Integrating competition and environment in the European electricity market.

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Abstract. This paper deals with the issue of liberalisation and competition in the electricity industry of the European Union. It stresses the need of considering jointly the effects of competition on the electricity market and environment. Both the effects are not univocal and positive or negative changes in the social welfare are possible. Many variables interact and influence the final impact of liberalisation so that it falls within the dominion of possibility. Nevertheless, through the environmental policy and an appropriate system of incentives, the public authorities can address forces such as the diffusion of renewables and cogeneration in order to generate positive environmental effects. Three possible solutions are synthesised in three qualitative scenarios

Europe electricity system towards competition

An international liberalisation process is reshaping the whole international electricity industry. Outside Western Europe, countries involved in such a process are Chile and Argentina, Pakistan, the Philippines and Malaysia, Hungary, Poland, Croatia and the Czech Republic, Australia, Canada and New Zealand.

In the European Union (EU), the liberation trend gave rise to the Directive 96/92/EC. It entered into force on 19 February 1997 and Member States have two years to comply with it. The Directive sets common rules for generation, transmission and distribution of electricity. Essentially, its main points are: freedom of generation for new production capacities, freedom to choose the supplier for eligible customers, right of access to the transmission and distribution systems. The final result of such changes should be more competition and more electricity trade among EU countries, and as from February 1999 all Member States must open at least 25.4% of the markets for free competition.

Such a restructuring process affects both the supply and the demand side. With reference to supply, as far as generation of new capacity is concerned, competition is introduced through two alternative transparent and non-discriminatory procedures among which Member States can choose: authorisation or tendering. As for the demand side, competition is introduced in subsequent steps: to users above 40 GWh/year from 1/1/97, above 20 GWh/year from 1/1/2000, above 9 GWh/year from 1/1/2003. At the end of the six years (1997-2003), around one third of the market will be liberalised. Finally, with reference to transmission, which is the link between supply and demand, Member States can choose between two alternatives: Third Part Access (TPA), that can be either regulated or negotiated, and Single Buyer. However, within the Directive's framework, Member States can impose public service obligations in the general economic interests. Particularly, they can intervene in order to assure security of supply, regularity, quality and price of supplies, environmental protection.

Europe electricity system setting

The changes which are being generated by the Directive 96/92/EC do not occur in a uniform environment. Each EU countries is characterised by its own peculiarities. The specificity of each country is shown in the following table where four elements are considered: market structure, sources of generation, tariffs and degree of restructuring.

Country	Market Structure	Main Sources (1995)	Tariffs 1995 (ECU)	Restructuring
Austria	Grid and production hold by VbG (51% State, 49% private)	Hydro: 67.3% Gas: 15.5% Coal: 10.6% Other: 3.5% Oil: 3.1%	Household: 0.132 Industrial: 0.065	Advanced: single buyer and choice of supplier for consumer≥40G Wh
Belgium	Production: 94% by Electrolabel (private); distribution: 600 municipals.	Nuclear: 56.2% Coal: 26.2% Gas: 13.8% Oil: 1.8% Other: 1.5% Hydro: 0.5%	Household: 0.140 Industrial: 0.047	Advanced: large share of the market is private
Denmark	Generation and distribution hold by municipalities and consumers co-operatives; Transmission: 2 regional grids.	Coal: 75.2% Gas: 9.7% Oil: 9.4% Other: 5.7% Hydro: 0.1%	Household: 0.167 Industrial: 0.055	Medium: hypotheses of negotiated TPA
Finland	130 generating companies (private and public). Transmission: competition between state and industry.	Nuclear: 30.1% Coal: 26.7% Hydro: 20.2% Gas: 10.4% Other: 10.4% Oil: 2.3%	Household: 0.087 Industrial: 0.050	Advanced: fully liberalised in 1997
France	Generation, transmission and distribution: monopoly of Electricite de France (EdF)	Nuclear: 77.1% Hydro: 14.6% Coal: 5.4% Oil: 1.6% Gas: 0.8% Other: 0.5%	Household: 0.133 Industrial: 0.048	Low: hypotheses of single buyer
Germany	9 supra-regional companies control 80% of generation, 40% of the distribution, all the transmission.	Coal: 55.8% Nuclear: 28.9% Gas: 8.1% Hydro: 3.7% Other: 1.8% Oil: 1.7%	Household: 0.163 Industrial: 0.048	Medium: VEAG (generation and transmission) privatised in 1994
Greece	Generation, transmission and distribution dominated by Public Power Corporation (PPC).	Coal: 69.6% Oil: 21.5% Hydro: 8.6% Gas: 0.2% Other: 0.1%	Household: 0.090 Industrial: 0.049	Low: deregulation by February 2001
Ireland	Generation, transmission and distribution dominated by Electricity Supply Board (ESB)	Coal: 51.3% Gas: 29.3% Oil: 15.2% Hydro: 4% Other: 0.2%	Household: 0.105 Industrial: 0.063	Medium: partial introduction of competition
Italy	Generation: 80% ENEL;	Oil: 50.9%	Household:	Low: proposals

