The liberalization of the Spanish electricity system and its effects on its environmental performance

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1. The liberalization process in Spain

1.1 Description of the liberalization process

Following the general trend of liberalization of previously-monopolistic sectors all around the world, the Spanish government from 1997 set as one of their industrial priorities the opening of the electricity market, with the major reason being the desire to allow consumers to access to lower electricity prices because of competition forces.

The first step towards this liberalization of the electricity sector was the Protocol negotiated by the Ministry of Industry and the major electric utilities in Spain before 1997. The reason for this protocol was the need of the Ministry to reach a general agreement with utilities before changing the law. Its major objectives were:

- to set the framework for the electricity sector which would guarantee its competition and competitiveness,
- to define a transition period towards full liberalization,
- and to establish the appropriate rates for regulated activities.

Based on the Protocol and on the Electricity Directive, the Electric Power Act 54/97 was approved on November 1997, which set up the general framework of the liberalized electricity sector and scheduled it beginning for the 1st January 1998. This act, which was further developed by a series of Royal Decrees and Ministerial Orders, clearly distinguished two types of activities: generation and retail, which should be liberalized, and transmission and distribution, which should remain under a regulated scheme. The economic and technical management of the system were also considered regulated activities. The major aspects the process are described below.

An important issue to be stated also is that electric utilities in Spain were already private, so that there was no need for a privatization process as in other countries.

1.1.1 Electricity Generation

Electricity peninsula production in Spain is based on approx. 50-46% thermal, 35% nuclear and 15-19% hydroelectric power generation (this share depends of the level of rainfall of the year). The gross electricity production in 2000 was 176.7 TWh. The net production in the same year was 168.9 TWh. Over this production it is necessary to add the international exchanges (4.4 TWh) and the self-generation (26.5 TWh).

The main electricity generation companies, which also carry out distribution and supply activities, are Endesa, Iberdrola, Unión Fenosa, and Hidrocantábrico. These are all privately owned. Their total install capacity is 44 TW. Self generators count for about
13% of the market. The Spanish authorities expect that between 2002 and 2004, 10 new generation companies will enter the market, with a total expected generation capacity of 7,200 MW.

Electricity islands production is based on thermal power generation. The gross electricity production in 2000 was 10.8 TWh. The net production in the same year was 10.1 TWh. Over this production it is necessary to add the self-generation (0.7 TWh). The installed capacity is 3 TW.

In terms of implementation of the electricity Directive, Spain has opted for an authorization procedure for the construction of new generating capacity. In case of an explicit or implicit rejection of the authorization application, the applicant may lodge an appeal to the relevant administrative authority.

The Spanish system distinguishes between a general and a special generation regime.

For generation under the general system, a pool-based system is organized. Under, this regime, generators submit their bids, and eligible customers, distributors and suppliers place their purchase bids. The pool price is a marginal price determined on the basis of a merit order. Under the general system, all producers above 50 MW capacity are obliged to bid into the pool, except for the quantities that they sell on the basis of bilateral contracts. Negotiations within the general regime are carried out in the framework of three negotiating sessions: a daily market, an intra-daily market (managed by the Market Operator), and a market of ancillary services (managed by the System Operator).

Only electricity generators with production of equal or less than 50 MW, self-generators using cogeneration or other forms of electricity generation associated with non-electricity operations and renewable energy producers, are granted authorization to produce electricity under the so-called special regime. Pursuant to this regime "the installations authorized for this type of electricity production shall be given differentiated treatment according to their particular conditions, albeit without any type of discrimination or privileges between them. Thus, these generators are not obliged to submit bids to the pool. They benefit from a takeoff guarantee for their surplus electricity by the system. Its remuneration is the wholesale market price plus a premium or economic incentive."

Finally, Article 25(1) of the Act 54/1997 provides the Government with the power to introduce priority dispatching for generators using indigenous coal tip to 15% of national consumption. This power has not been used until present.

The Spanish legislation also establishes that in order to cover at least 12% of the Spain's total energy demand with renewable energies by the year 2010, a Plan for the Promotion of Renewable Energy Sources will be drawn up. Its objectives will be taken into account in the setting of incentives.
1.1.2 Opening of the market time schedule

The Spanish electricity market is gradually developing towards full competition. The threshold for eligible customers that was initially defined at 15 GWh/year consumption and from the year 2007 all consumers shall be regarded as qualified customers.

