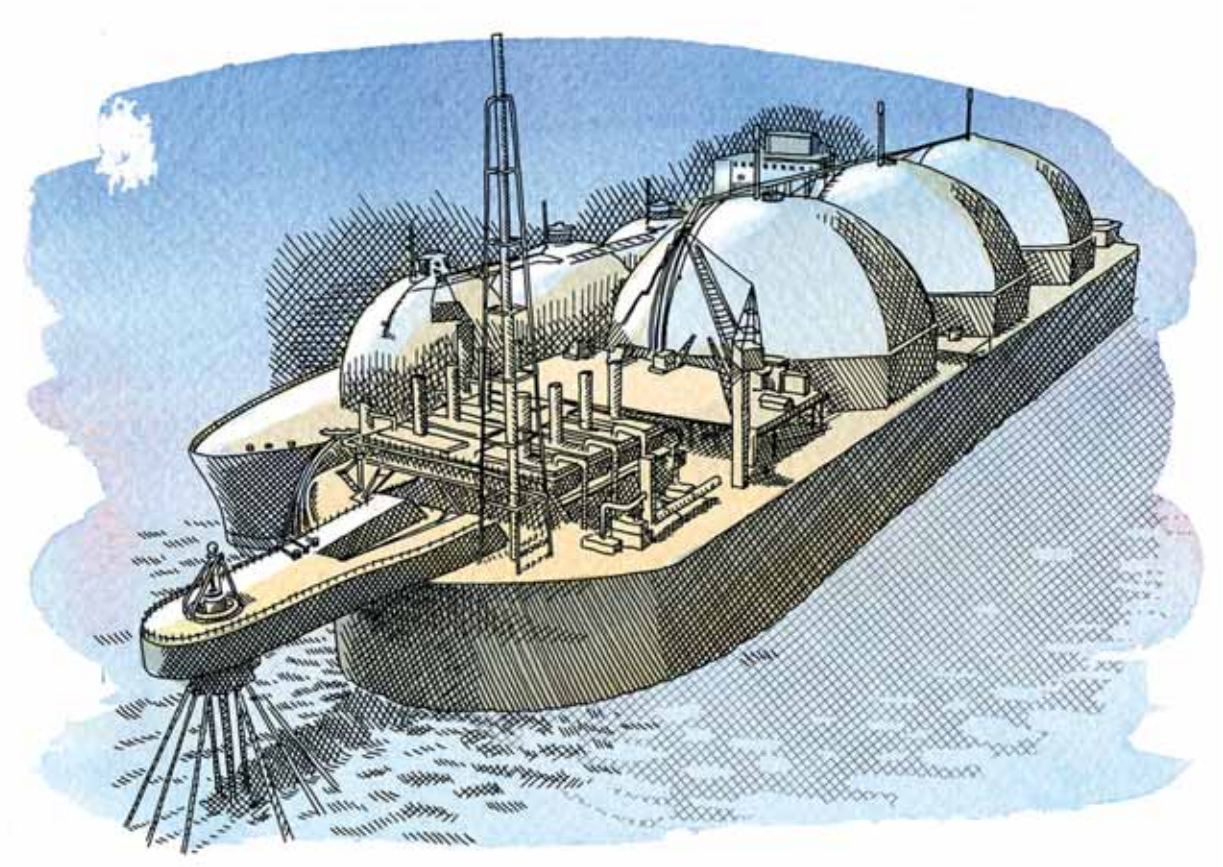
For electricity, this means boosting interconnection levels to make for a more efficient and more integrated European grid. Interconnection levels are currently low (see p. 6). For natural gas, diversification of supply is paramount given the EU's rising dependence on gas imports to compensate for the reduction of indigenous gas production. If the range of suppliers is not sufficiently diverse, there will always be a risk that logistical problems or geopolitical developments could affect security of supply. New transit routes are needed to take full advantage of the range of available supplies (see map on p. 7).

More interconnected energy networks will also support greater competition on EU energy markets. The fragmentation of energy networks – which are still being built solely with national perspectives and national markets in mind – hampers the EU internal energy market. It also makes it difficult to transport energy across national borders, in the sense of network exchanges within Europe.

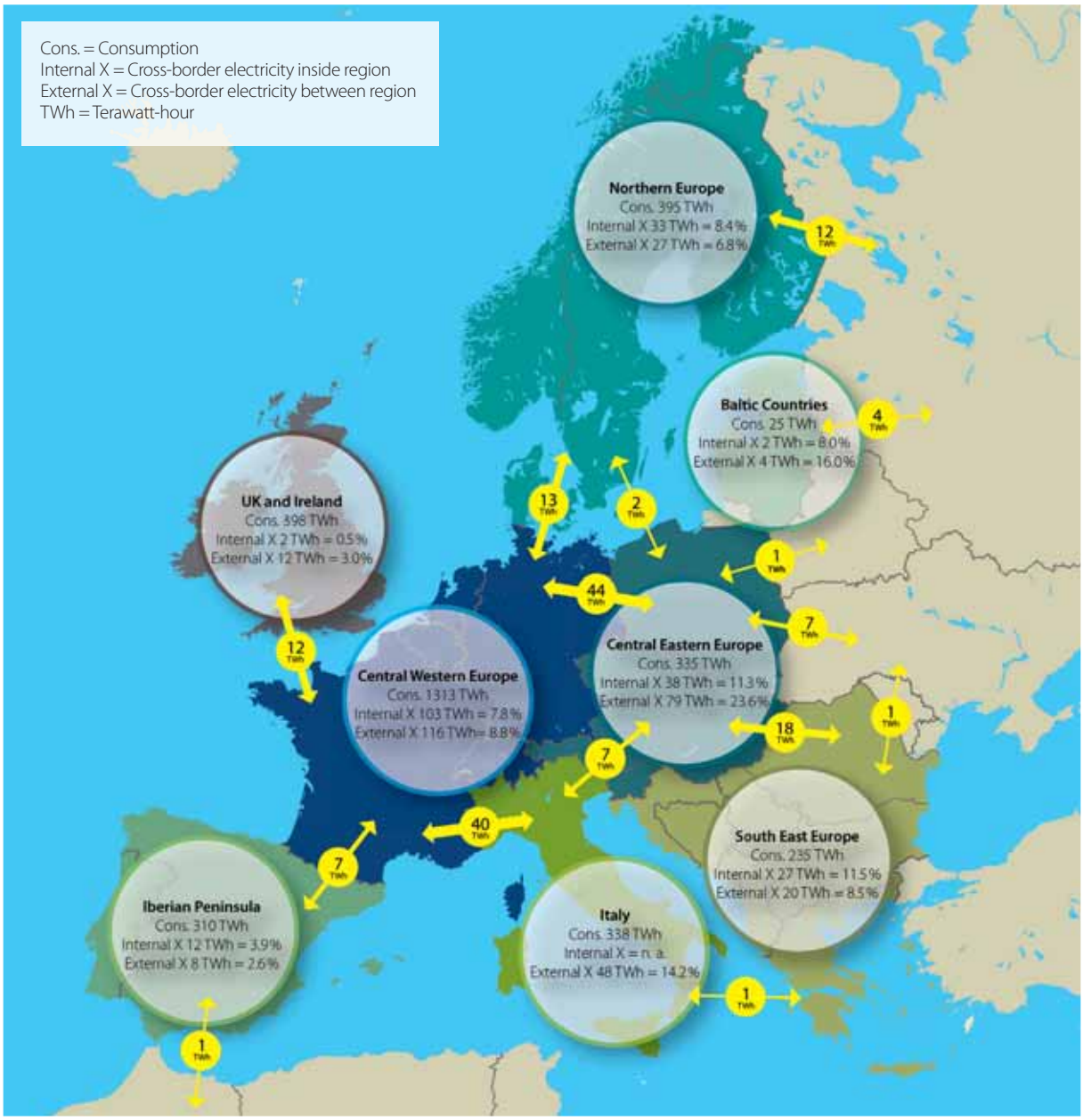
Meanwhile, energy networks need to play their part in making the overall energy system more sustainable and more environment friendly. Energy networks must be energy-efficient (see p. 28), and must enable more electricity from renewable sources to be connected to the grid (see pp. 26-27).

The current state of the EU's energy infrastructure will simply not allow for sustainability, competitiveness and security of supply. Energy networks are facing a range of problems such as ageing installations, insufficient investments in infrastructure, the risk of temporary supply interruptions, the network access regime and a lack of network transmission capacities. The existence of 'energy islands' – countries or regions largely cut off from the rest of the internal market, such as the three Baltic States or the Iberian peninsula, have to be vigorously addressed.

This situation calls for an appropriate policy response on energy networks, including at EU level, and such a response is indeed being developed (see p. 8).



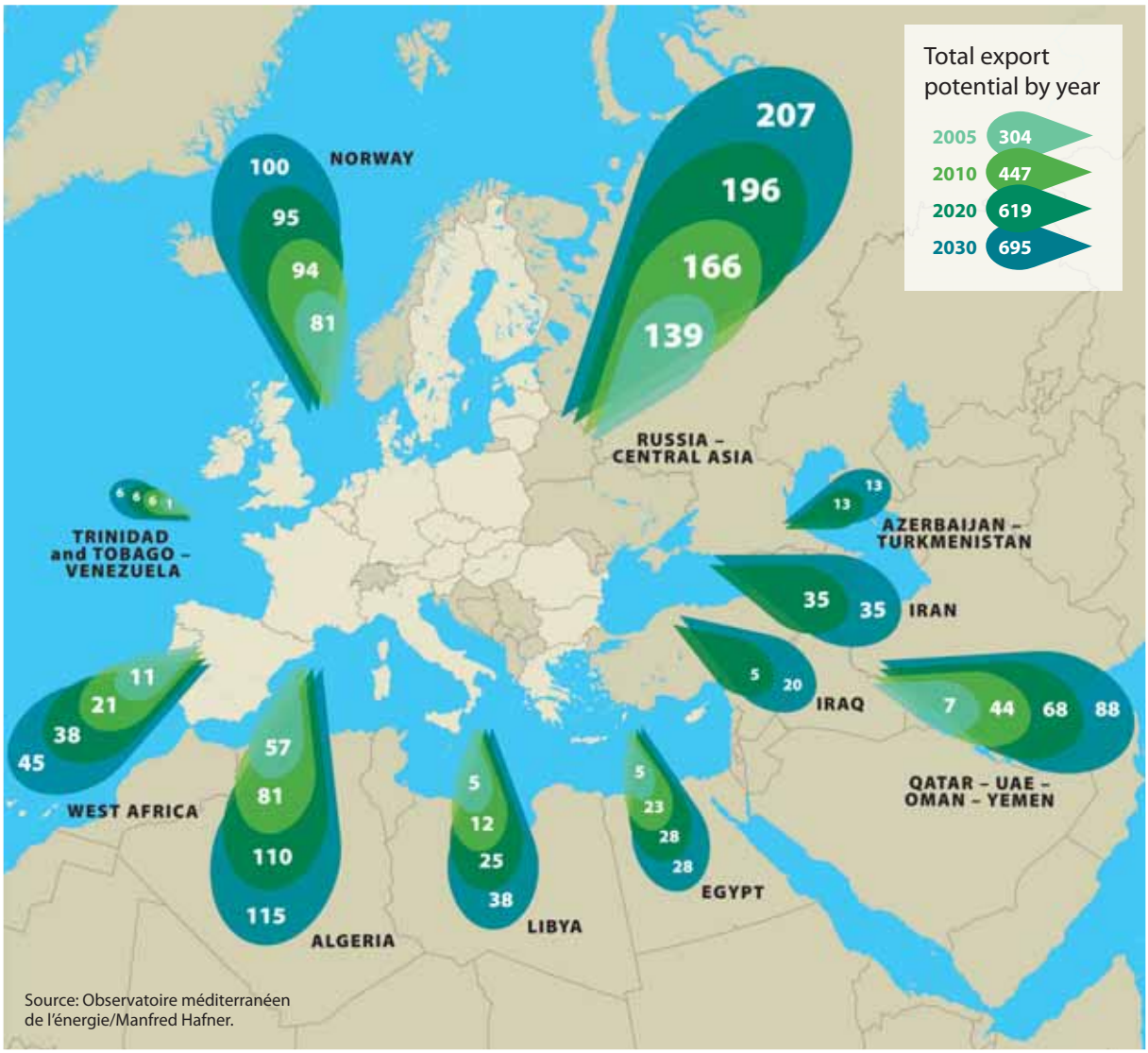
Electricity consumption and exchanges in regions in Europe in 2006 (in TWh)



N.B.: The chart above shows the cross-border flow quantities inside and between certain regions in Europe, as defined by the amended congestion management guidelines ([1]), with the addition of South East Europe. In this chart, those countries belonging to several regions have been counted in the region to which they have the strongest physical connection. Switzerland has been included in the Central Western Europe region and Norway in the northern Europe region.

