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European energy policy—A review

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HIGHLIGHTS

- Historical evolution and current status of energy policy in the European Union.
- EU is faced with fossil fuel dependence and growing energy imports and costs.
- Overall policy orientation is commendable, but there is room for improvement.
- Policy priorities need to be reassessed in view of recent global developments.

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ABSTRACT

This article presents the implemented policies of the European Union in the broader field of energy and provides a picture of the Union's strategy on energy related issues. A brief historical background is provided, covering the period from the beginning of the Union's creation in 1951, when coal was considered as the heart of its economic growth, up to 2012. Policy development principles, as well as the consultations that take place before the proposal of each option are also discussed. Implemented policies are classified into seven broad categories: Renewable Energy, Energy Efficiency and Savings, Internal Energy Markets, Security of Energy Supply, Environmental Protection, Nuclear Energy and Research and Development. For each category, an introduction covering important milestones towards its development is followed by the presentation of the relevant policies and a description of their purpose.

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1. A brief historical background

In 1951 six European countries decided to join forces in two key sectors of the economy, coal and steel, thus creating a Community that would replace conflict with cooperation and animosity with prosperity. The European Coal and Steel Community (ECSC) was formed and a cross jurisdictional control on the energy resources was applied paving the way for greater economic cooperation in general.

At the same time however, it was recognized that coal would not be the driver of economic growth but would be replaced by nuclear energy as the center of the economy in order to cover the need for abundant low cost energy. As a result the European Atomic Energy Community Treaty (Euratom) was introduced in 1957, aiming to guarantee the safety and control of radioactive materials and promote the development of nuclear energy for peaceful purposes.

Different visions between Member States led to a focus on a national state level in the 1960s as most West European governments were promoting nuclear power development as a substitute to their increased dependency on imports of oil, coal and/or natural gas. Renewable Energy (RE), with the exception of hydro-power in countries having significant potential, attracted very little interest, as their initial cost was deemed too high.

A push for a common energy policy was triggered in the early 1970s as a consequence of the 1973 oil and in the 1974 Copenhagen summit meeting, Member States agreed to a declaration on energy policy, adopting guidelines concerning energy supply and demand.

The Single European Act (1986), the Maastricht Treaty (1992) and then the Amsterdam Treaty (1997) widened the focus of energy related matters with security of supply as a main issue. Although energy market deregulation, environmental protection and climate change problems became more prominent, they did not translate into a European legislation, especially as climate change was not yet high on the agenda.

The first assessment report of the Intergovernmental Panel on Climate Change (IPCC) in 1990 together with the adoption of the Kyoto protocol in 1997 led the EU's executive body (the European Commission—EC) in the early 2000s to develop a common position

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regarding important strategic issues for climate change and energy security. After many years of limited success, legislation in the area of energy policy, a mandatory concept of energy policy was approved at the meeting of the European Council on October 27, 2005 in London.

In 2007 the EC's "An energy policy for Europe"¹ strategy marked the beginning of an action plan that laid out the three major challenges for European energy policy, forming the core of the common energy policy up to now: sustainability, security of supply, and competitiveness. In order to reach these goals, the EC also laid out quantifiable targets, the famous 20/20/20 targets up to 2020. The action plan was complemented with changes in legislation shortly afterwards with the Lisbon Treaty (2007) finally including specific provision on energy.

2. Energy policy development

European policy development follows the important political principles of subsidiarity,² proportionality³ and better regulation⁴ as described in Treaties and political statements.

The aim is to ensure that policies are developed in a democratic, transparent and representative way with clear justifications and balanced assessment of options. Impact assessments accompany all legislative proposals outlining advantages/benefits and drawbacks/costs of different policy actions, and justifying the course taken in the proposed policy.

Reflecting these requirements, new energy policy proposals are prepared on the basis of wide stakeholder consultations including national authorities, regional bodies, industrial associations, companies, consumers as well as associations and non-governmental organisations.

Acknowledging the sensitivities regarding some aspects of energy policy in Member States, EU energy policy actions will always respect two main principles: first, that Member States are ultimately responsible for their national energy mix and secondly, indigenous energy resources are a national, not European, resource (IEA, 2008).

3. Legal basis

Energy policies are introduced through European legislation, (directives, regulations and decisions) which is based on EU Treaties, since the creation of the Union.

Before the Lisbon Treaty in 2009, the founding Treaties of the EU did not include a specific provision on EU intervention in the field of energy and the legal basis for energy-related legislation was structured on: Environment (Art 175); Approximation of laws (Art 81–97); Trans-European networks (Art 154); Difficulties in the supply of products (Art 100); Research (Art 166); and External relations (various articles).

The Lisbon Treaty introduced a specific legal basis for the field of energy with the creation of Article 194. In a spirit of solidarity between Member States, this policy aimed to establish and ensure the functioning of the EU's energy market its security of supply; to promote energy efficiency and saving, to develop renewable energy infrastructure and interconnect existing energy networks.

4. Energy policy options

Policy options are adopted in order to address different kind of barriers; some technical in nature, some related to human behavior and others related to public policies and institutions.

They can be grouped into the next categories: Research and Development (R&D), Financing schemes, Financial incentives, Accurate pricing, Voluntary agreements, Regulations, Information dissemination and training, Procurement, Market reforms, Market obligations, Capacity building, Planning techniques and Supporting tools.⁵

The appropriate mix of policies in any particular situation depends on technological barriers and existing market conditions. This conceptual framework is referred to as the innovation system. The innovation system consists of a wide range of factors including the knowledge base, prices and relative performance of competing technologies, the behavior of different actors in the marketplace, the networks among these actors, institutions that can foster or impede innovation and finally, cultural context (Geller, 2003).

5. Implemented policies

5.1. Renewable energy

Back in 1986 a Council resolution highlighted the promotion of RE as one of the Community's energy objectives. In the 1995 White Paper⁶ the main objectives for improved competitiveness, security of supply and protection of the environment were identified and RE was recognised as a factor to help achieve these objectives. In the 1997 White Paper⁷ an indicative target of a 12% share of Renewable Energy Sources (RES) in total final energy consumption by 2010 was set.