	transmission and distribution: monopoly of ENEL and municipal utilities.	Gas: 19.8% Hydro: 15.9% Coal: 11.6% Other: 1.8%	0.135 Industrial: 0.074	of restructuring and privatisation
Luxembourg	97% imported electricity; 2 grids owned by State and industry	Coal: 39.1% Gas: 30.8% Hydro: 17% Other: 12.1% Oil: 1%	Household: 0.116 Industrial: n.a.	Low: proposals of restructuring
Netherlands	Generation: 4 companies; transmission: grid owned by SEP; distribution: 33 companies	Gas: 51.8% Coal: 35.6% Nuclear: 5% Oil: 4.8% Other: 2.7% Hydro: 0.1%	Household: 0.108 Industrial: 0.056	Medium: proposals of negotiated TPA
Portugal	Generation: CPPE; transmission: REN; distribution: 4 companies.	Coal: 40.6% Oil: 31.1% Hydro: 25.2% Other: 3.2%	Household: 0.144 Industrial: 0.097	Medium: split and partial privatisation (30%) of Electricidade de Portugal (EDP)
Spain	Generation and distribution in the hands of 7 companies. Grid held by Red Electrica (public ownership)	Coal: 40.5% Nuclear: 33.5% Hydro: 14% Oil: 8.8% Gas: 2.3% Other: 1%	Household: 0.155 Industrial: 0.065	Medium: privatisation and retail competition underway
Sweden	Generation: 90% hold by 8 companies; distribution: 280 municipals;	Nuclear: 47.6% Hydro: 45.6% Oil: 2.4% Coal: 2.2% Other: 1.8% Gas: 0.5%	Household: 0.75 Industrial: 0.031	Advanced: competition on both the demand and the supply side
United Kingdom	Generation: 3 main operators; transmission: monopoly of National Grid in the high voltage; distribution: 12 companies	Coal: 43% Nuclear: 26.7% Gas: 17.5% Oil: 10.7% Hydro: 1.6% Other: 0.5%	Household: 0.75 Industrial: 0.031	Advanced: privatisation carried out; full competition by 1 April 1998

This table shows that the current setting of the EU electricity system is far from being homogeneous. Large differences exist in all the four parameters considered. Market structure is characterised by situations in which either monopoly (e.g. France, Italy and Greece) or competition (e.g. UK and Sweden) dominates, or an hybrid situation. The move towards competition is at its beginning and only few Member States have completed the restructuring process. Oppositions, which generate delays and influence the way in which the Directive is implemented, exist in some countries. As far as generation sources are concerned, again very different combinations and large variation from the average prevail (in 1995, on average in the EU the output shares were the following: nuclear 35.2%, solid fuels 34.4%, gas 13.7%, hydro 8.8%, oil 7.4%, renewables 0.5%). Finally, it is relevant that tariffs, which are the result of the interaction of the different market and institutional forces, are not homogeneous too. All these elements, especially the last one, indicate that competition can operate big changes in the EU electric setting. Its diffusion should generate more uniform market structures, homogeneous tariffs and a less differentiated picture as regards the generation sources. In fact, as competition takes place within and across countries, the most favourable options should be rewarded by the market so that, as the standard economic theory suggests, equilibrium prevails.