([1]) 2006/770/EC: Commission Decision of 9 November 2006 amending the Annex to Regulation (EC) No 1228/2003 on conditions for access to the network for crossborder exchanges in electricity, OJ L 312, 11.11.2006, p. 59-65.

Gas export potential (in billion cubic metres) of the main producers to the European Union, Switzerland and the Balkan countries



Source: Observatoire méditerranéen de l'énergie/Manfred Hafner.

Policies for stronger energy networks

The EU has formulated a series of policies to support the development of an effective energy infrastructure in Europe, accompanied by specific guidelines for trans-European energy network (TEN-E) projects (see box).

The EU agreed already in 2002 that minimum electricity interconnection levels between Member States should be increased to 10% – although, as the graphic on page 6 shows, this target has not yet been achieved by a number of Member States. There is also EU legislation designed to ensure an appropriate level of electricity interconnection and gas supply between Member States (see box on p. 9).

Moreover, the heads of EU governments have highlighted the importance of the 'realisation of an interconnected, transparent and non-discriminatory internal energy market, with harmonised rules' ([1]). They have also asked to 'give full support to infrastructure projects compatible with environmental considerations and aimed at opening up new supply routes with a view to diversifying energy imports which would benefit all Member States' ([2]).

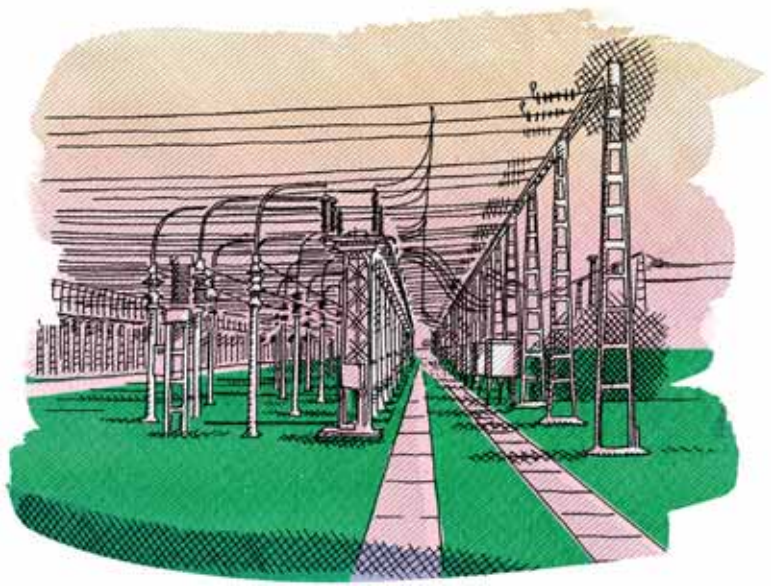
Concrete TEN-E projects have been identified at EU level that will contribute to the development of the trans-European energy network (see pp. 9-20), along with various cross-cutting measures to help their implementation (see pp. 21-25). The European Council of March 2007 underlined the key importance of energy networks and invited the European Commission to develop this policy further.

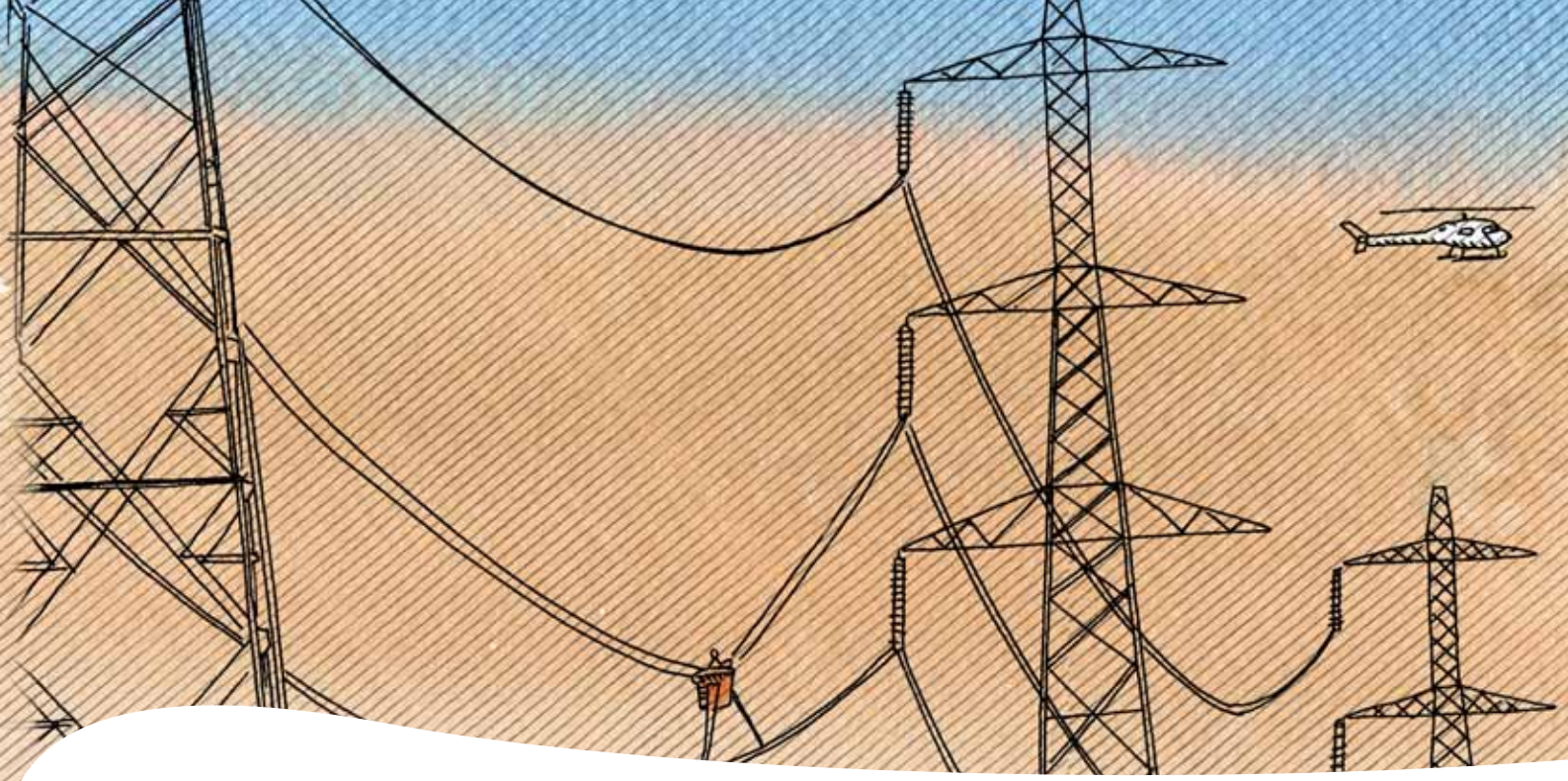
([1]) European Council, Presidency Conclusions (16879/I/06), December 2006.
([2]) European Council, Presidency Conclusions (10633/I/06), June 2006.

TEN-E guidelines

The TEN-E guidelines specify which projects are eligible for EU funding under the TEN-E budget line. They provide a framework for increased coordination and for monitoring progress in implementation. The European Commission published a Green Paper on the future TEN-E policy in November 2008, with a view to extending the existing guidelines to oil and CO_2 infrastructures, and to take into account the latest developments regarding: the EU's security of supply of oil, gas and electricity; interconnections for oil, gas and electricity; liquefied natural gas (LNG) terminals and storage facilities for gas and for CO_2 (carbon capture); and infrastructure links between the EU and supplying and transit countries.

For more information, see: http://ec.europa.eu/energy/index_en.htm





Projects for stronger energy networks

To support the development of the trans-European energy network, the European Commission has published a priority interconnection plan (PIP). The PIP – elaborated in 2006 and adopted in 2007 – sets out five main priorities:

- identifying the most significant missing infrastructure up to 2013 and ensuring pan-European political support to fill the gaps (pp. 10-11);
- appointing European coordinators to pursue the most important priority projects (see pp. 16-20);
- agreeing a maximum of five years within which planning and approval procedures must be completed for projects that are defined as being 'of European interest' under the TEN-E guidelines (see p. 23);
- examining the need to increase funding for the trans-European energy networks, particularly in order to facilitate the integration of renewable electricity into the grid (see p. 25);
- establishing a new mechanism and structure for transmission system operators (TSOs), responsible for coordinated network planning (see p. 21).

Based on the TEN-E guidelines, the EU has identified 43 electricity and gas projects 'of European interest', projects that cross borders or that have a significant impact on cross-border transmission capacity (see pp. 10-20). The PIP describes project progress (see pp. 10-11), including in graphic form in various annexes as well as in an accompanying working document.

The EU makes available funds for such projects (see p. 25). These projects also include a number of particularly significant ones for which a European coordinator has been appointed to facilitate and accelerate project development (see pp. 16-20).

Trans-European energy networks for electricity and natural gas are integral to the EU's energy policy objectives. TEN-E electricity and gas projects aim to develop connections – either within the EU or between EU and non-EU countries – that meet the needs of the EU internal market.

For electricity, integration of renewable energy sources is important, while for gas, in particular, the aim is to improve energy security by diversifying sources and supply routes. Many gas-related projects are linked to pipelines importing gas in order to enhance security of supply.

EU energy legislation

The electricity directive (2003/54/EC) and the gas directive (2003/55/EC) are the key EU laws establishing the internal market for electricity and for gas. Regulation (EC) N°1228/2003 on cross-border trade in electricity sets rules for transmission of electricity between Member States, while Regulation (EC) N°1775/2005 on conditions for access to the natural gas transmission networks sets rules for transmission of gas between Member States. Directive 2005/89/EC concerns measures to safeguard security of electricity supply and infrastructure investment, while Directive 2004/67/EC concerns measures to safeguard security of gas supply.

The state of Europe's energy infrastructure: electricity projects

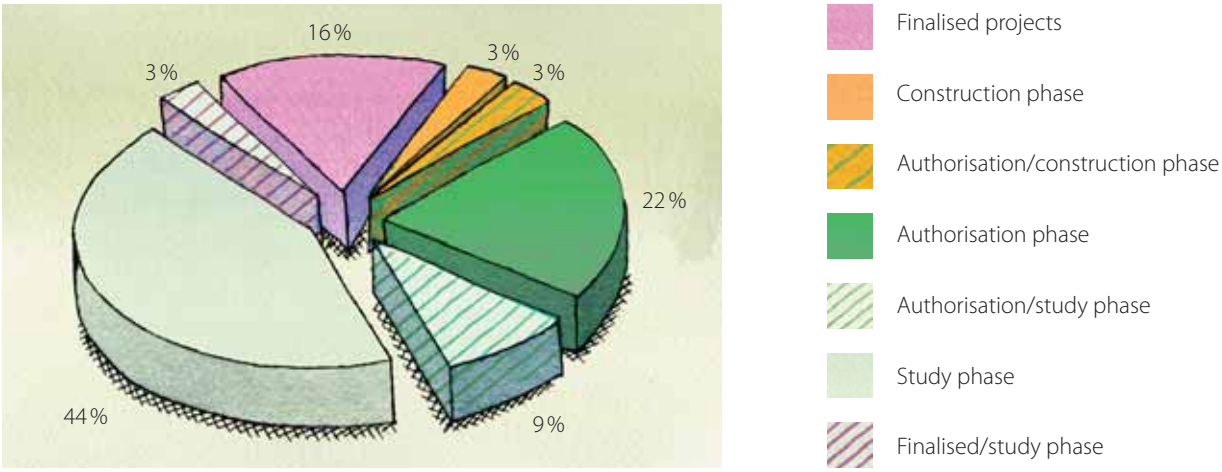
The electricity infrastructure projects of European interest (see map on pp. 12-13) are all being actively pursued with a view to developing interconnections across Europe. Indeed, some projects with a long history appear to have been given renewed impetus by being named a project 'of European interest' (see p. 9). Several projects have been completed (see chart).