At the end of 2001 the Directive 2001/77/EC on electricity production from RES set an indicative target of 22.1% of total EU-15 electricity gross consumption from RES for 2010. On April 2003, with the Accession Treaty, national targets were adopted for the ten countries that formally became EU Member States in 2004. Gross renewable electricity target for EU-25 was 21% of overall electricity consumption by 2010 and indicative targets for the share of renewable electricity production per EU Member State were set.

In 2003 the Directive 2003/30/EC on biofuels was adopted. Member States should set national indicative targets to raise the share of biofuels in their transport fuel market, based on the reference value of a 2% increase by 2005 and of 5,75% by 2010 in the share of biofuels for transport purposes calculated on the basis of energy content.

Continued policy support from a large number of Member States and the Commission led to significant progress on RE since 1990. However the framework established from the first RES directives was proven too loose to help towards the achievement of the 2010 renewable electricity and biofuels targets (European Commission (EC), 2007). In 2007, EU adopted a binding target of 20% RE in final energy consumption by 2020. In early 2008, the EC presented a draft directive on the promotion of the use of energy from RES in order to help the 20% target become a reality, leading to the RES Directive 2009/28/EC.

¹ An energy policy for Europe, COM(2007)1 final (10/1/2007).

² Taking EU action where it adds value and leaving alone matters best done at national level.

³ Not going beyond what is necessary to achieve the objectives.

⁴ Avoiding burdensome legislation; consulting widely on proposals and assessing their full impact before they are made.

⁵ Measures established in order to support or/and supervise the progress of implemented policies and help the stakeholders involved in the energy market through actions like coordination of efforts or financing.

⁶ An Energy Policy for the European Union, COM(95)682, December 1995.

⁷ Energy for the future: Renewable sources of energy, White Paper for a Community Strategy and Action Plan, COM(97)599 final (26/11/1997).

5.1.1. National targets

As mentioned above, up to 2009 targets were indicative. Each Member State had its own target for RE share in electricity and all had an overall 5.75% share target of biofuels and other renewable fuels in transport by 2010.

Following Directive 2009/28/EC, there are binding national targets for RE shares in each Member State's final energy consumption up to 2020, (including a 10% share of renewables in the transportation sector for all Member States): these are calculated on the basis of the 2005 share of each country plus both a flat rate increase of 5.5% per Member State as well as a GDP-weighted additional increase (European Commission (EC), 2009a).

Interim country specific targets were set for 2011/12, 2013/14, 2015/16 and 2017/18 as a percentage share of their 2020 target. They are crucial for monitoring the progress of RE development, although they are of an indicative nature.

5.1.2. National Renewable Energy Action Plans

The National Renewable Energy Action Plans (NREAPs) were introduced in 2009 and were considered crucial towards achieving the 2020 mandatory targets. They outline targets for the energy shares from RES in transport, electricity, and heating and cooling by 2020 as well as adequate measures to achieve these targets.

5.1.3. Renewable energy guarantees of origin

The renewable energy guarantees of origin (RE-GO) were introduced with the first directive in 2001. Member States had to establish a system under which RE-GO were to be issued to all producers of renewable electricity, where it was required to prove the share or quantity of energy from RES in their energy mix.

The expectation at the time of introduction was that the establishment of the RE-GO system would eventually enable trade between Member States and it was seen as necessary to facilitate trade and increase transparency for consumers.

5.1.4. Grid priority access and operation

Transmission system operators (TSOs) and distribution system operators (DSOs) all over EU must guarantee the transmission and distribution of electricity produced from RES. When dispatching electricity, TSOs are to give priority to installations using RES so far as the secure operation of the national electricity system permits (European Commission (EC), 2009a). Additionally, steps towards the development of infrastructure for energy transmission and distribution, smart grids and storage facilities must be taken, as to facilitate secure operation of the electricity system as it integrates electricity production from RES.

5.1.5. Cooperation mechanisms

Cooperation mechanisms were introduced in 2009 and can be used by Member States in order to reach their RE targets. They are allowed to make arrangements for the statistical transfer of a specified amount of RES from RES one Member to another. Cooperation between two or more Members and also with one or more third countries is allowed, on all types of joint projects regarding electricity production, heating or cooling from RES. Private operators can also be involved (European Commission (EC), 2009a).

The basic idea of the cooperation mechanisms is to fulfil part of a Member's RES target in another country by providing financial support, with the potential advantage of accessing cheaper RE production in other countries.

5.1.6. Support schemes

There are various categories of support instruments in the EU (Ecofys et al., 2011). Feed-in tariff is a fixed and guaranteed price

paid to eligible producers of RES electricity. Feed-in tariff systems have proved to be, the main instruments of support in the EU. They are used in France, Germany, Spain, Greece, Ireland, Luxembourg, Austria, Hungary, Portugal, Bulgaria, Cyprus, Malta, Lithuania, Latvia and Slovakia. The advantage of tariffs lies in the long-term certainty of receiving a fixed level support, which lowers investment risks considerably. Capital costs for RES investments observed in countries with established tariff systems have proven to be significantly lower than in countries with other instruments that involve higher risks of future returns on investments.

In a feed-in premium system, a guaranteed premium is paid in addition to the income producers receive for the electricity from RES that is being sold on the electricity market. Feed-in premium systems have gained ground over the last years and are used as main support instruments in Denmark and the Netherlands. In some countries premiums exist in parallel to the tariff system while in general there are different designs from country to country. They provide a secure additional return for producers, while on the same time exposing them to the electricity price risk.

Quota obligations have been introduced in Belgium, Italy, Sweden, UK, Poland and Romania, where governments impose minimum shares of renewable electricity on suppliers (or consumers and producers) that increase over time. If obligations are not met, financial penalties are to be paid. Penalties are recycled back to the suppliers in proportion to how much renewable electricity they have supplied. Obligations are combined with Renewable Obligation Certificates (ROCs) that can be traded. Hence, ROCs provide support in addition to the electricity price and are used as proof of compliance. Uncertainty about the current and future price of certificates increases financial risks as the risk of the certificate market is added to the risk of the electricity market.

Investment grants for electricity and heating and cooling are available in several Member States and are often devised to stimulate less mature technologies. In Finland, investment grants and subsidies are the only support available on a national level.