What competition should bring

Indeed, the process acting in Europe, is more complex that the one synthesised by the word competition. Currently, in the EU, at least four processes are under way: restructuring, liberalisation, competition and regulation. Certainly, these four processes are linked and overlap. Nevertheless, to some extent, they can be seen as subsequent steps. By restructuring, privatising and breaking monopolistic situations, Member States prepare the field for liberalisation, that is the freedom of generation, free choice of supply and opening of the grid. After the market opening and the introduction of a certain degree of freedom, competition can work: this means that an appropriate number of operators can interact and compete searching for profits and utility maximisation. However, due to the peculiarities of the good energy (e.g. the relevance of elements such as security of supply, environmental protection, conditions of access to the grid) the market has to be regulated by some authority that, ideally, acts in the defence of the public interest creating the right conditions for efficiency and/or equity.

The aim of these processes is an increase in efficiency and social welfare which, according to various theories, should be reached through a number of channels:

- the introduction of private ownership which removes the political discretion in the management of the electricity industry. In their strategic choices (e.g. location, technology, employment), firms should be no longer influenced by politicians whose targets are linked to the increase and conservation of personal power and unrelated to the social welfare.
- the removal of protections by the Government (e.g. barriers to free international trade, funds covering the firm's financial losses) and the introduction of a right system of incentives (e.g. profits linked to the firm's strategic choices and managers' rewards linked to profits).
- the removal of monopolistic revenues and the introduction of the possibility that firms can be expelled by the market.
- the firms' search for lower costs (e.g. use of cheap inputs, rationalisation of the productive processes) in order to have the possibility of pulling down prices, increase profits and/or extend their market share.
- the firms' search for innovation, new processes and best services for the clients in order to obtain competitive advantages over the competitors.
- the exploitation of local advantages, that is the transfer of the productive plants in regions where the inputs' prices (e.g. fuels, manpower) are lower.
- the firms' search for new markets abroad and the extension of the area of competition.

All these factors should act in favour of an increase of social welfare, mainly obtained through a decrease in prices. This seems to be the view of the operators, too. According to a survey carried out by Price Waterhouse (Price Waterhouse, 1997) over 300 energy consuming companies in seven EU Member States, the liberalisation of the European market will bring positive effects: 64% of the interviewed companies expect an improvement in service, 83% a decrease in cost and 81% expect that their company would benefit from market liberalisation.

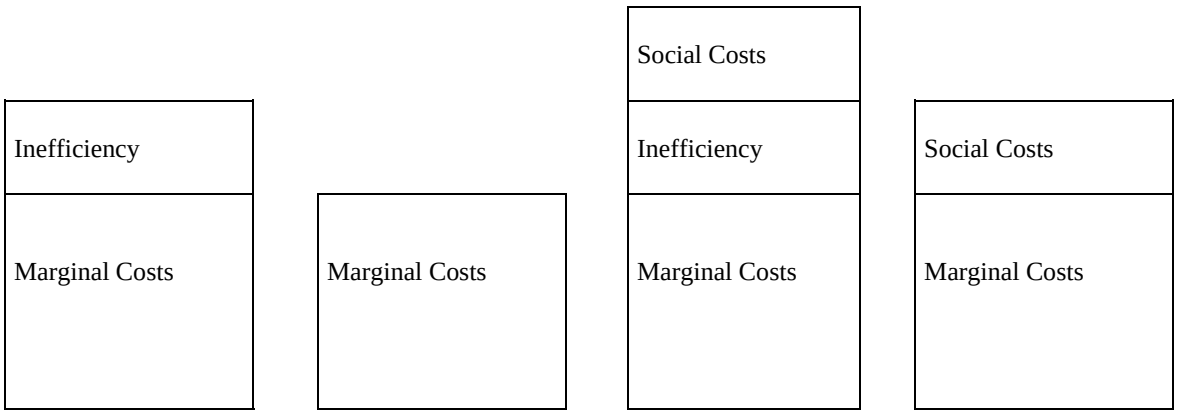
Nevertheless, the picture is not so simple and other views claim that the advantages of competition are far from being demonstrated (on the risks linked to deregulation Banks (1996) offers an interesting and wide picture). Firstly, as mentioned above, in the energy markets competition often brings with itself regulation, and regulation could generate inefficiency and uncertainty. Even if regulators are motivated by the defence of the public interest, their action can negatively influence the companies' behaviour since regulators do not possess perfect information on their real costs. Thus, for instance, companies can misrepresent their ability to reduce costs in the future and induce an increase in prices. In a similar way, regulation can negatively influence the firms' investment decisions since firms can be afraid to be unable to capture their future returns

because of regulatory reviews. This and other effects can be originated by the interaction of liberalisation and regulation, and compensate the efficiency improvements caused by competition. Moreover, and very important, liberalisation can give rise to situations where clients that are not profitable be disregarded and not served by energy companies not having any interest in the defence of social welfare.