However, more than half the projects have faced delays. The complexity of planning and other authorisation procedures is the major reason for most delays. But delays can also be caused by local opposition (often based on the rejection of the environmental impact of a project), or by insufficient increases in cross-border capacity by transmission system operators, or by the lack of cooperation between operators (which have tended to behave more as competitors than as partners with mutual interests).

The priority interconnection plan (PIP) started to solve such problems by identifying the most important infrastructure projects encountering significant difficulties ([3]). This in turn helps to ensure that appropriate attention and effort are focused on these schemes on the part of stakeholders and national authorities. It is emphasised that the EU Member States have a clear responsibility for monitoring and coordination to ensure their completion. To help the coordination of Member States concerned and the promoters of the project, European coordinators were appointed in September 2007 to accelerate the implementation of initially three key projects related to electricity (see pp. 16-19).

([3]) For the complete list, see the PIP (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52006DC0846:EN:NOT).

Projects of European interest – electricity sector



The state of Europe's energy infrastructure: gas projects

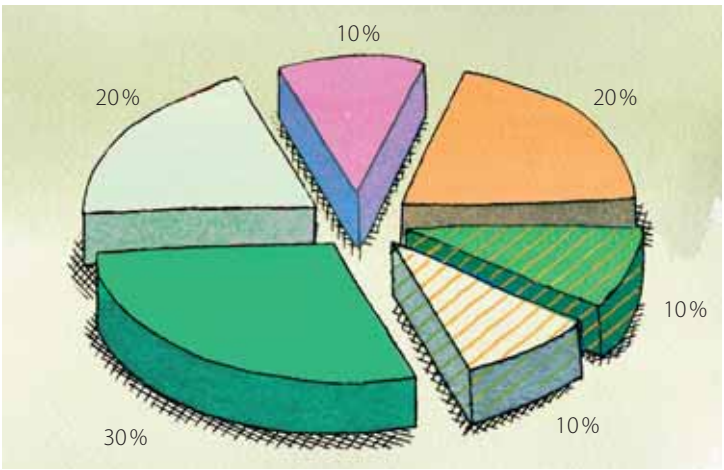
The EU needs to diversify its gas supplies, using mainly pipelines to maximise sources and routes of supply. The EU also needs to make sure that imported gas reaches the end consumer. This means developing downstream distribution within the EU, by means of pipelines linking the Austrian, Benelux, British, Danish, French, German, Spanish and Swedish gas markets. Meanwhile, importing liquefied natural gas (LNG) through terminals located on Europe's coasts and islands can also offer greater diversity and security of supply, though at higher cost.

Most of the 11 gas pipeline projects 'of European interest' (see map on pp. 14-15) are progressing reasonably well. No significant delays have been reported for the majority of the projects. And at least 7 of the 11 projects should start operating by 2010-13. This infrastructure will represent yearly additional import capacity for the EU of around 80 billion m^3 to 90 billion m^3 by 2013 – or 16-17 % of the EU's estimated gas needs for 2010.

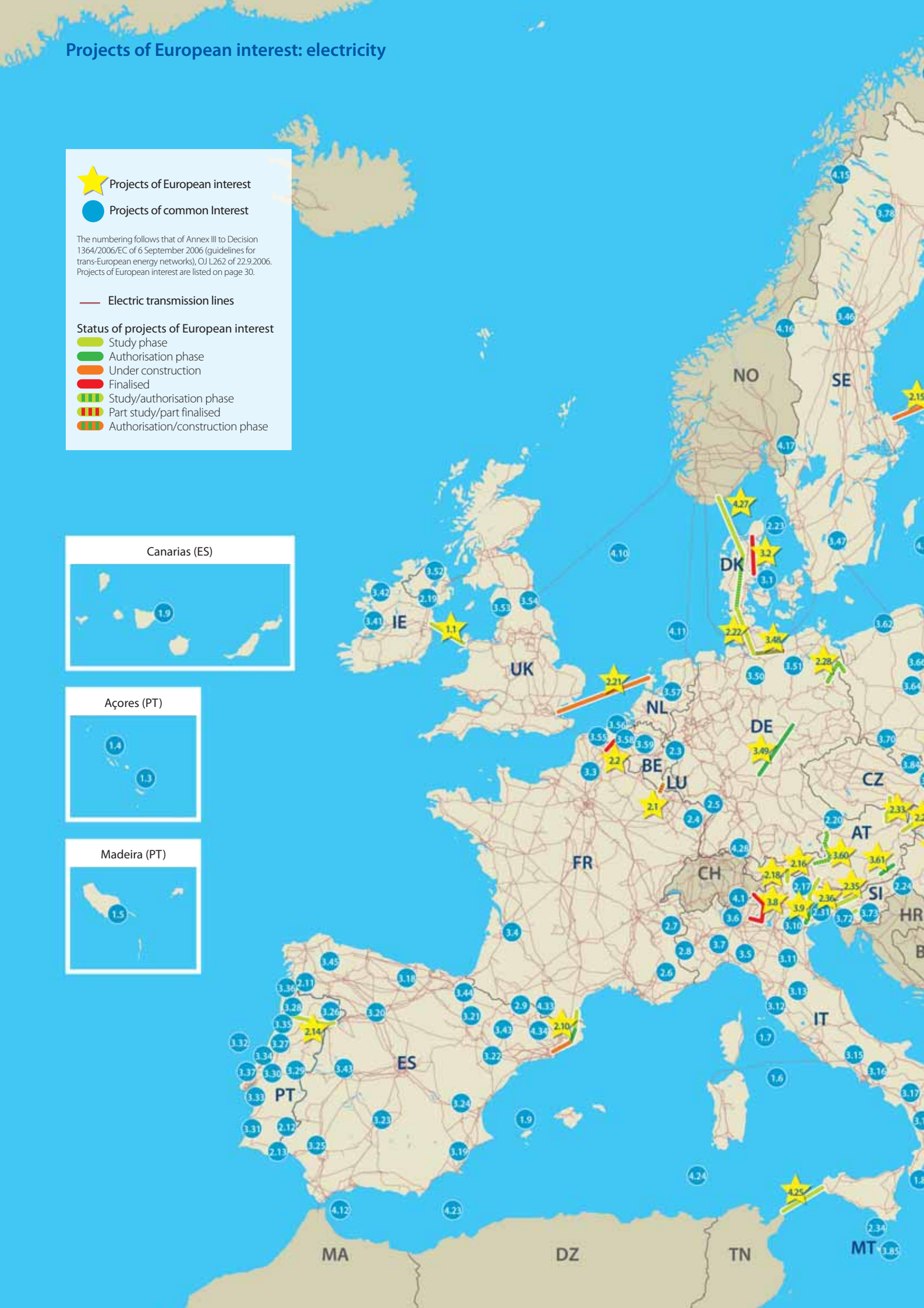
A European coordinator was appointed in September 2007 to oversee the Nabucco pipeline project (see p. 20) – a major project that will be particularly important for the diversity and the security of the EU's energy supply in supplying Europe with gas produced in Central Asia, the Caspian region and the Middle East.

LNG projects do not have the label of projects 'of European interest', but they are also progressing. However, work on terminals and storage facilities has been hampered in various Member States and a number of projects have been abandoned or blocked. Delays can be caused by environmental concerns or local opposition. Nevertheless, LNG terminals located within the EU provide significant additional gas capacity wich is likely to increase in future. LNG represents today 10 % of EU gas consumption and might represent between 15 % and 20 % in 2020. Underground storage of gas should also be expanded to enhance the flexibility of supply.

Projects of European interest – gas pipelines



Projects of European interest: electricity



Electricity regional initiative (ERI)

Baltic: Estonia – Latvia – Lithuania
Central-East: Austria – Czech Republic – Germany – Hungary – Poland – Slovakia – Slovenia
Central-South: Austria – France – Germany – Greece – Italy – Slovenia
Central-West: Belgium – France – Germany – Luxembourg – Netherlands
Northern: Denmark – Finland – Germany – Norway – Poland – Sweden
South-West: France – Portugal – Spain
France – UK – Ireland: France – United Kingdom – Ireland

Baltic

Central-East

Central-South

Central-West

Northern

South-West

France – United Kingdom – Ireland

Projects of European interest: gas

Gas regional initiative (GRI)

North-West

North-West: Netherlands – Belgium – France – Ireland – Great Britain – Germany – Denmark – Sweden – Northern Ireland – Norway (observer)

South – South-East

South South-East: Austria – Bulgaria – Czech Republic – Greece – Hungary – Italy – Poland – Romania – Slovakia – Slovenia

South

South: Spain – Portugal – France

GAS PIPELINES

Pipelines of European interest
- Study phase
- Authorisation phase
- Under construction
- Finalised
- Potential section

Pipelines of common interest
- In operation
- Planned

Other important pipelines
- In operation
- Planned

- Projects of European interest
- Projects of common interest

The numbering follows that of Annex III to Decision 1364/2006/EC of 6 September 2006 (guidelines for trans-European energy networks), OJ L262 of 22.9.2006. Projects of European interest are listed on page 30.

LNG TERMINALS

Regasification terminals of common interest
- In operation
- Under construction
- Extension planned or ongoing
- Planned

GAS STORAGE FACILITIES

Projects of common interest
- In operation with extension planned
- Planned

St-Petersburg
Moskva
Minsk
Kyjiv
Dnipropetrovs'k
Kryvyj Rih
Zaporizzja
Chisinau
Dzubga
White stream
Blue stream
South stream
Transcaspian
Baku
T'bilisi
Akhalts'ikhe
Yerevan
Dogubayazit
Constanta
Bucuresti
Varna
Samsun
Istanbul
Ankara
Cigli
Cizre
Kavala
Bursa
Nabucco
ITG
Baghdad
Revithoussa
Athina
Lefkosia
Vassilikos
Beirut
Dimašq
Amman
Tel Aviv
Heraklion
Cairo
9.14
9.23
9.21
9.22
7.16
9.35
6.11
6.12
6.13
6.7
6.8
8.10
8.21

European coordinators for key network projects

European energy coordinators were appointed in September 2007 to boost progress on four particularly significant TEN-E cross-border projects that have faced technical, political or financial difficulties. The move reflects a commitment to realising major energy infrastructure projects in Europe.

As proposed in the PIP, the coordinators monitor and facilitate the implementation of these top-priority energy network schemes. The coordinators offer strategic support and provide practical advice. This includes tackling obstacles to project development, bringing interested parties together across borders to work out solutions, assessing the impact of projects and defining appropriate implementation strategies, as well as securing top political attention in the Member States concerned.