Tax incentives or exemptions often complement other types of RES incentive programs. They are powerful and highly flexible policy tools that can be targeted to encourage specific RES technologies and to impact selected RE market participants, especially when used in combination with other policy instruments. A wide range of tax incentives are present in the EU. Some Member States (Spain, Netherlands, Finland and Greece) provide tax incentives related to investments while others (Latvia, Poland, Slovakia, Sweden and UK), have devised production tax incentives that provide income tax deduction or credits at a set rate per unit of produced renewable energy, thereby reducing operational costs. Investment and production tax exemptions are most prominently present in the EU.

The fiscal incentives include soft or low-interest loans. On a national level, soft-loans are available in Germany, Netherlands, Bulgaria, Estonia, Malta and Poland.

Finally, tenders are used for larger-scale projects in the Netherlands, UK, Denmark and Spain. Its advantages include the amount of attention it draws towards RE investment opportunities and the competitive element incorporated in its design.

5.1.7. Restrictions on biofuels and bioliquids

The binding nature of the 10% target from renewable fuels in the final energy mix of the transport sector, forced the Commission to adopt restrictions and sustainability criteria for energy deriving from biofuels and bio-liquids. They apply from the cultivation of raw materials up to the greenhouse gas emissions due to end use (European Commission (EC), 2009a).

Members have to take steps in order to verify that sustainability criteria have been fulfilled whether the biofuels or bioliquids are produced within the Community or imported.

5.1.8. Renewable energy technologies in buildings

Integration of RE technologies in buildings was introduced in 2009. Member States must embed, in their building regulations and codes, appropriate measures in order to increase the share of RES in the building sector (European Commission (EC), 2009a). Through these measures, by the end of 2014, a minimum amount of energy from RES in new buildings and in existing buildings that are subject to major renovation will be obligatory (especially RE technologies that achieve a significant reduction in energy consumption like heating and cooling systems). RE technologies' integration in buildings is one of the major pillars towards the nearly zero-energy buildings concept which will be implemented from 2018 onwards.

5.1.9. Reporting and monitoring

Members must submit reports to the Commission on progress in the promotion and use of energy from RES. The first report was submitted in 2011 with the next due every two years thereafter, up to 2021. The reports will provide detailed information on the whole progress of RE penetration and the framework for their promotion (European Commission (EC), 2009a). On the basis of these submitted reports, the Commission will report every two years to the European Parliament and the Council in order to evaluate the progress of each Member State.

5.2. Energy efficiency

Energy efficiency is often considered to be the fastest and most cost-effective way of increasing security of supply and reducing greenhouse gases emissions. Thus, it has been identified as a cornerstone in the Commission's energy policy and is one of the pillars of the Commission's 20/20/20 by 2020 targets. If the 20% efficiency target was achieved, the EU would use approximately 13% less energy than in the late 2000s, saving 100 billion € and around 780 million tonnes of CO₂ each year by 2020 (IEA, 2008). It would also make the RES target easier to attain.

EU has implemented a variety of energy efficiency policies and directives across many sectors. In 2006 the Energy Efficiency Action Plan⁸ was adopted, establishing the overall framework for the future development of the energy efficiency policy in the EU. Also the 2003 Directive on Energy End-Use Efficiency and Energy Services (ESD) provided another essential part of the framework for those sectors not covered by the Emissions Trading Scheme (ETS).

However, estimations made in 2011 on the national energy efficiency targets for 2020 suggested that the EU would achieve only half of the 20% target in 2020 (European Commission (EC), 2011a), forcing the Commission to put forward a new Energy Efficiency Plan⁹ (EEP) setting out measures to achieve further savings in energy supply and use in 2011.

This proposal transforms certain aspects of the EEP into binding measures (not binding targets) while on the same time looks beyond the 20% target seeking to set a common framework to promote energy efficiency in the EU beyond 2020. In 2012, a non-paper¹⁰ on the ESD was presented, supporting the discussions on the proposal for a new Energy Efficiency Directive.

⁸ Action Plan for Energy Efficiency: Realizing the Potential, COM(2006)545 final (19/10/2006).

⁹ Energy Efficiency Plan 2011, COM(2011)109 final (8/3/2011).

¹⁰ Non-paper of the services of the European Commission on Energy Efficiency Directive, Informal Energy Council, 19–20 April 2012.

5.2.1. National targets

Each member must take measures designed to contribute towards achieving an overall national indicative energy savings target of 9% by 2016 (European Commission (EC), 2006a). This target refers to non-ETS sectors and is the minimum in order to achieve the overall 20% energy savings target. It must be set and calculated in accordance with the provisions and methodology laid out in Annex I of the ESD.

5.2.2. National Energy Efficiency Action Plans

A key aspect of the energy efficiency strategy is the requirement for Member States to prepare National Energy Efficiency Action Plans (NEEAPs) (European Commission (EC), 2006a). They are important because they describe in detail the strategy of each member in order to promote and monitor progress in achieving their 9% energy efficiency target up to 2016. Three NEEAPs in the period between 2007 and 2014 are to be submitted, with the last one in June 2014.

5.2.3. Cogeneration

Cogeneration is not only a way to increase energy efficiency, but also a way to improve security of supply. In order to promote and develop high efficiency cogeneration, measures similar to RE systems have been taken: guarantees of origin for electricity produced from combined heat and power (CHP), support schemes and grid priority access to CHP power plants. In order to achieve high efficiency energy production, a methodology for determining the efficiency of the process with cogeneration technologies complying with national efficiency criteria is also provided (European Commission (EC), 2004a).

5.2.4. Public procurement

A list of eligible energy efficient public procurement measures is provided, from which Members must ensure that the public sector applies at least two (European Commission (EC), 2006a).

The first time that the Council and the European Parliament set mandatory energy efficiency criteria for public procurement was in 2007 when the European Council adopted a new regulation for implementing the EU-US Energy Star program in the EU. Recognising that the procurement of energy-efficient equipment and appliances by public institutions is one way to stimulate the market for energy-efficient products, EU institutions and relevant government authorities are required to use energy efficiency criteria when purchasing office equipment. The Commission has also developed a handbook for energy-efficient public procurement (IEA, 2008).