Some studies have been implemented in order to establish whether or not the effects of liberalisation are positive. Pollit (Pollit M. G., 1997) offers a review of such studies which gives prudent indications. In some cases liberalisation gave rise to large positive effects (e.g. UK, Chile, Argentina), in other cases the effects are modest (e.g. Scandinavia). In other words, "electricity privatization is still at too early stage in most countries to provide clear evidence on what its impact is likely to be (...) however the direction of the gains will almost certainly be positive". Yet, such probable and not sure positive effect depends on the country situation: inefficient public sectors, large monopolistic advantages, electricity industries managed for many years outside the market laws are elements that render more probable and high the increase in public welfare following liberalisation. Given the EU settings, positive effects are foreseeable in countries like Italy, Greece, Portugal, Ireland, Netherlands and Germany where the restructuring process does not yet exploit all its potentialities.

Competition and environment: forces at stake

Thus, a simple answer to the issue of the effects of liberalisation cannot be given. Reality does not always coincide with the ideal picture and only in favourable cases there are increases in social welfare (consumers' and/or producers' surplus). Moreover, such an unclear situation is complicated by the effects that competition could have on the environment. Competition could eliminate the distortions arising from monopolies and inefficient management of the European electricity system. But, beside such distortions there are the ones caused by externalities. In other words, not only prices do not reflect marginal costs; they do not fully incorporate externalities, too. In spite of the uncertainties existing in evaluating externalities, ExternE showed that the only damages to the public health are often very high (e.g. 13 mECU/kWh for coal in Germany). Currently, in the EU, such costs are not fully internalized by the dominant system of internalisation, that is command and control (environmental standards). This means that the correction of the distortions induced by competition could be unable to improve the price structure. Such a possibility is described in the following picture that shows four possible theoretical situations of structure price.



A no internalisation, market distortions

B no internalisation, no market distortions

C Internalisation, market distortions

D Internalisation, no market distortions

- Structure A is one in which both the market mechanisms and the environmental policy are inefficient. This results in a price that incorporates inefficiency (e.g. monopoly) but non externalities.
- Structure B is a case in which the market distortions are removed but there is no internalisation.

- Structure C is the situation in which market distortions still exist but social costs are internalised.
- Structure D is the case in which internalisation occurs and market distortions are removed. It is obvious that the target of the authorities should be this last, optimal case D, in which both the efficiency of the market and the environmental policy act.

Where is the EU electric system today? Certainly, even if the above four cases are theoretical and are not able to represent the complexity of reality, the European electric system is either in A. or in C, or in something between them: more probably, Europe is closer to A than to C because of a system mainly based on environmental standards that only partially internalise social costs. The Directive 96/92/EC aims just to eliminate the burden of inefficiency within prices. Nevertheless, because of the existence of externalities not fully internalised, the risk exists that, starting from a situation close to A the European electricity system ends in B. It is interesting to notice that, in B, the elimination of market distortions without internalisation creates a price structure which is more distant from the optimal one (D) than the starting point A. In a sense, in A market inefficiencies making prices higher act as internalising forces. Naturally, this setting is not the correct one since internalisation requires that different damages generated by different energy sources and technologies are internalised exactly and not by a general increase in prices due to other causes.

Such a possible, negative and undesired effect on the environment is not the only one that can be generated by competition. The search for cheaper processes and inputs originated by market forces can give rise to dirty productions and increases in pollution. This mechanism is more probable in those situations in which the financial and economic strength of the energy firms is strongly unequal so that the weaker ones compete lowering their environmental efforts. Moreover, in poor areas, this strategy can be favoured by the government by means of weak environmental standards. The final effect could be a very unequal burden of pollution in the different regions. On the other hand, the environment could benefit by liberalisation because of the diffusion of cheap and efficient productions such as technologies based on combined-cycle gas turbine. Again, as when environment is not at stake, the effects of competition are far from being clear and various possibilities exist. Among the authors who suggested positive environmental effects of competition are Newbery and Pollit (1997), Palmer and Burtraw (1997), Grubb (1997). On the other hand, Haas, Orash, Huber and Auer (1997) claim that liberalisation could have a negative impact on the penetration of the renewables due to their high investment costs.