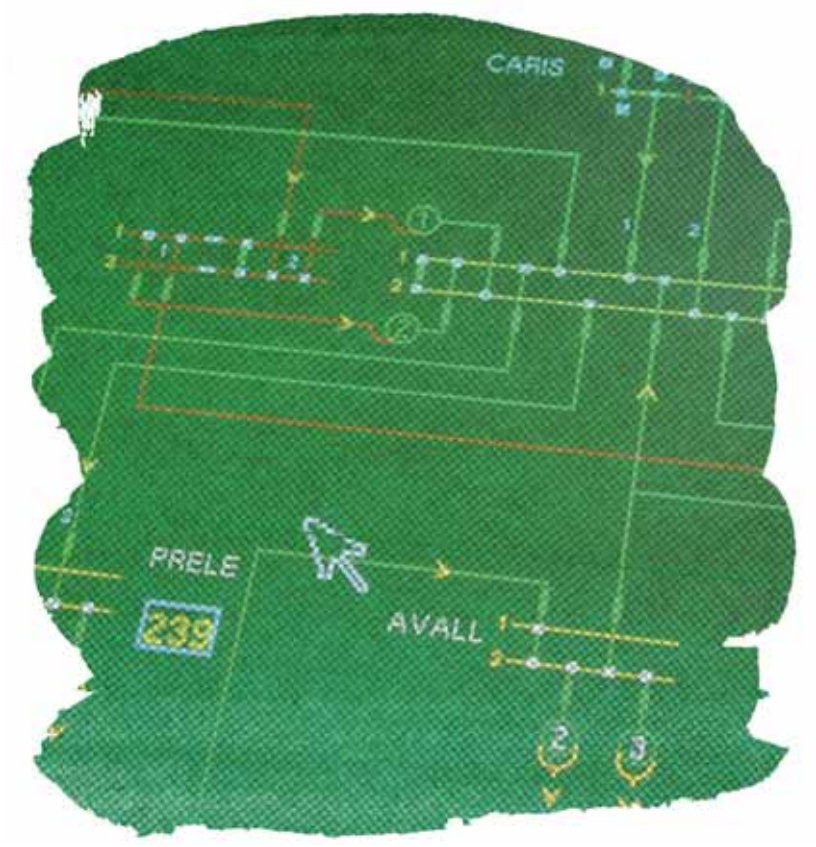
EU Energy Commissioner Andris Piebalgs, speaking in July 2007 ([4]), underlined the added value of appointing European energy coordinators: 'This is not just another bureaucratic exercise – it is something which the project organisers have asked for and which all Member States have welcomed. It will bring real added value, and help us strengthen the economic foundations for the future prosperity of our citizens'.

The four projects and European coordinators are:

- high-voltage electricity connection between France and Spain: Mario Monti (see p. 17);
- offshore wind connections in the Baltic and North Sea areas: Georg Wilhelm Adamowitsch (p. 18);
- northern Europe power link between Germany, Poland and Lithuania: Wladyslaw Mielczarski (p. 19);
- the natural gas axis linking the Caspian Sea countries and the Middle East to the European Union including the Nabucco gas connection project between Turkey and Austria through Romania, Bulgaria and Hungary: Jozias Johannes van Aartsen (p. 20).

Meanwhile, enhanced coordination at European level needs to be accompanied by more coordinated planning of energy networks at regional level. This issue is addressed in the PIP and in the development of various regional electricity and gas initiatives (see p. 22).

([4]) European Commission press release IP/07/1106.



The French–Spanish connection

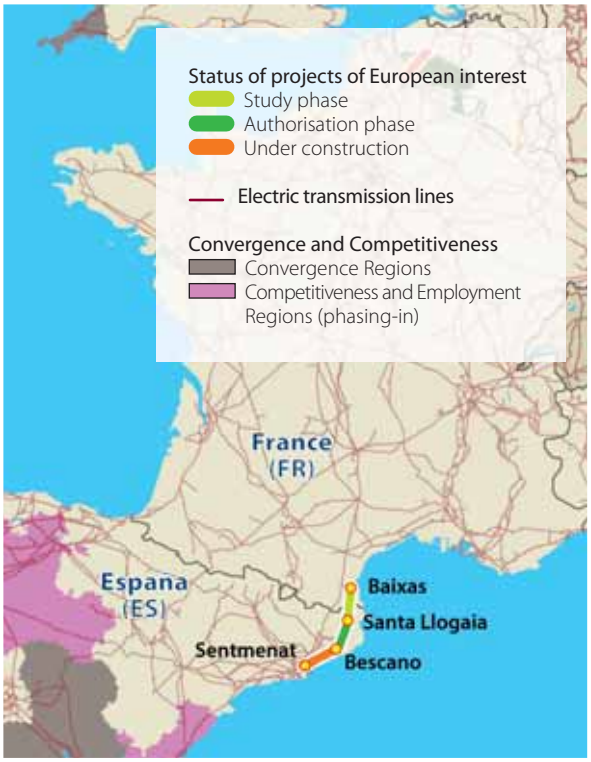
The planned high-voltage electricity connection between France and Spain, on the 210 km Sentmenat (Spain) to Bescanó (Spain) to Baixas (France) line, is crucial for linking the core of the EU with the Iberian electricity 'island' (see map). The link is needed to secure the supply of both countries and to ensure the creation of an effective EU internal energy market.

The link has, however, experienced significant difficulties over the years. Crossing the Pyrenees represents a physical and an environmental challenge, while the difficulty of defining cross-border points between Spain and France and local opposition have also been obstacles.

However, on 10 January 2008, the two EU Member States, following a proposal of Mario Monti, the European coordinator, agreed to relaunch the project on the basis of a joint venture between the two transmission system operators (TSOs) concerned. The coordinator was asked by President Sarkozy of France and Prime Minister Zapatero of Spain to present, by the end of June 2008, a report on a possible solution to overcome the outstanding difficulties. On 27 June 2008, Mr Zapatero and French Prime Minister Fillon signed an agreement to launch the implementation of the cross-border section of the connection running through the Pyrenees based on the conclusions of the report.

The solution is to bury the 60 km international section underground and to operate it with direct current. The report recommended that the buried line should follow the existing infrastructure (rail-road) already crossing the Pyrenees. The two Member States charged the French and Spanish TSOs to begin without delay the procedures to implement the project. The cost will be higher compared to an overhead solution, but the underground solution should have long-term potential for the TSOs in terms of profitability.

It is foreseen that the link could be operational towards the end of 2011.



Meet the coordinators: Mario Monti

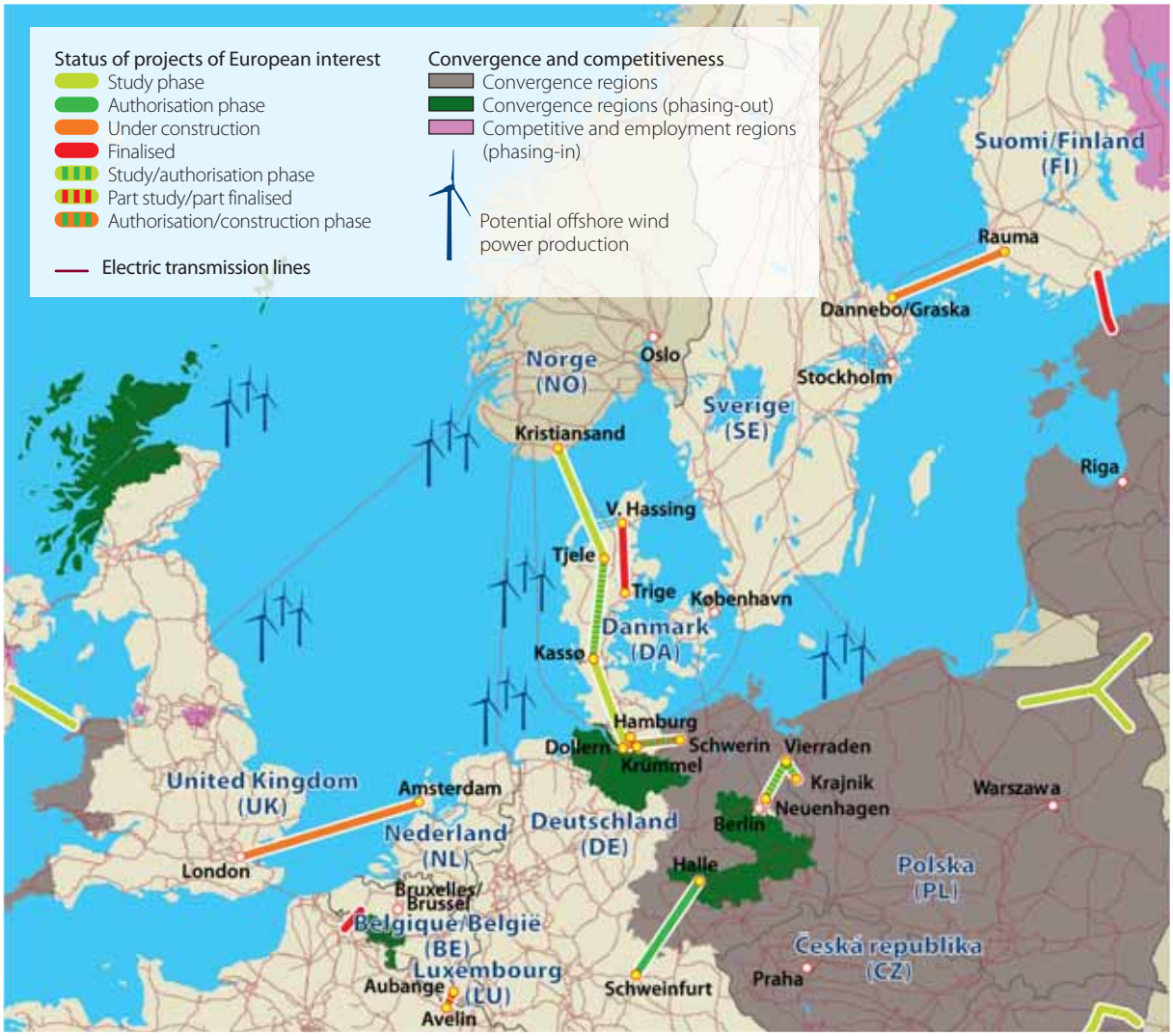
Mario Monti of Italy is helping to speed up the implementation of a high-voltage electricity connection between France and Spain. Mr Monti was a European Commissioner from 1995 until 2004, in charge of the internal market, financial services and tax policy (1995-99) and competition policy (1999-2004).

Baltic and North Sea offshore wind connections

The connection of offshore wind power in the Baltic and North Sea areas (see map) aims to integrate the wind energy produced there into the continental power grid. The project will contribute to the creation of a more environmentally sustainable energy network.

As the power generated offshore needs to be transmitted to the load centres, i.e. to the consumers, onshore grid improvements need to be in line with – or even ahead of – the increase in offshore capacity. The project list of the 2006 TEN-E guidelines does not in fact fully reflect the large wind power generation capacities planned in the North Sea and the Baltic Sea. Such additional links are being identified in the European wind energy integration study (see p. 27) supported by the European Commission.

In the context of the projects of European interest, of key importance is the planned Kassø (Denmark) to Hamburg/Dollern (Germany) line. However, there are significant challenges because the line passes through a densely populated area. Furthermore, it is difficult to plan for such a large amount of wind power to be transmitted between the two countries. The Hamburg/Krümmel–Schwerin and Halle/Saale–Schweinfurt lines in Germany are equally significant for the integration of wind electricity, along with the links north of Kassø in Denmark. Local opposition and fragmented authorisation procedures can significantly delay the implementation of the links in Germany.



Meet the coordinators: Georg Wilhelm Adamowitsch

Georg Wilhelm Adamowitsch of Germany oversees the connection of offshore wind power in northern Europe (North Sea and Baltic Sea). Mr Adamowitsch is a former State Secretary in the German Ministry of Economy.