5.2.5. Improvement of building's energy performance

Buildings account for 40% of total EU energy consumption (EC (European Commission), 2010a) giving room for significant energy savings in this area. Towards the promotion of the improvement of the energy performance of buildings the next significant policies have been adopted:

Each Member State has adopted a methodology for calculating the energy performance of buildings and setting the minimum energy performance requirements (requirements may differ between new and existing buildings and between different categories of buildings) according to the general framework set out in the Energy Performance of Buildings Directive (EPBD).

When buildings are constructed, sold or rented, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant. The validity of the certificate is limited to 10 years. For a building that is occupied by public authorities with a total useful floor area of over 500 m², the

energy performance certificate must be displayed in a prominent place clearly visible to the public. From 2015, this threshold will be lowered to 250 m².

In order to increase the number of nearly zero-energy buildings, Member States must draw up national plans which include targets differentiated according to the category of building. After 2019 all new buildings occupied and owned by public authorities are to be nearly zero-energy buildings and from 2021 onwards all new buildings are to be nearly zero-energy buildings. Towards this target the potential integration of CHP and RE systems will have a major contribution. For this transition Member States must take appropriate steps to provide financial incentives and address market barriers that should thereafter be updated every three years.

For better identification of cost-optimal levels of minimum energy performance requirements, a binding comparative methodology framework was established in 2012 (European Commission (EC), 2012a). It specifies rules for comparing energy efficiency measures and lays down how to apply these rules to selected reference buildings from 2013 onwards.

Finally, as far as it is technically possible and financially reasonable, final energy consumers must be provided with individual meters reflecting actual energy consumption and providing real time information.

5.2.6. Eco-management and audit scheme

The eco-management and audit scheme (EMAS) is a voluntary EU initiative designed to promote continuous improvements in a company's or other organization's environmental performance. It was developed by the EC in 1993 and became available for participation only for companies of the industrial sector in 1995. The last updated framework improving applicability and credibility of the scheme, entered into force in 2010 providing in detail the registration procedure as well as the obligations of the registered organization (European Commission (EC), 2009b).

5.2.7. Improvement of energy related products

All energy-related products having a significant, direct or indirect, impact on energy consumption (e.g. household appliances or office equipment), are to fulfil specific criteria and requirements, in order to contribute to sustainable development and move freely within the internal market.

Integration of environmental aspects in the design and development of energy-using products (ecodesign requirements) was adopted in 2009 (European Commission (EC), 2009c). It defines the principles, conditions, criteria and methods for setting ecodesign requirements for the products. Also a labelling and standard product information system on the consumption of energy is applied, allowing end-users to choose more efficient products (European Commission (EC), 2010b).

5.2.8. Taxation

Energy taxation is seen as a powerful tool for providing long-term price signals to consumers and thereby encouraging energy efficiency, and has therefore received increased attention by the Commission. Energy product taxation is to a certain extent harmonized at EU level. Energy Taxation Directive 2003/96/EC set minimum rates for energy product taxation such as motor and heating fuels as well as electricity. However, the directive is nowadays deemed as outdated (European Commission (EC), 2011b).

The Commission has presented a proposal to overhaul the outdated rules on the taxation of energy products in the EU¹¹

aiming to restructure the way energy products are taxed, taking into account both their carbon footprint and energy content. The revision was supposed to improve the structure of the existing directive, so as to enable Member States to use energy taxation more effectively for environmental and other policy purposes and to improve the internal market (European Commission (EC), 2011b). The revised Directive was scheduled to enter into force as of 2013 with a transitional period until 2023, for the industry to adapt to the new taxation system. However, both the European Parliament and the EU Council of Economy and Finance Ministers (Ecofin) criticized certain aspects of this proposal, which was therefore still under negotiation and revision until late 2012.

5.2.9. Fiscal incentives

Direct fiscal incentives for energy efficiency purposes are, or have been, used in a number of countries, either in the form of a subsidy or rebate. Apart from home appliances there are also programs, including various subsidy schemes, promoting the purchases of compact fluorescent lamps (CFLi) (IEA, 2008).

5.2.10. Education and awareness

The success of the energy efficiency policies is strongly influenced by the consumers' purchasing decisions. Therefore a number of educational measures, including education and training programs (such as competitions to reward the most energy-efficient school in the EU) on energy and climate change issues are planned by the EC. Also, the EC plans to obtain EMAS certification for all the buildings it owns, and then to extend the initiative to all EU institutions.

5.2.11. Monitoring and evaluation

Impact assessment, monitoring and evaluation are to be an integral part of the EU's energy efficiency policy. There is no general requirement to undertake an ex post evaluation of directives or policies. However, monitoring requirements are usually written into the relevant directives. For example, articles 14 and 15 in the ESD outline in detail how the NEEAPs will be evaluated and the process for reviewing the overall energy services framework.

5.2.12. International partnership

The International Partnership for Energy Efficiency Cooperation (IPEEC) is a high-level international forum which aims to enhance global cooperation in the field of energy efficiency. Other international initiatives related to energy efficiency in which the EC is playing an important role include the Energy Community Treaty, the Euro-Mediterranean Energy Partnership and the Baku Initiative.

5.3. Internal energy markets

EU efforts to reform electricity and gas industries started in the middle of the 1990s. Negotiations between EU authorities, Member States and market stakeholders during the 1990s culminated in an Electricity Directive in 1996, (Directive 96/92/EC) and, in 1998, in a Gas Directive (Directive 98/30/EC), that introduced a first set of common rules for the EU energy market. With only relatively few and brief experiences with market liberalisation in Europe and in the rest of the world, and with relatively strong opposition from some EU Member States, the first market directive included only soft reform provisions.

Even before the implementation of the first directives was completed, there was a push to accelerate gas and electricity market liberalisation. The reason for this was that the first directives did not provide much of the legislative framework necessary for comprehensive and targeted liberalisation, and had therefore led to uneven results (IEA, 2008). When the inadequacies in the light-handed approach towards regulation and unbundling in the first market

¹¹ Proposal for a council directive amending Directive 2003/96/EC restructuring the Community framework for the taxation of energy products and electricity, COM(2011)169/3, 2011.

directives became clear, a new process was launched leading towards a second liberalisation package.