Indeed, the variables that act on the relationship competition-environment are numerous and a complete picture has to take into account a sum of possible forces, positive and negative. In favour of positive environmental effects generated by liberalisation are the following elements:

- the replacement of large coal based plants with smaller and cleaner ones. In economies in which monopolies are broken, financing large installations characterised by long construction periods becomes difficult and risky since high monopolistic revenues are no longer assured. The UK experience, where after liberalisation the combined-cycle gas turbine spread enormously (around 20% in seven years), confirms such a possibility.
- the diffusion of cogeneration, a technology that can increase the efficiency of energy use up to 80% and allow primary energy savings up to one third. In fact, liberalisation could remove some of the barriers to the use of cogeneration, e.g. transaction costs related to technical authorisation procedures and high costs for (or impossibility of) using the grid to supply energy to a third party. Moreover, the shorter time period necessary to the construction of cogeneration plants should be an important decision variable in a competitive context in which flexibility plays a major role.
- the removal of subsidies to coal in Germany and Spain and the diffusion of gas plants due to the decrease of their cost. This last effect should be reinforced by the restructuring of the gas market currently under way in Europe.
- the emergency of a plurality of operators and the dispersion of the economic and decision power at local level (municipals). This trend brings coherence between the restructuring of the electricity markets and

the message of Agenda 21 in defence of local sustainability. In contrast with choices done by the big companies, municipals should incorporate in their investment choices the preservation of environment.
- the penetration of renewables due to the search for new opportunities, advanced technologies and local advantages related to the existence of a plurality of competing operators.

Nevertheless, besides such pros, some drawbacks exist:

- in a competitive market where wrong choices can be fatal, the operators can continue to prefer traditional forms of investment avoiding the new, less known and more efficient technologies (e.g. cogeneration). This attitude can be very relevant for banks and financial institutions.
- investments in technologies based on renewables can be disadvantaged by the fact that they are often characterised by high investment costs and long pay-back periods. This effect is reinforced by the search for returns in the short term which is typical of a competitive market.
- the role of DSM and IRP can be strongly weakened in a system where the decision processes are spread and decentralised. On the contrary, in the traditional monopolistic system the authorities can directly act on the utilities and manage their actions on the demand and supply side in order to increase energy efficiency and conservation. The US experience, where after liberalisation DSM and IRP have lost relevance, confirms the importance of such a problem.
- the search for savings and the possibility of free trade of electricity can bring municipals to buy cheap and "dirty" energy from regions which have relaxed their environmental efforts in order to boost their sales.

It is important to notice that the above pros and cons often are related to the same variable. In particular, the diffusion of small scale technologies, cogeneration and renewables are characterised by both points of strength and weakness. In other words, the effects of liberalisation fall within the dominion of possibility. No univocal and mechanical route exists, and this is the reason why the public authorities have a great role in inducing a virtuous course.

What environmental policy should bring: three possible scenarios

As seen, given the current institutional setting, the trends that can arise from competition are numerous and many evolutions can be imagined. Moreover, it must be stressed that the current European energy panorama is fluid and many elements that are not yet stabilised interact. They add uncertainties to the ones linked to the effects of liberalisation. In building some representative scenarios, factors that can have a very important impact on the environment are the following:

1. the EU obligations agreed in Kyoto (8% CO_2 emission reduction in the year 2010 from the 1990 level) that represents a macro target which, in order to be respected, will necessary imply strong efforts for the European electricity industry. In fact, on the basis of the past trends, a rise in the CO_2 emissions of 16% compared with 1990 is projected. At the present, the path to be followed to reach the Kyoto agreement is not defined.
2. the current emission standard rules that, as expressed in the Large Combustion Plants Directive, will continue to represent unsurpassable boundaries for the electricity industry. Moreover, the Directive is going to be revised and very probably more stringent limits will be set.
3. the hypothesis of a reform in the taxation area that could extend the excise duty system from oil to coal, natural gas and electricity. In particular, an output tax of 1 ECU per MWh, to be increased to 3 ECU MWh, should burden on electricity.
4. the indicative objective of 12% (i.e. doubling) for the contribution by renewable sources to the EU's gross inland energy consumption, which was set in the Green Paper on renewables (1996).
5. the EU commitment to provide a strategy for the promotion of Combined Heat and Power (CHP) that was declared in the White Paper "An Energy Policy for the European Union" (European Commission, 1995)

for the European Union. If a strategy is going to be pursued, CHP could have a strong boost with positive effects on the environment.