The northern Europe power link

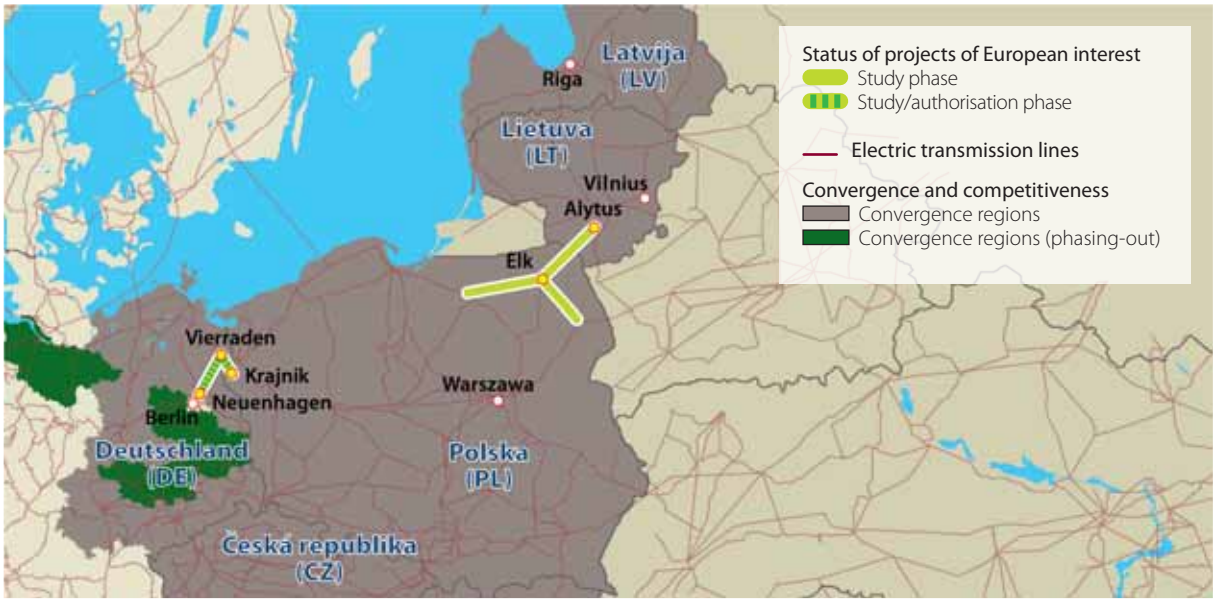
The northern Europe power link connecting Germany, Poland and Lithuania (see map) will link the Baltic grid to the continental network (Germany, Poland) in order to improve the countries' security of supply and to help the internal energy market function correctly.

The power link is composed of the interconnector itself (400 kV interconnectors and converters) as well as of related internal network developments in Lithuania and Poland and on the Poland-Germany section.

The technical solution proposed for the interconnector is a direct current back-to-back converter station at Kryonis in Lithuania, together with a 400 kV alternating current interconnecting line between the converter station and Elk in Poland.

Following the recommendation of the European coordinator, the Polish and Lithuanian TSO's created a joint venture 'LitPol Link' that would prepare the plan, analyses and financing as well as obtain permits for the construction of the power bridge that is to link Elk (PL) with Alytus (LT).

Furthermore, the Polish grid has to be upgraded from east to west up to the Poland–Germany connections. Relevant work also includes the Neuenhagen (Germany)–Vierraden (Germany)–Krajnik (Poland) line and a new interconnection between Germany and Poland.



Meet the coordinators: Wladyslaw Mielczarski

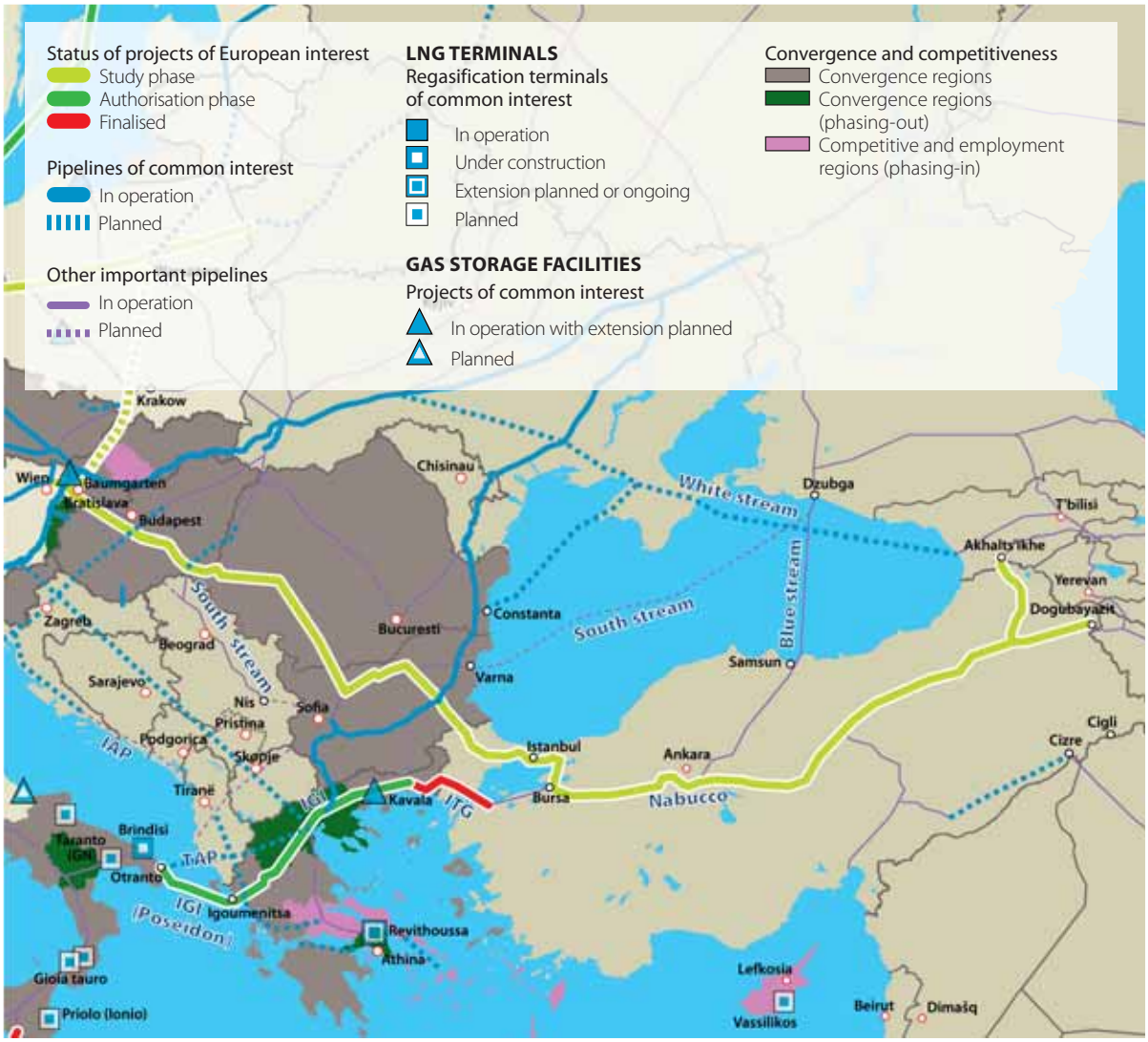
Wladyslaw Mielczarski of Poland is helping to speed up the implementation of the power connection between Germany, Poland and Lithuania. Mr Mielczarski, a professor at the University of Łódź, has a wealth of experience in the field of electricity networks.

The axis linking Caspian Sea countries and the Middle East to the European Union, including the Nabucco pipeline

The Nabucco gas pipeline project linking Azerbaijan, Georgia and Iran, through Turkey, to Austria via Bulgaria, Romania, and Hungary aims to develop a new route to supply Europe with significant volumes of gas produced in Central Asia, the Caspian region and the Middle East. The project is of great importance for the diversity and the security of the EU's energy supply.

The pipeline will link the Caspian Basin and the Middle East to Baumgarten in Austria across five countries and a distance of more than 3 000 km (including 20 km offshore and 70 m deep). Nabucco is a complex and unique project with very specific challenges, with a number of countries from both in and outside the EU trying to activate new supplies from countries traditionally dominated by one single buyer of their gas. The sheer physical challenges involved in building a pipeline of that length, and over some difficult terrain, explain why construction is expected to cost approximately EUR 7.9 billion. Sustained political is also required for the scheme to be realised.

Construction should begin in 2010, in order to have the pipeline in operation in 2013. The project is driven by OMV (Austria), MOL (Hungary), Transgas (Romania), Bulgargaz (Bulgaria) and Botas (Turkey), who signed a cooperation agreement in 2002, while RWE (Germany) joined the project in February 2008.



Meet the coordinators: Jozias Johannes van Aartsen

Jozias Johannes van Aartsen of the Netherlands deals with the Nabucco gas connection project. Mr van Aartsen is a former Dutch Minister for Foreign Affairs (1998-2000).

Further measures to develop energy networks

There is more to the EU's energy interconnection initiatives than TEN-E projects and the appointment of European coordinators, important as these are. The European Commission is also pursuing a range of cross-cutting measures that should aid the development of energy networks, with an emphasis on the need for regional, cross-border cooperation.

Such cross-cutting measures concern: network planning (see below), project-related authorisation procedures (p. 23), the framework for investment in energy networks (p. 24), and EU funding (p. 25).

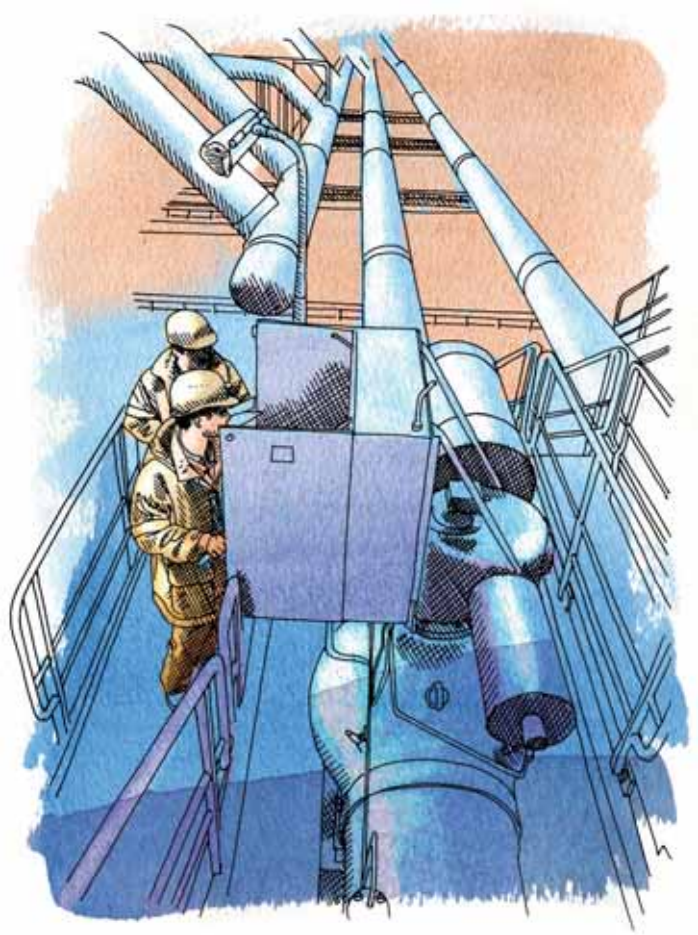
Better planning

Planning and building Europe's network infrastructure in a situation of liberalised energy markets is an ongoing process that requires regular monitoring and coordination between market actors.

Open and transparent planning in conjunction with coordinated measures is essential. It is also essential to involve citizens as well as local authorities from the beginning. This is why the European Commission proposed, in its September 2007 'package' of draft internal energy market legislation, to establish a European network for transmission system operators (TSOs). The aim is to step up cooperation between TSOs for a more efficient transmission network and a more efficient market.

The prospective network would, among other things, be responsible for coordinating the planning of network investments and monitoring the development of network capacities. The network would publish forward-looking investment plans every two years, to help identify investment gaps. Operators would be obliged to consult with industry, including on network planning activities.

Meanwhile, coordinated planning at regional level has an important part to play in developing energy networks. A number of 'regional initiatives' for electricity and gas (see p. 22 and maps on pp. 12-15) are working to promote regional integration of energy networks and markets, in effect putting in place building blocks for what should ultimately be EU-wide integration.



Regional initiatives: towards single European markets for electricity and gas

Regional initiatives are contributing to the development of EU-wide markets for electricity and gas. In 2006, the European Regulators' Group for Electricity and Gas (ERGEG) launched an electricity regional initiative (ERI) and a gas regional initiative (GRI), based on a number of multi-country regional energy markets (see maps on pp. 12-15).

The aim is to integrate national electricity and gas markets into coherent wider regional markets, and to promote convergence between these regions as a stepping stone towards the establishment of competitive single European markets. The initiatives bring together energy regulators, the European Commission, EU Member States, companies and other relevant parties.