In 2002, the European Council decided opening the market for business energy users in 2004 and to all in 2005. In 2003, the second market directives for gas and electricity were adopted together with the regulation on conditions for access to the network for cross-border exchanges in electricity and full market opening for all customers was agreed from 1 July 2007. The directives were to be implemented by Member States by transposing them into their relevant national legislation by 1 July 2004, whereas the regulation was immediately applied.

The detailed assessments of the implementation of the market directives on an annual basis led to benchmarking reports which were very critical about the lack of implementation of directives and regulations in a large number of countries. Further inquiry led the Commission to propose a third liberalisation package in 2007. This agreement materialised in proposals for a third market directive and for a new regulation on cross-border electricity trade. The proposals were mainly aimed at strengthening the requirements and provisions in the second market directive, and maintaining the vision for a truly competitive internal market. Finally, in 2009 a series of directives for electricity and gas and regulations for establishing the Agency, cross-border exchanges in electricity and natural gas transmission networks were adopted.

The above illustrates the difficulties in realising a real internal energy market in the EU. As Helm (forthcoming) noted, as of the time of this writing the internal energy market has not materialised yet, and the EU energy arena is characterised by differences in energy prices, different national energy policies and lack of energy interconnections between Member States.

5.3.1. Designation of independent regulatory authority

All Member States must designate a single national regulatory authority at national level (European Commission (EC), 2009d, 2009e). It must be legally distinct and functionally independent from any other public or private entity. The duties of the regulatory authority are to oversee and monitor the whole electricity and gas market, facilitating their regular function and the rights and obligations of each one of the legal entities and undertakings involved in the markets.

5.3.2. Promotion of regional cooperation

A strong step towards the creation of a fully liberalised internal market is the Member States' and regulatory authorities' cooperation in order to integrate national markets at regional levels. Regulatory authorities and Member States must promote and facilitate the cooperation of transmission system operators at a regional level, for a competitive internal market in electricity and gas sectors (European Commission (EC), 2009d, 2009e).

5.3.3. Unbundling of transmission system operators

From 3 March of 2012 and thereafter, each undertaking which owns a transmission system acts as a Transmission System Operator (TSO). The same person that exercises control over a TSO is not allowed to perform any of the functions of generation or supply. For the unbundling of the TSOs, one of the following three models is permitted: the Ownership Unbundled TSO (OU), the Independent System Operator (ISO) and the Independent Transmission Operator (ITO). Each one provides different degrees of structural separation of network operation from production and supply activities and they are expected to be effective in removing any conflict of interests between producers, suppliers and TSOs (European Commission (EC), 2009d, 2009e).

5.3.4. Unbundling of distribution system operators

The distribution system operator (DSO) when part of a vertical integrated undertaking (VIU) must be independent at least in terms of its legal form (legal unbundling) and organization and decision making from other activities not relating to distribution (functional unbundling). However, it is not obligatory to separate the ownership of assets of the DSO from the VIU. Provisions are laid for DSOs serving less than 100,000 connected customers or serving small isolated systems (European Commission (EC), 2009d, 2009e).

5.3.5. Unbundling and transparency of accounts

Electricity and natural gas undertakings have to comply with the national legislation concerning the annual accounts of limited liability companies. They must keep separate accounts for each of their transmission and distribution activities as well as for other electricity and gas activities not relating to transmission or distribution. Internal accounts must include a balance sheet and a profit and loss account for each activity.

5.3.6. Public service obligations

One of the main rules for the organization of the electricity and gas sectors is the possibility of imposing on undertakings public service obligations (PSOs). PSOs belong to the universal services, which came as a consequence of market liberalization, and are considered as the right of all households to be supplied at a reasonable, easily and clearly comparable and transparent price. The main elements of the universal services are the obligation to connect, the quality and regularity of supply and prices. In the above, the establishment of last resort, the protection of remote customers, the universal services to small enterprises and the environmental protection are included. Ensuring universal services may be one of the reasons for imposing a PSO, especially in less developed markets.

5.3.7. Third party access

Member States must ensure the implementation of a system of third party access (TPA) to the transmission and distribution systems based on published tariffs. However the TSO or DSO can refuse access where it lacks the necessary capacity or where the access to the system would prevent them from carrying out the PSOs. Clearly specified reasons must be given for such refusal and the system user who has been refused access can make use of a dispute settlement procedure. The TSO or DSO must provide relevant information on measures that would be necessary to reinforce the network (European Commission (EC), 2009d, 2009e).

5.3.8. Dispatching and balancing criteria

National regulatory authorities must determine the criteria on which the dispatching of generating installations and the use of interconnectors will be based.

Dispatching priority must be given to generating installations using RES and CHP. Provisions are made so that priority can be given to the dispatch of generating installations using domestic primary energy sources, up to 15% of the overall annual primary energy for electricity consumption (European Commission (EC), 2009d).

TSOs must adopt rules for balancing the electricity system and charging system users of their networks for energy imbalance.

5.3.9. Subsidies

Traditionally, the most important subsidies have been to support coal production, but with the emerging policy objective of decarbonising energy supply, subsidies have become available for RE as well.

5.3.10. Supporting tools

Towards the difficult task of energy market liberalization, policy supporting tools play a crucial role. The agency for the cooperation of energy regulators (ACER) was established in 2009 (European Commission (EC), 2009f) with the purpose of assisting regulatory authorities in exercising regulatory tasks performed in the Member States and, where necessary, to coordinate their action.

The establishment of the European Network of Transmission System Operators (ENTSO) for electricity and gas aims at providing the base for cooperation of the TSOs at Community level in order to promote the completion and functioning of the internal market in electricity/gas and cross-border trade (European Commission (EC), 2009g, 2009h). ACER is also tasked with monitoring the execution of ENTSO's tasks and reporting to the Commission.

5.4. Security of energy supply

The main pillar of a common energy policy since the very beginning of the European integration is security of supply. The EU depends to varying degrees on energy imports of oil, gas, coal and electricity. Some individual Member States may be self sufficient in one of these energy sources, or overall net exporters. All the previous mentioned policies in the fields of renewable energy, energy efficiency and internal energy markets aim at securing energy.