All of these five factors are key issues for the environmental policy: factor 1 is a macro objective which can be reached through many routes; 2 and 3 refer to two basic tools of the environmental policy: standards and pigouvian taxes; finally, 4 and 5 refer to two elements relevant in any environmental protection strategy: the mix of fuels and technology. They render any previsions on the future EU electricity system very difficult. In fact, they introduce further uncertainty since the only factor 2 represents a fix limit for the energy industry. However, even in the current context characterised by great variability, some qualitative scenarios can be proposed as a synthesis of the future possibilities:

A. Collision: gains by competition but mediocre environmental policy.
B. Harmony: gains by competition and appropriate environmental policy.
C. Transition: no gains by competition and appropriate environmental policy.

	Scenario A: Collision	**Scenario B: Harmony**	**Scenario C: Transition**
Advantages by competition (lower prices, higher efficiency)	Yes	Yes	Yes
Environmental Taxation	Weak	Full internalisation	Full internalisation in the long run
Renewables' share	Stable/Low increase	High increase (up to 12%)	High increase (up to 12%) in the long run
Cogeneration's share	Stable/Low increase	High increase (up to 18%)	High increase (up to 18%) in the long run
Energy efficiency measures (e.g. DSM, IRP)	Weak	Strong	Strong in the long run

Scenario A. Collision: gains by competition but mediocre environmental policy.
In this case, positive effects of liberalisation on the economy are assumed. They induce efficiency improvement but they are annulled by a bad environmental policy. In particular, competition brings the electricity prices down so generating an expansion in consumption. Nevertheless, the environmental policy is not able to capture such benefits. In particular:

- an appropriate set of actions able to expand renewables (e.g. economic incentives, research, development and demonstrations, adequate internalisation) is not stimulated.
- the barriers to the diffusion of CHP (e.g. low rates for cogenerated electricity export, high prices for inputs, short term contracts, expensive license procedures) are not removed.
- DSM, IRP and measures that increase energy efficiency are not pursued.
- the command and control approach remains the main instrument used by authorities, taxes are not introduced, prices do not fully incorporate external damages and dynamic efficiency is not favoured

If this negative scenario holds, it could be impossible for Europe to respect the Kyoto agreement.

Scenario B. Harmony: gains by competition and gains by environmental policy.
This case is, as far as environmental policy is concerned, the opposite of scenario A. The advantages of competition are reinforced by a sound environmental policy implemented without delay. Ideally, if an appropriate incentive system is set (e.g. environmental taxes, IRP which takes externalities into account), this scenario could bring to:

- a share of gross inland energy consumption equal to 12% which, according to the White Paper (European Commission, 1997 b), means: up to 402 CO_2 million ton/year reduction in 2010 with respect to 1997, i.e. annual benefits in the range 5-45 billion ECU; import reduction equal to 17.4% in 2010 with respect to 1994; avoided annual fuel cost in 2010 equal to 3 billion ECU.
- a doubling of the current share of CHP from 9% to 18% of the total gross electricity generation by the year 2010. Such a doubling implies, considering a replacement of the existing electricity and heat production plants, CO_2 emission reduction equal to 4% of the total EU CO_2 emissions in 2010 (European Commission, 1997 a).

Scenario C. Transition: gains by competition, and gains by environmental policy in the long run.
This case is a mix between A and B. Increased energy efficiency and lower electricity prices are rapid effects of liberalisation, nevertheless some time passes before the environmental policy fully exploits its potentiality. In this case, a delay occurs. In particular:

- the convergence towards a spread use of environmental taxation in all the EU countries takes time to be realised.
- measures that favour CHP, renewables and energy efficiency improvements are implemented only when the deadline of the agreement signed in Kyoto approaches.

Conclusions

The effects of competition on the EU electricity industry can be both positive and negative. Key elements in the determination of the final impact are the possible elimination of the barriers to the diffusion of clean technologies (e.g. small plants, cogenerations) and renewables, the search for new opportunities and technologies, the removal of subsidies, the diffusion of combined-cycle gas turbines. The environmental policy can play a big role in pushing the EU electricity system towards a solution where the environment is more protected. An appropriate level of environmental taxation and a system

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