For electricity, closer integration of networks through greater cooperation between regulators and network operators will help to move towards a unified European grid which will support markets and security of supply. The ERI focuses on the practical issues that are most important to the further development of effective competition. For example, key issues in electricity wholesale markets are the management of congestion at borders and cross-border capacity.

Similarly, for gas, creating a single market depends on developing a true European gas network in which regional markets are well interconnected. This includes improving the way gas is imported and traded (at and between gas hubs) as well as looking at other factors such as the geo-political situation, transparency, information provision and access to networks. Particular attention should be paid to those countries facing a high dependence on a single supplier or those that are 'energy islands'.

The ERGEG reports on the ERI to an electricity regulatory forum called the Florence Forum (named after the original venue for the forum's meetings), and on the GRI to the equivalent forum for gas, the Madrid Forum. The forums discuss issues relating to the creation of true EU internal electricity and gas markets.

- **ERGEG regional initiatives:** http://www.energy-regulators.eu/portal/page/portal/EER_HOME/EER_INITIATIVES
- **Florence Forum:** http://ec.europa.eu/energy/electricity/florence/index_en.htm
- **Madrid Forum:** http://ec.europa.eu/energy/gas/madrid/index_en.htm

Swifter authorisation procedures

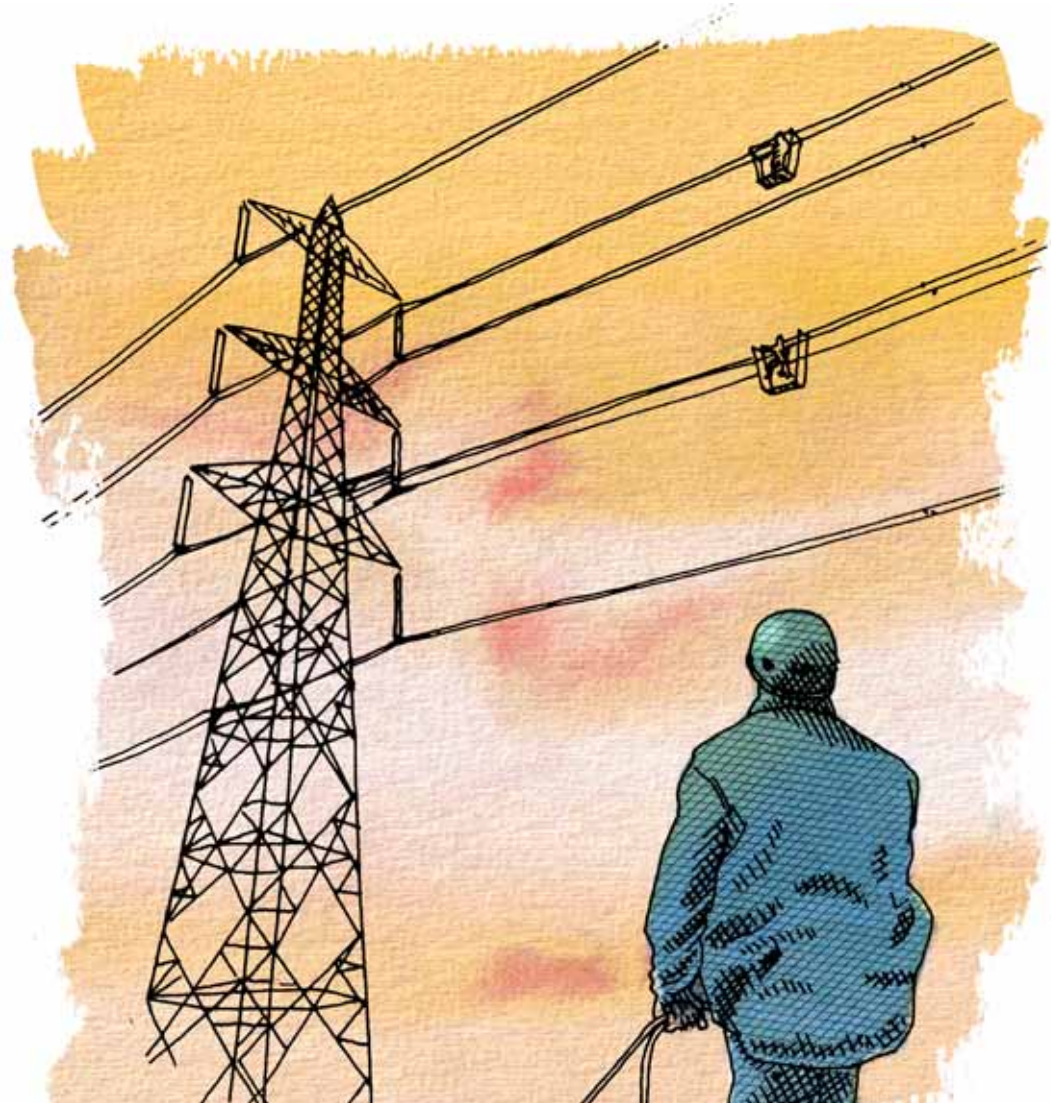
Authorisation procedures for electricity and gas infrastructure projects need to be sped up. Reducing planning and construction times for priority EU infrastructure – in a way that takes due account of environmental, safety and health concerns – is vital to maintain the right level of security of supply.

Time-consuming legal and licensing procedures constitute significant barriers to the development of energy infrastructure projects. Fragmented procedures, local opposition, frequent use of veto powers, and the large number of entities involved in authorisations represent major obstacles. A lack of coordination and different timescales often delay authorisation procedures for connections between EU Member States.

Some countries have simplified their authorisation procedures, but in general the main difficulties still persist. Building a new connection may in some cases take more than a decade, whereas it takes two to three years to construct a wind farm or a combined-cycle gas turbine. This makes it difficult for Europe's energy network to keep pace with market developments, such as demand for renewable energy.

The priority interconnection plan (PIP) addresses this issue in two ways. Firstly, it foresees that declaring projects 'of European interest' can bring added visibility and impetus. Secondly, the PIP envisages streamlined authorisation procedures whereby national procedures are in place under which planning and approval processes for projects of European interest are completed within five years at the most.

The revised TEN-E guidelines which could be proposed by the European Commission after the debate on a Green Paper should, among other things (see p. 9), consider solutions for accelerating authorisation procedures for important infrastructure projects which serve to enhance security of supply and the solidarity between Member States. The goal is to ensure that national procedures are completed within a reasonable timeframe, while respecting environmental legislation and the legitimate interest of affected citizens.



A clearer investment framework

Energy infrastructure projects also need a suitable environment for making investments. A stable regulatory framework must be in place to attract investment from the private sector.

The EU's estimated energy investment needs are substantial: some EUR 1 800 billion up to 2030, including nearly EUR 1 600 billion for electricity and gas together ([5]). For electricity, investment tends to be needed to replace or upgrade existing infrastructure rather than install it from scratch (see graph below). For gas, the main need is for new pipelines, underground storage and LNG terminals.

However, investment in new energy transmission lines has slowed down. This seems to be at least partially due to the way energy markets in the EU are structured: without greater competition, it can be difficult for new entrants to access the market, and incumbent suppliers may not feel sufficient incentive to invest in the network.

The September 2007 internal energy market proposals aim to increase competition by means of 'unbundling' energy firms – separating the operation of transmission networks from supply and generation and distribution activities. The proposals also foresee stronger powers for energy regulators and greater market transparency.

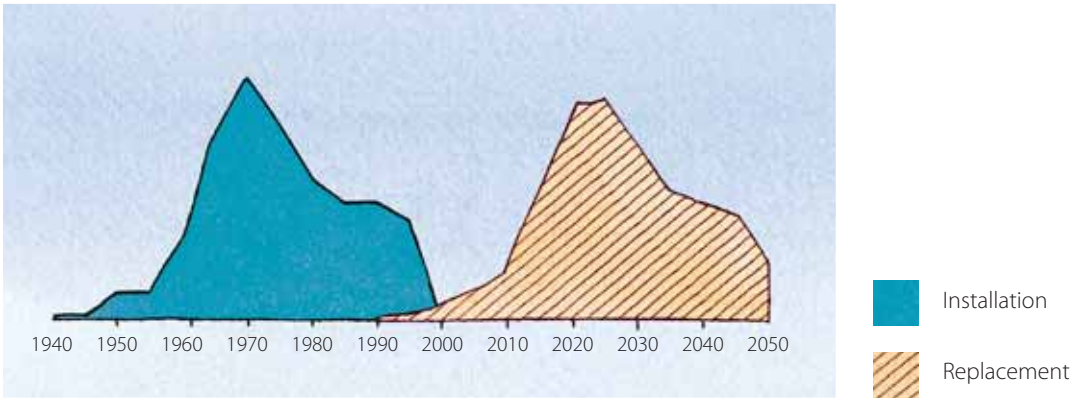
The EU can also encourage investment in other ways. EU energy legislation ([6]) provides for the possibility of exemptions, under certain circumstances (such as a limited period and a certain share of the capacity), from the requirement to give third parties access to major new gas infrastructure or new electricity interconnectors. This can be an important incentive for companies to invest in long-term projects.

Meanwhile, EU funding for TEN-E projects is also available (see next page).

([5]) EU-27 cumulative energy investment needs up to 2030 (baseline scenario) from European Commission staff working document 'EU energy policy data'.

([6]) The electricity regulation ((EC) No 1228/2003), Article 7; the gas directive (2003/55/EC) Article 22.

Installation and replacement distribution for electrical switchgears



Source: CIGRE/TEN-Energy Invest, summary report.

EU funding

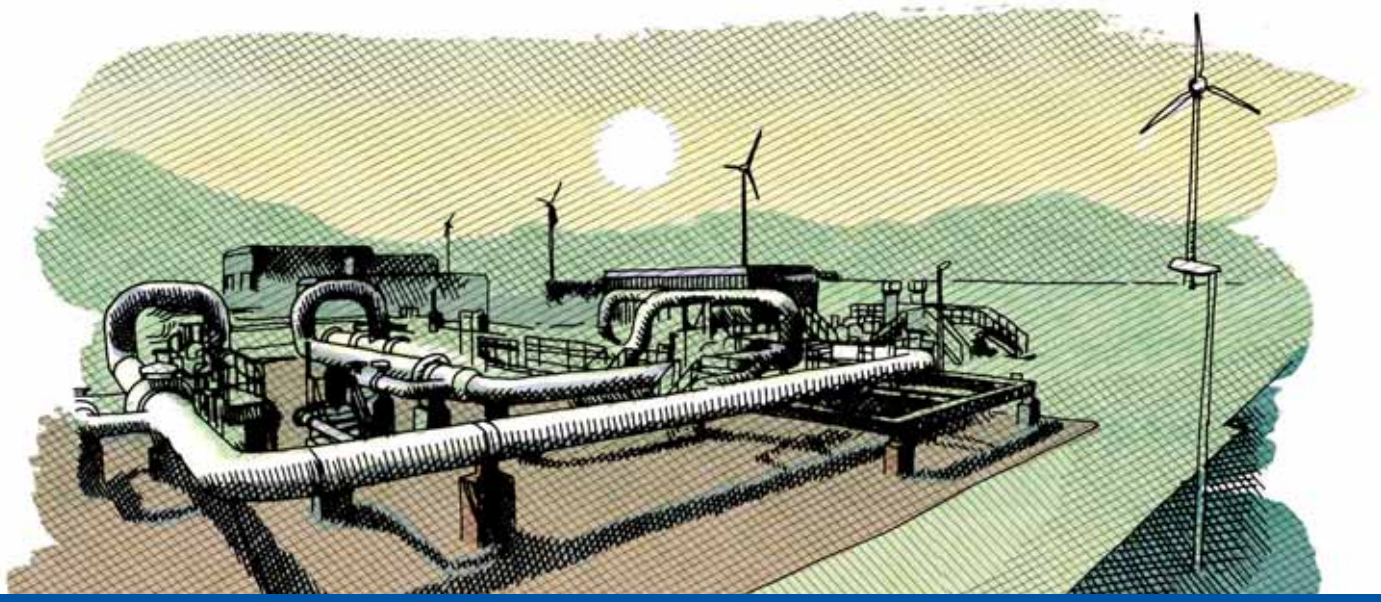
It is primarily up to the economic operators concerned to finance TEN-E projects. The EU nonetheless helps to fund projects with a view to developing the trans-European energy network, with priority given to projects of 'European interest'.