The first incident which exposed the vulnerability of importing countries was the Suez Crisis in 1956–1957. Following the crisis, the Council adopted Directive 68/414/EEC which obliged Member States to maintain emergency oil stocks enough for at least 65 days (European Economic Community (EEC), 1968). After the oil crisis of the 1970s, the Council adopted, in 1972, two regulations, one requiring Member States to inform the Commission about their hydrocarbon importations (European Economic Community (EEC), 1972a), the other requiring them to report on investment projects in the oil, gas and electricity sectors (European Economic Community (EEC), 1972b). Additionally, the emergency oil and petroleum stock requirement was raised to 90 days of consumption (European Economic Community (EEC), 1972c).

In 1977 the Community developed its own emergency system by adopting two decisions: one on the export of crude oil and petroleum products from one member state to another in the event of supply difficulties (Decision 77/186/EEC) and another to cut back consumption of primary energy resources in the case of supply difficulties (Decision 77/706/EEC).

Recent events, including the rapid oil price increase since 2004, the interruption of gas supplies from Russia in 2006 and the major electricity blackout on November of 2006 affecting large parts of north-western Europe, turned the energy security policy into a major challenge for the EU-27.

5.4.1. Emergency oil stocks

As mentioned before, members are obliged to hold emergency oil reserves under Directive 2006/67/EC, which is the codification of older legislation dating back to 1968. Stocks have to cover 90 days of the average daily domestic consumption during the previous calendar year. Member States who have their own petroleum production may deduct this proportionally from their stock-holding obligation. Such deduction may not, however, exceed 25% of domestic consumption (European Commission (EC), 2006b). Oil stocks should be held in the form of petroleum products, fuel oil, diesel, or gasoline and should be a monthly report on their stockholding.

Directive 2009/119/EC which will come into force from 2013, aims to make the framework of oil stockholding in the EU more compatible with the IEA emergency stockholding system.

5.4.2. National Emergency Plans

In the event of a major supply disruption Members are to have procedures in place and contingency plans to be implemented. These procedures will enable competent authorities to release quickly, effectively and transparently some or all of their emergency stocks. They will also impose general or specific restrictions on consumption in line with the estimated shortages, by allocating petroleum products to certain groups of users on a priority basis. In case of a local crisis, a Member State may release emergency stock in amounts lower than the compulsory minimum level set by the Directive 2006/67/EC.

5.4.3. Explicit provisions for security of gas and electricity supply in the internal market

Provisions aiming at safeguarding the security of gas supply by ensuring the proper and continuous functioning of the internal market in natural gas were established in 2004 (European Commission (EC), 2004b) and updated in 2010 (European Commission (EC), 2010c). Towards this direction a list of market and non-market based security measures is provided and Member States must create preventive action plans and emergency plans. A Gas Co-ordination Group is also established to facilitate the coordination of measures concerning security of gas supply (European Commission (EC), 2010c).

Respectively, a framework for the security of electricity supply concerning measures on operational network security, maintaining balance between supply and demand and network investments is also established (European Commission (EC), 2006c).

5.4.4. Enforcing infrastructure—The trans-European Networks Energy Program

The Trans-European Networks–Energy (TEN-E) program aims at increasing the interconnections in both electricity and gas sector and enforcing their infrastructure. The first ten projects were chosen by the European Council in 1994. TEN-E financing is always complementary to Member State financing. In the electricity sector, the primary aim of the TEN-E program is to establish additional internal interconnections to support trade of electricity within the EU, while in the gas sector is to provide additional routes and access to more sources of gas, to increase diversification. Projects can either be pipelines, or LNG import terminals, or storage.

5.4.5. External relations

Co-operation with supplier and transit countries takes place within multilateral frameworks such as the World Trade Organization and the Energy Charter Treaty, through regional initiatives such as the Energy Community Treaty and in the bilateral context through Partnership and Co-operation Agreements and Free Trade Agreements, which provide legally binding rules for the energy sector.

5.4.6. Supporting tools

In response to the 2008 energy and financial crises the European Energy Program for Recovery (EEPR) was established on July 2009. It provides financial assistance to the energy sector, especially to the introduction of interconnection infrastructures (2.3 billion € out of the total budget of 4 billion €) enforcing the investments concerning the security of energy supply (European Commission (EC), 2009i). The EEPR is considered as the key element of the European Economic

Recovery Plan¹² and also focuses on RE, energy efficiency and environment, funding offshore wind and CCS projects.

The Europe 2020 Project Bond Initiative is a recent policy decision which aims at increasing debt financing availability for large scale infrastructure projects in energy (TEN-E projects can benefit from this initiative). It is an Initiative between EU and the European Investment Bank (EIB) that intends to complement the existing sources of project financing through bank loans or public sector grant programs (European Commission (EC), 2012b).

5.5. Environmental protection and climate change

EC's Fourth Environmental Action Program (EAP) covering the period 1987–1992 was the first time that climate change was addressed. When the Fifth EAP for the period 1993–2000 was passed, climate change was identified as one of the seven priority areas for the Community's environmental policy and since then actions regarding climate change and environmental protection have gained momentum.

In 2002 the Kyoto Protocol was ratified and a commitment for an 8% reduction of greenhouse gas emissions during the commitment period 2008–2012, compared to base-year emissions, which vary between Member States was made. This target was distributed among EU-15 through a burden-sharing agreement in 2002. The latest EU-12 are not subject to the burden-sharing agreement but instead have to fulfil their targets as signatories of the Protocol.

Until 2005, the Commission pursued climate change policy solely as a co-operative exercise within the Kyoto framework. In the short period up to the date of expiry of this framework by 2013 and because of a perceived lack of urgency on the part of international partners, a policy change took place. As a consequence, in 2007 EU agreed to pursue unilateral greenhouse gas emissions reductions of 20% by 2020, while offering to step these up to 30% in the case of a new global agreement.

5.5.1. EU emissions trading scheme

The EU ETS is the first and biggest international scheme for the trading of greenhouse gas emission allowances operating in 30 countries (the 27 EU Member States plus Iceland, Liechtenstein and Norway). It covers approximately 45% of the EU's CO₂ emissions from about 11,500 installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board. NO_x emissions from certain processes are also covered.

The system operates through the allocation and trading of greenhouse gas emission allowances throughout the EU. One allowance represents one tone of CO₂ equivalent. A 'cap' is set by each member state on the total amount of emissions allowed from the installations covered by the system. The allowances are then distributed by Member States to the installations in the system. Operators of all these installations are then free to trade in allowances.