The EU's specific TEN-E budget line – worth about EUR 20 million every year – is spent mainly on supporting feasibility studies. Other possible sources of EU funding are also available (see box). For example, European Investment Bank loans worth EUR 9.1 billion for TEN-E projects had been signed by the end of December 2005. Structural and Cohesion Funds may also support such projects in eligible countries.

Public financing of TEN-E projects gives a European label to the private operators and this may help overcome financial, environmental and administrative problems.

However, the TEN-E budget alone will not be enough to bring about the massive infrastructure investments that Europe needs, especially given the considerable challenges facing the EU's energy network, including: indispensable increases in gas import capacities; integration of renewable sources of electricity; increasing infrastructure needs due to EU enlargement; and the connection of isolated markets.

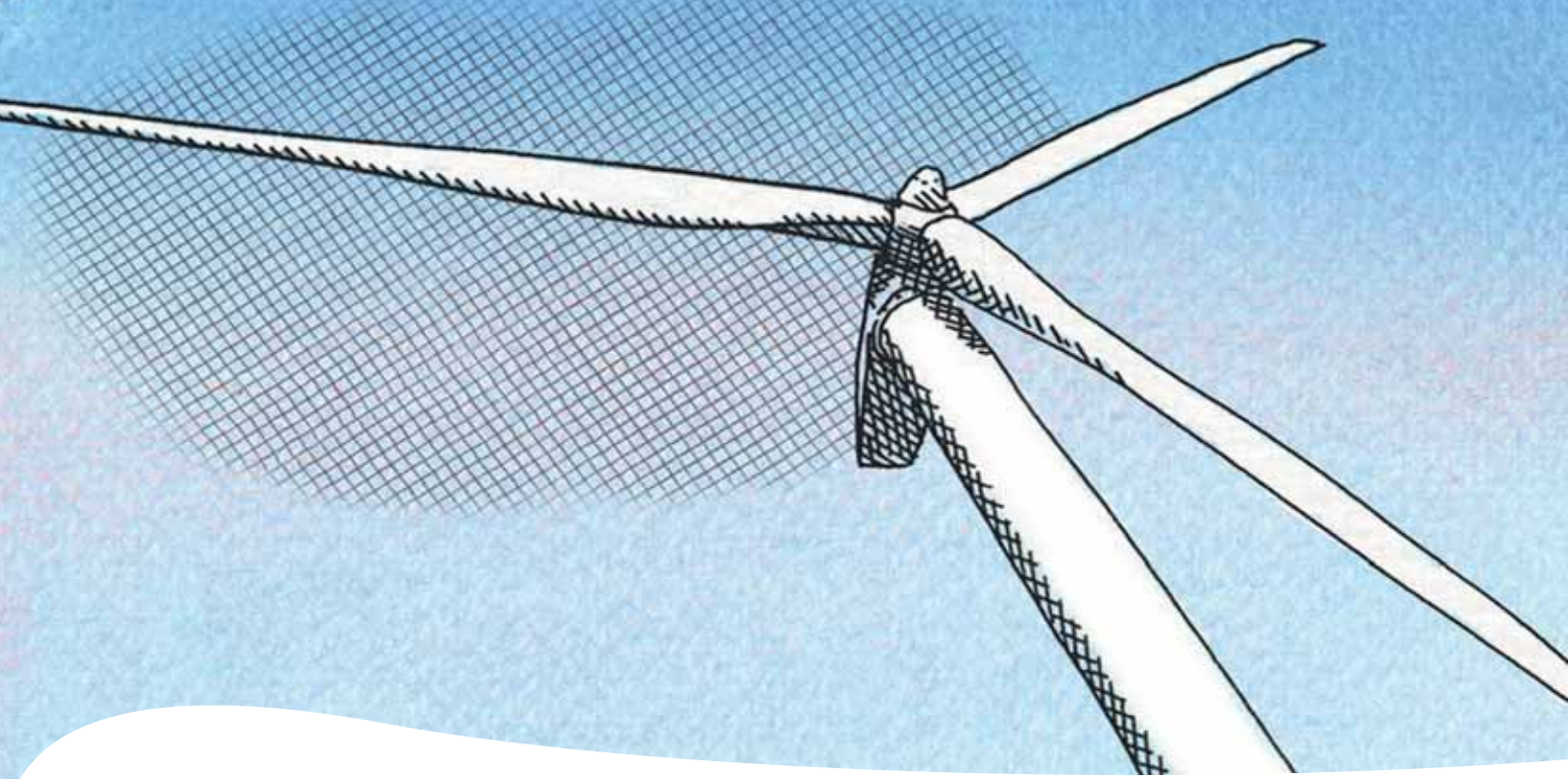
Looking to the future, TEN-E financing should mainly be deployed for socio-economic and planning studies of a much greater EU impact, such as the incorporation into the main grid of offshore wind generation, or the development of major gas import infrastructures.



Main sources of EU funding for energy networks

- ***TEN-E budget line***
- ***Structural and Cohesion Funds (mainly for the 'regions of cohesion')***
- ***European Investment Bank (EIB) loans***
- ***European Investment Fund (EIF) loan guarantees***
- ***Programmes for cooperation with non-EU countries, including pre-accession countries and partners under European neighbourhood policy***

For more information, see:
http://ec.europa.eu/energy/index_en.htm



Harnessing renewable energies

Another challenge facing EU energy networks is to contribute to the sustainability of the EU's energy system by harnessing environment friendly sources of energy and integrating greater volumes of renewable energy into the electricity grid.

Renewable energy is already helping to generate the electricity that households use every day for cooling, cooking or lighting, for example (see table below). And the use of renewables is set to increase, supported by consumer demand and backed up by the EU's efforts to raise the share of renewable energy in the overall energy mix to 20 % by 2020. According to European Commission projections ([7]), renewable electricity output could roughly treble between 2004 and 2020.

Energy networks have to keep pace with such developments if they are to be able to deliver more renewable electricity, heat and gas. The task is not an easy one, however. The practicalities involved in integrating renewable energies into the grids differ from those of traditional power stations. Renewable sources tend to be intermittent (as in the case of solar and wind power). They may be smallscale, located close to the point of consumption (small bio-methane units or hydropower systems, for example) or much more remote (as in offshore wind power). And they are simply not available uniformly across the EU.

The electricity system is in future likely to need increased long-distance transmission capacity as well as more load flexibility and more active distribution networks to deal with the various challenges posed by integrating renewables. This calls for timely investment in appropriate network infrastructure, as well as new technologies for the integration of renewable sources (see next page). The same need may arise, albeit over a longer-term horizon, for the gas system.

([7]) European Commission 'Renewable energy road map' p. 20 – Renewables growth: electricity projections by 2020, COM(2006) 848 final.

Gross EU-27 electricity generation from renewables (TWh)

	1995	2000	2005
Hydro*	324.2	354.7	307.0
Biomass	24.2	40.5	80.0
Wind	4.1	22.3	70.5
Geothermal	3.5	4.8	5.4
Solar**	0	0.1	1.5
Total renewable energy sources (RES)	356.0	422.4	464.4
Total electricity generation EU-27	2 732.8	3 021.4	3 309.1
Share of RES	13.0 %	14.0 %	14.0 %

Source: Eurostat, December 2007.

* Not including generation from hydro pumped storage, but including electricity generation to pump water to storage.

** Photovoltaic thermal.

Research projects

EU-funded research projects are helping to find ways to make it easier to integrate renewable energies into electricity networks.

Eight electricity grid projects were selected in the last call for projects under the EU's sixth research framework programme (FP6) and were officially launched at a workshop in Brussels in March 2008. These projects deal with:

- storage;
- grid policies and regulations;
- IT solutions;
- power lines and link to TEN-E;
- power electronics.

The first results will be available by mid-2009; the final results in 2011. EU funding for the projects is about EUR 15 million over three to four years. Among these projects, two major ones relating to wind energy – described below – are representative of the sort of demonstration actions funded under FP6 and managed by the European Commission's Energy and Transport DG. EU funding is EUR 6.6 million over two years.

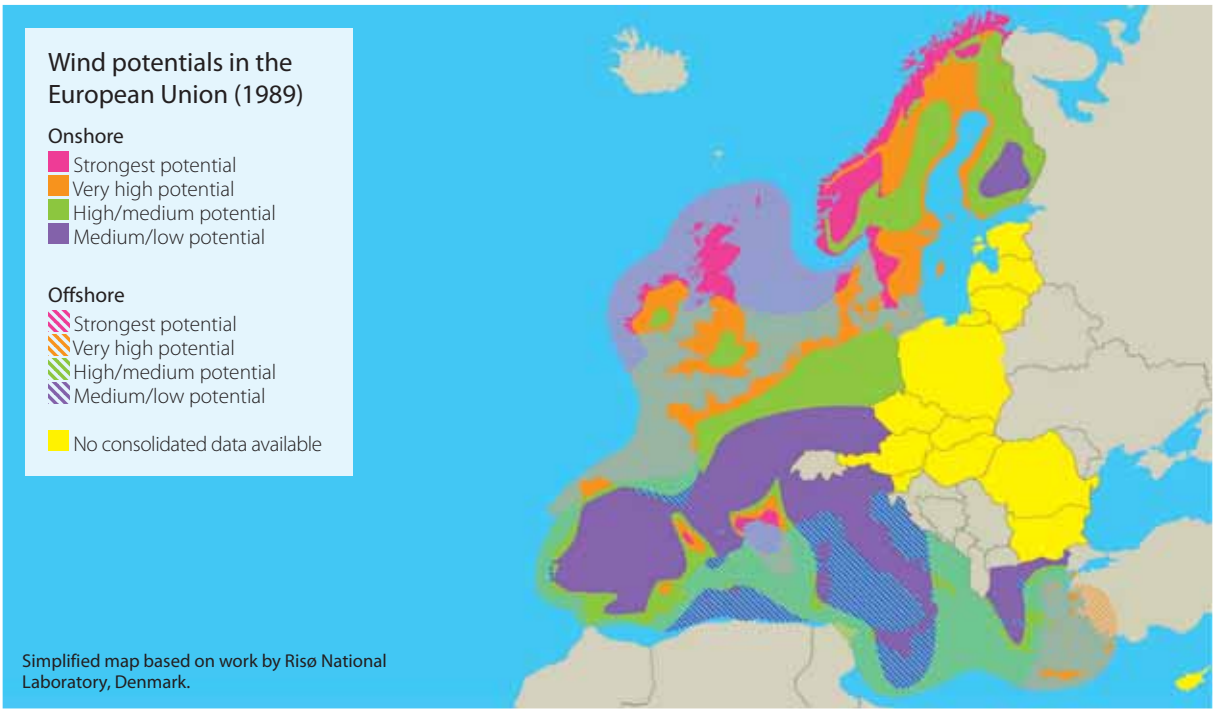
The seventh research framework programme for 2007-13 (FP7) will continue EU support for research into renewable electricity generation, with an emphasis on technologies to increase overall conversion efficiency, cost efficiency and reliability. Several projects have been selected which are looking at the networks of the future (up to 2050).

European wind energy integration study – EWIS

A key factor for the success of wind power is its efficient integration into the European electricity transmission and distribution grid network. EWIS looks at the impact of introducing a large number of wind plants into Europe's electric power systems and seeks to develop models for operating and planning a transmission system with a significant in-feed from wind power. The project consortium involves 15 transmission system operators representing 13 countries and Europe's four main synchronous electricity systems. The short-term objective (for 2008) is to find solutions to problems of load flows due to wind power. For the longer term (2015), the goal is to produce pan-European recommendations on integration of wind power.

Anemos Plus

Although there has been progress in wind prediction techniques there is still room for improvement. Reducing forecast error will help firm up wind power for systems operators. Anemos Plus aims to integrate forecasts of wind farms' power output into management and decision support tools. The project looks, in a first stage, to enhance wind forecasting tools, and, in a second stage, to develop new operational tools for managing wind generation and for trading in electricity markets. Integrating the needs and knowledge of daily users like operators and traders is a key part of the project. Anemos Plus is the successor of the Anemos project for the 'development of a next-generation wind resource forecasting system for the large-scale integration of onshore and offshore wind farms'.



Simplified map based on work by Risø National Laboratory, Denmark.

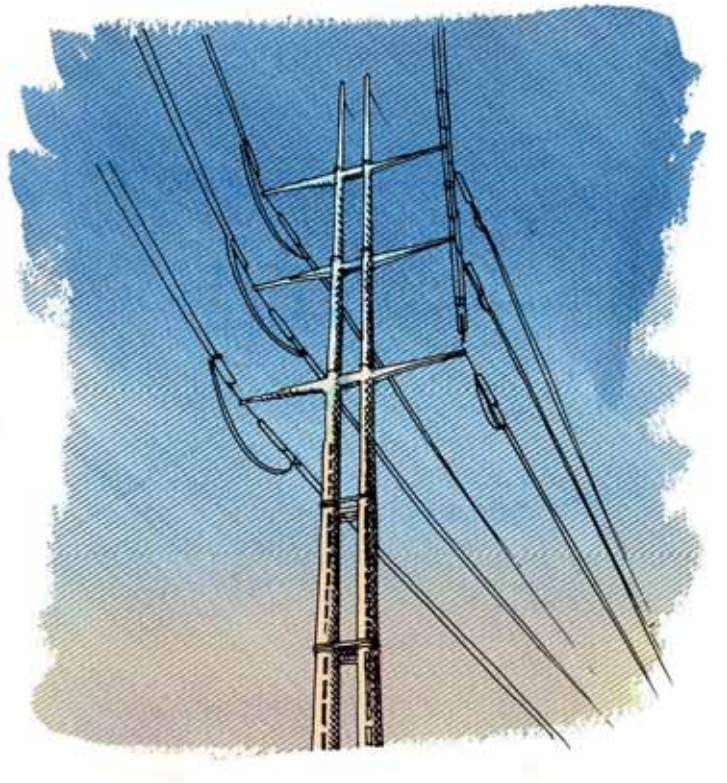
Developing more efficient networks

To be sustainable, Europe's energy system needs to be designed and operated efficiently. As set out in the European Commission's energy efficiency action plan ([8]), the EU is looking to save over 20 % of its annual primary energy consumption by 2020, compared with the business-as-usual scenario.

Energy networks have an important part to play in cutting down on energy waste. The energy efficiency action plan foresees, among other things, drawing up guidelines on good regulatory practices to reduce losses in the transmission and distribution of electricity and gas.

Meanwhile, new technology is important for reducing transformation and transport losses for both electricity and gas and for increasing the overall efficiency of the energy network. The FP7 supports research into energy efficiency and 'smart energy networks'. The emphasis for such networks is on increasing the efficiency, safety, reliability and quality of energy systems and networks in the context of a more integrated European energy market. Integration of renewable energy is among the aims.

([8]) See: http://ec.europa.eu/energy/action_plan_energy_efficiency/index_en.htm



SmartGrids – the electricity networks of the future

The 'SmartGrids' European technology platform brings together representatives from industry, transmission and distribution system operators, research bodies and regulators to work on a long-term vision for the European electricity networks of the future. According to details of the 'SmartGrids design' unveiled in November 2007, SmartGrids will connect both large and small, centralised and dispersed power sources, linking and coordinating local and remote generation. This would, for example, bring solar power from southern Europe, wave power from the Atlantic coast, and wind power from northern Europe to blend with large-scale hydro, clean coal or gas-fired generation.
See: http://www.smartgrids.eu/

Annex: list of projects of European interest (1)

Electricity

1.1. Submarine cable Ireland – Wales (UK)
2.1. Moulaine (FR) – Aubange (BE) line
2.2. Avelin (FR) – Avelgem (BE) line
2.10. Eastern Pyrenees connection between France and Spain
2.14. Valdigem (PT) – Douro Internacional (PT) – Aldeadávila (ES) line and 'Douro Internacional' facilities
2.15. Connections north of the Gulf of Bothnia and Fennoscan submarine cable between Finland and Sweden
2.16. Lienz (AT) – Cordignano (IT) line
2.18. Austria-Italy (Thaur-Brixen) interconnection through the Brenner rail tunnel
2.21. Submarine cable between south-eastern England and central Netherlands
2.22. Reinforcement of connections between Denmark and Germany, e.g. the Kassø – Hamburg line
2.26. Moldava (SK) – Sajóivánka (HU)
2.27. Stupava (SK) – south-east Vienna (AT)
2.28. Poland – Germany line (Neuenhagen (DE) – Vierraden (DE) – Krajnik (PL)
2.29. Poland – Lithuania link (Elk – Alytus)
2.30. Submarine cable to link Finland and Estonia
2.32. New connections to link the UCTE and CENTREL systems
2.33. Dürnrohr (AT) – Slavětice (CZ)
2.35. New interconnections between Italy and Slovenia
2.36. Udine Ovest (IT) – Okroglo (SI) line
3.2. Connection on the Danish north-south axis
3.8. S. Fiorano (IT) – Nave (IT) – Gorlago (IT) line
3.9. Venezia Nord (IT) – Cordignano (IT) line
3.48. Hamburg (DE) – Schwerin region (DE) line
3.49. Halle/Saale region (DE) – Schweinfurt region (DE) line
3.60. St. Peter (AT) – Tauern (AT) line
3.61. Südburgenland (AT) – Kainachtal (AT) line
3.75. Lemešany (SK) – Moldava (SK)
3.76. Lemešany (SK) – Veľký Kapušany (SK)
3.77. Gabčíkovo (SK) – Veľký Ďur (SK)
4.9. Philippi (EL) – Hamidabad (TR) line
4.25. Electricity connection between Tunisia and Italy
4.27. Upgrading of connections between Denmark and Norway

Natural gas

7.12. Greece – Italy interconnection pipeline
7.16. Gas transport corridor between Austria and Turkey through Hungary, Romania and Bulgaria
7.17. Interconnecting pipelines between the United Kingdom, the Netherlands and Germany, linking the main sources and markets of north-west Europe
7.24. The Baltic gas interconnector between Denmark – Germany – Sweden
9.3. North European gas pipeline: Russia, Baltic Sea, Germany
9.6. New gas pipelines from Algeria to Spain and France and related capacity increase of the internal networks in these countries
9.13. Algeria – Spain submarine pipeline and pipelines for the connection to France
9.16. Yamal – Europe II natural gas pipeline
9.20. Gas pipeline from Libyan resources to Italy
9.22. Greece – Turkey gas pipeline
9.34. Gas pipeline from Algerian resources to Italy, via Sardinia with a branch to Corsica

(1) Denominations and numbering according to Annex III to Decision 1364/2006/EC of 6 September 2006 (guidelines for trans-European energy networks), OJ L262 of 22.9.2006.

For further information

The European Commission's energy homepage:
http://ec.europa.eu/energy/index_en.htm

The European Commission's 'Climate action' website:
http://ec.europa.eu/climateaction/

SmartGrids European technology platform:
http://www.smartgrids.eu/

Energy research in the seventh research framework programme:
http://cordis.europa.eu/fp7/energy/home_en.html

European Commission

Interconnecting Europe: new perspectives for trans-European energy networks

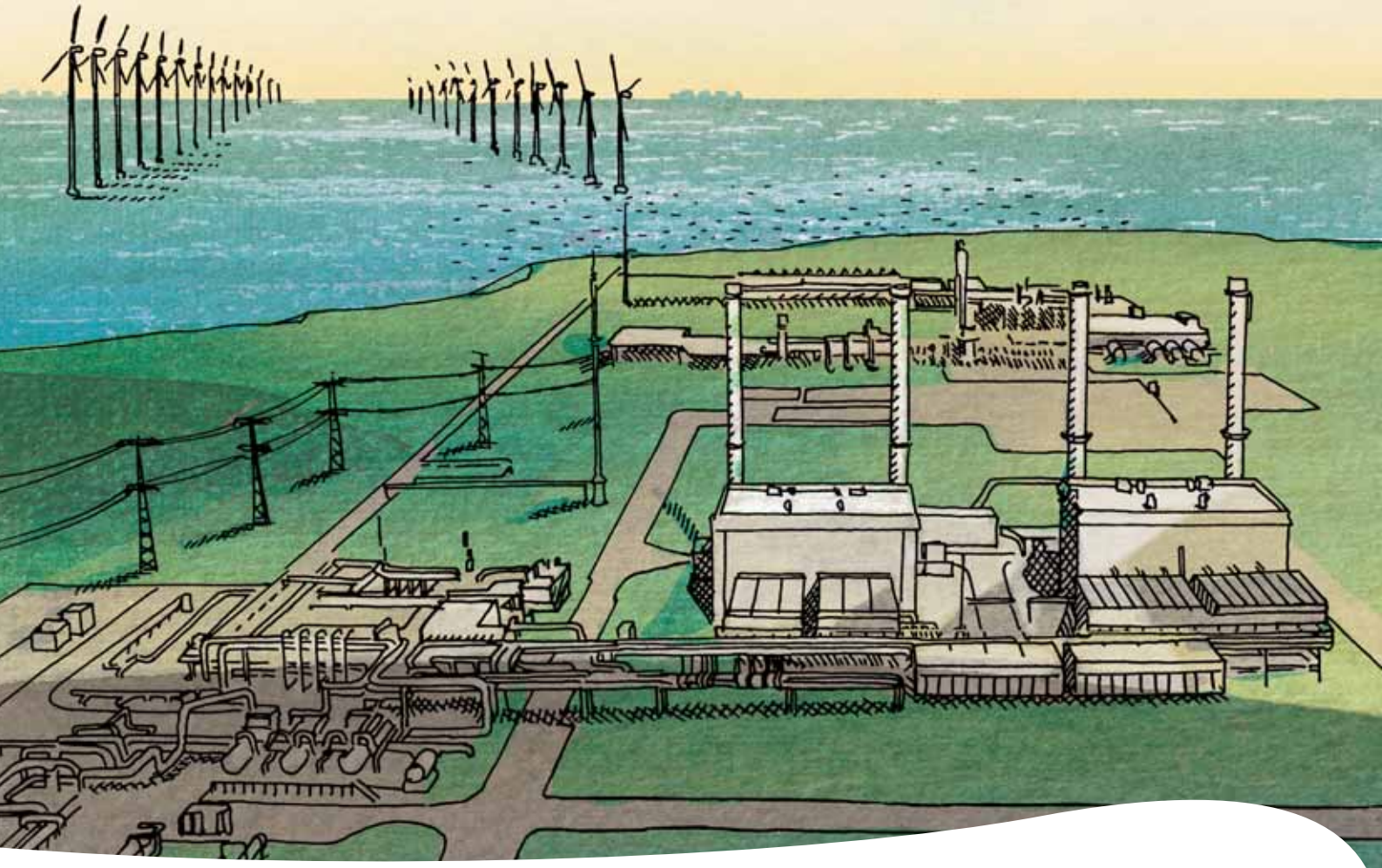
Luxembourg: Office for Official Publications of the European Communities

2008 – 31 pp. – 21 x 29.7 cm

ISBN 978-92-79-07295-6

KO-70-07-025-EN-C

Energy networks are central to the European Union's efforts to ensure the sustainability, competitiveness and security of its energy supply. The EU's policy for trans-European energy networks (TEN-E) has an important part to play in achieving these goals by identifying shortcomings in the energy network and by developing priority routes for electricity transmission and gas distribution. This brochure, which updates a previous European Commission brochure on TEN-E published in 2004, describes how TEN-E projects – along with other measures to develop energy networks as well as research to harness renewable sources of energy – will help Europe to rise to its energy challenges and to support the action plan endorsed by the European Council in March 2007.



Publications Office
Publications.europa.eu

ISBN 978-92-79-07295-6
9 789279 072956