The system was launched in 2005, its first phase ended in 2008 and its second phase ended in 2012. In the short term it works as a statistical transfer mechanism between power stations and industrial plants. Year by year, the number of allowances is reduced so that total emissions fall with the aim to be 21% lower in 2020 than of 2005 levels.

5.5.2. National Allocation Plans

National Allocation Plans (NAPs) are plans that set out each member state's allocation of CO₂ emission allowances under the

EU ETS. NAPs fix both the total of emission allocations available in each member state and the allocation made to each installation covered by the scheme (European Commission (EC), 2003).

5.5.3. Emission limit values for large combustion plants

Large combustion plants whose thermal input is equal to or greater than 50 MW, irrespective of the type of fuel used, have to comply with limit values for SO₂, NO_x and dust. These values are fixed in the Directive 2001/80/EC (European Commission (EC), 2001) which aims to reduce emissions of acidifying pollutants, particles, and ozone precursors.

5.5.4. Provisions for industrial activities

Specific measures for industrial activities are designed to prevent or reduce emissions in the air, water and land, including measures concerning waste, in order to achieve a high level of protection of the environment. In order to receive a permit an industrial or agricultural installation must comply with certain basic obligations so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause (European Commission (EC), 2008).

5.5.5. Vehicle labelling

For motor-vehicle it isn't electrical efficiency that is indicated through labeling but information on fuel consumption and/or CO₂ emissions. Labeling is a practical method to inform consumers about the fuel economy and environmental standards of the new cars. Car manufacturers and distributors are to display information on fuel consumption and CO₂ emissions of new passenger cars in showrooms and within any marketing activity.

5.5.6. Carbon capture and storage

Directive 2009/31/EC established a legal framework for the environmentally safe geological storage of CO₂ as a way to mitigate climate change and to eliminate negative effects to the environment and human health (European Commission (EC), 2009j).

The Carbon Capture and Storage (CCS) Directive provides extensive requirements for the selection of storage sites and storage permits. It also contains provisions on closure and post-closure obligations, and sets out criteria for the transfer of responsibility from the operator to the member state.

The EC has taken several initiatives to ensure the coherent implementation of the CCS Directive throughout the EU such as the establishment of an Information Exchange Group to facilitate exchanges between the competent authorities and the adoption of a Commission Opinion on a draft storage permit on February 2012.

5.5.7. Supporting tools

The European Climate Change Program (ECCP) was launched by the EC in 2000 and it is considered the first comprehensive policy on climate mitigation. A second phase followed, with new working groups established. It aims to further explore cost-effective options for reducing greenhouse gas emissions.

The European Environment Agency (EEA) was established by the Regulation 1210/1990 and it came into force in 1993. Its purpose is to provide information on the environment, being the major source for those involved in developing, adopting, implementing and evaluating environmental policy. EEA helps the Community to make informed decisions on environmental issues towards sustainable development.

5.6. Nuclear energy

Although nuclear power accounts for roughly one-third of Europe's overall electrical generation, pronounced differences in

¹² A European Economic Recovery Plan, COM(2008)800 final (26/11/2008).

national nuclear energy policies have prevented the EU from developing a common nuclear energy policy. Within the EU there are widely differing attitudes to the acceptability of nuclear power and it is up to each member country to choose to include it as part of its energy mix. Similarly, nuclear regulation is a national responsibility.

Nuclear power generation was gaining favor within Europe due to the fact that it enhances EU efforts to reduce greenhouse gas emissions and clean air initiatives as it is a low-emission technology with no direct emissions of CO₂, NO_x, SO_x, ozone and particulate matter. It also enhances EU security of energy supply, since uranium is widely distributed and about 50% of global mine production comes from reliable, politically stable trading partners (Canada, Australia, US).

However, the accident in Fukushima in 2011 restarted the debate on the future of this controversial energy source with several countries immediately called into question their nuclear programs. The different responses were quick to emerge and demonstrate the heterogeneity of national situations in EU. Germany announced the immediate closure of seven of its oldest reactors (built before 1980) for a period of three months, as well as a moratorium on the law extending the life of several plants by 12 years on average. It also announced a decision to end its nuclear program in the long term, without specifying a time frame. Italy placed a moratorium on its calendar to restart its nuclear program, and announced a referendum in June 2011.

Other EU countries have announced that their programs will continue, while emphasizing the need to take lessons from the accident in order to make future plants safer. Poland restated its ambition to build a reactor. France defended its choice of nuclear power, while ordering an audit of its plants. The United Kingdom declared that it was too early to question the future of its planned new plants (four EPR reactors are due to enter service in 2018). Spain announced a review of the security at its six plants and the launch of a study on the risk from earthquakes and flooding. The Czech Republic did not envisage the closure of its two plants but might reconsider the planned new plant negotiated with Russia. Finland simply committed itself to heeding the lessons of Fukushima during the continuing construction of the French EPR at Olkiluoto (Andoura et al., 2011).

EU nuclear policy aims to establish a European framework for nuclear safety through the obligation of Member States to adopt a legislative and regulatory framework which ensures the existence of national safety measures (system of licenses, inspecting and assessing nuclear facilities, management and storage of radioactive waste, crisis management mechanism, damage reparation guarantees in case of an accident). It also aims to greater international cooperation, for example through the Multi-National Design Evaluation Process and the activities of the Western European Nuclear Regulators' Association. Moreover, the EU contributes financially to the development of nuclear energy and the promotion of nuclear safety.

5.7. Research and development

Energy R&D has a long history in the EU, as it was considered a top priority policy sector and a key element in the Commission's low-carbon strategy, with significant contribution towards the energy efficiency and RES penetration.

Since 1984, the main instrument for the implementation of European energy research policy and for the provision of funding R&D activities is the multi-annual Framework Program for Research and Technology Development (FP). It covers almost all aspects of European research and is the EU's main financial and legal instrument to the European R&D implementation.

An important milestone for the energy R&D in the EU was the creation of the European Research Area (ERA). It was proposed by the EC on January 2000 and shortly afterwards, at the March 2000 Lisbon European Council, it was endorsed by the EU. It is composed of all R&D activities, programs and policies in Europe which involve a transnational perspective and its aim is to become the "common internal market" of the EU R&D sector. The development of ERA is crucial in order to overcome the fragmentation of research in EU along national and institutional barriers and achieve a high multinational cooperation.

On March 2008, the European Council emphasized the need for sustained investment in R&D. Thus, considering its crucial role, investment in R&D is at the heart of the Europe 2020 strategy.¹³

5.7.1. The Framework Program

The Seventh Framework Program (FP7) is running from 2007 to 2013. Under its structure, energy research is split into nuclear, with the program running from 2007 to 2011, and non-nuclear energy research, from 2007 to 2013.

Under the energy theme of the FP7 Co-operation Program, nine subject areas for non-nuclear energy research have been identified: Hydrogen and fuel cells, Renewable electricity generation, Renewable fuel production, Renewables for heating and cooling, CCS technologies, Clean coal technologies, Smart energy networks, Energy efficiency and savings, and knowledge for energy policy making.

The bulk of nuclear spending in FP7 is allocated to the ITER fusion reactor project at Cadarache in France with priority activities on waste management, development of reactor systems and radiation protection.

5.7.2. Strategic Energy Technology Plan

Because of the timing of the start of FP7 it had not been possible to reflect the need to strengthen energy research in renewable, low-carbon and energy efficient technologies, the Commission adopted the Strategic Energy Technology Plan (SET Plan) on November 2007. Its main goal is to accelerate the development and implementation of low-carbon technologies, and strengthen industrial participation in energy R&D through the European industrial initiatives. SET-Plan includes the initiatives of wind, solar, bioenergy, CCS, European electricity grid, fuel cells and hydrogen, smart cities and sustainable nuclear fission.

Its time horizon includes both a 2020 perspective and a long-term vision to 2050; it sets out the key EU technology challenges to meet the 2020 targets and also the technology challenges that will have to be addressed to put the EU on course to achieve the 2050 vision.

5.7.3. Research fund for coal and steel

The industry-focused research program of the research fund for coal and steel (RFCS) was created when the ECSC Treaty expired on July 2002. It is complementary to and managed outside FP7. It supports research projects in the areas of coal and steel, financed by the interests accrued each year by the assets of the ECSC, about €55 m/year. As the world relies and will rely on steel, more sustainable and clean production techniques must be developed and implemented. Also, since coal remains one of the main energy sources, clean coal technologies are to be developed.

5.7.4. Supporting tools

The European Technology Platforms (ETPs) are fora which bring together industry-led stakeholders in order to define medium- to

¹³ EUROPE 2020, A strategy for smart, sustainable and inclusive growth, COM (2010) 2020 (3/3/2010).

long-term R&D objectives on a number of technological areas where achieving EU growth, competitiveness and sustainability requires major research and technological advances. There are seven ETPs relative to energy issues: Hydrogen and fuel cells (established in 2003), Solar photovoltaics (2005), Zero-emission fossil fuels (2005), Smart grids (2006), Biofuels (2006), Solar thermal (2006) and Wind (2006). ETPs help the stakeholders establish long-term strategic research agendas (SRAs), and contribute directly to the FP work plans, ensuring that EU-funded R&D is relevant for users.

The Joint Technology Initiatives (JTIs) have been developed by some ETPs. The concept of JTIs was introduced in FP7 as a way of creating public-private partnerships in European R&D. They are a means to implement the SRAs of a limited number of ETPs of which the scale and scope of the objectives is such that cannot be supported by the regular instruments of the FP. To help identify such cases identification criteria have been developed by the EC. While ETPs allow public and private stakeholders to jointly define research needs, JTIs are a way of implementing large-scale applied and industrial focused research activities, based in part on the needs identified by ETPs.

The Competitiveness & Innovation Program (CIP) and especially its Intelligent Energy for Europe (IEE) pillar are aiming to complement the FP7 activities by addressing non-technological barriers and providing support to accelerate investment and stimulate the market uptake of innovative technologies across the Community. The key aim of the CIP is to create an EU-wide network of actors capable of participating in European as well as national, regional and local initiatives furthering sustainable energy use.

6. Conclusions

This paper has provided an overview of the historical evolution and the current status of energy policy in the European Union. As our review has tried to illustrate, the breadth and complexity of energy-related issues are increasing in a globalised world with economic and environmental constraints. The EU is called to face an increasing dependence on fossil fuels, growing energy imports and rising energy costs—although recent drastic changes due to unconventional worldwide discoveries of oil and gas reserves may change the latter. These challenges are making European societies and economies vulnerable and in order to deal with them, progress towards a sustainable energy development seems the only way. The European Commission has risen by proposing a range of policies that aim to address these challenges and transform them into opportunities for global economic and technological leadership.

The Union's energy policy started with the first steps of the European integration and the first initiatives took place in order to address the security of the Community's supply. It took few decades since 1950s for a common energy policy with ambiguous targets to be achieved, because of Member States' differing interests. Energy-related issues such as environmental protection and energy efficiency gradually gained in importance, therefore the need for a common EU position and concrete action grew stronger and finally led to the shift of energy policy from an entirely national matter to a supranational policy initiative.

From 2005 onwards, the EC is developing and driving a strong energy policy at EU level. It recognizes the increasingly pressing challenges of growing imports of energy, while addressing the environmental impact of energy production and use. The development of this strategy is built upon three intrinsically linked elements: sustainable low-carbon development, actions to achieve the goal of a single energy market in order to lower energy costs

and promote competitiveness, and energy security and external relations.

These closely interlinked challenges are very difficult to resolve. While the overall policy development is commendable, there is room for improvement in the policy making of the Commission. The combination of energy policy with climate policy objectives has led to a suite of measures (notably the '20/20/20 energy and climate package') that has been criticized for not passing the cost-benefit test (Tol, 2012); and the contradiction between climate policies and internal energy market initiatives may endanger the competitiveness of the European economy (Helm, forthcoming). Therefore, the EU energy policy should be reassessed in order to reconcile the basic priorities mentioned above, taking account of recent global events such as the financial crisis, the negotiations on climate policy agreements and the technological advances in fossil fuel exploration and renewable technologies.

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