Recently the Government has decided to speed up the process. As a consequence, as from October 1999, the threshold was lowered to 1 GWh/year representing 46% of the market or 9,100 eligible customers. By July 2000, all high voltage customers will be eligible. This would represent 61,200 customers or 54% of the market. Next 1st January 2003 all customers will be eligible customers (21,000,000).

This opening-up of the market has already lead to significant new commercial activity in the Spanish electricity market. 42 new traders and 3 new external agents have been registered during 1998.

1.1.3 Access to the transmission and distribution network (TPA)

Transmission

The system for access to the transmission and distribution network is based on regulated third party access. As regards the functions of pooling and transmission system operation, the Act 54/1997 provides for the creation of two different legal entities, namely the Market Operator (Art. 33) and the System Operator (Art. 34).

The market operator, OMEL, will carry out management tasks and will settle the payments between the market participants. The market operator is responsible for the economic operation of the physical daily spot market, the financial futures market as well as the determination of the dispatch merit order (in co-ordination with the System Operator -SO-).

The system operator is responsible for the technical operation of the grid as well as for monitoring and co-ordinating production and transmission, in particular for the short-term intra-daily management of technical constraints and redispatch. Both operators enjoy a high level of independence, not only in terms of accounting and management unbundling but also in terms of legal unbundling.

Planning is only mandatory for the transmission activity. It needs to be carried out by the Central Government with the participation of the Autonomous Regions.

The SO is responsible for the development and reinforcement of the transmission network. The SO will need to make proposals to be submitted to the Ministry of Industry, in order to maintain the system capacity, and thus cover the demand complying with the quality standards at the least possible cost.

The Spanish basic Act 54/1997 establishes that construction, operation, modification, transfer and shut down of transmission facilities require previous administrative
authorization, which may be granted by the State Administration or the Autonomous Regions.

Distribution

As regards the distribution system, the Government designates the undertakings responsible for the operation of the system in each distribution zone.

According to section VI of the Act 54/1997, the distribution business will continue to be a regulated activity. The access fees for the transmission and distribution systems are regulated. Secondary legislation provides for "postage stamp" flat rates, determined on the basis of voltage levels and use of the network. These fees, as well as the final tariffs charged to captive customers, reflect all the costs of the system operation, as these are defined in the relevant legislation. Additionally, they need to be approved by the Government in the manner set out in the regulations while they are understood as maximum amounts to be charged.

The distribution systems are defined as the grid systems below 220 kV. The Spanish Law differentiates clearly between distribution stricto sensu, which is confronted as a regulated activity, and the supply of electricity, which is a totally liberalized activity, in the sense that any legal entity is able to act as an electricity trader after holding the corresponding administrative authorization. The trading entities are free to provide electricity to eligible customers while captive customers, who are still subject to the tariff system, are to be exclusively provided with electricity by the distribution companies.

Unbundling

Management unbundling

The Electricity Act 54/1997 provides in Article 14 for a complete legal separation of the entities, which are engaged in the three regulated activities: system management, transmission, and distribution. Companies carrying out one of these regulated activities may not carry out generation or retailing of electricity. As an exception, this restriction applies "without prejudice to the possibility of sales to captive customers as acknowledged for distributors".

The complete separation between regulated and liberalized activities must have been achieved by the end of the year 2000. Nevertheless incompatible activities can be carried out by a group of companies, provided that these are run by legally different entities and under specific guarantees for the non-flow of commercially sensitive information between them.

The Act designs a complete management, legal and (partial) ownership unbundling scheme for the entities responsible for system and market operation, which aim to guarantee the independence of these undertakings. More specifically, according to Articles 33 and 34 of the Act, both the Market and the System Operator's shares are not to be held by companies engaged in the electricity sector at a percentage, which exceeds
40%. Additionally, one same shareholder may not hold more than 10% of the overall shares, with the exception of the State Company for Industrial Shareholdings, which will keep an equity participation in the System Operator (REE) of at least 25% until the end of December 2003. Furthermore, the Law provides for the transfer of all the necessary assets to the separate legal entities, which shall be created, in order to render them capable to perform the duties assigned to them. 14

In summary, the Act prohibits the development of regulated and non-regulated activities by the same legal entity, although it allows their integration into a holding of companies.

**Unbundling of accounts**

The transitional period for legal unbundling in the 5th transitional provision of the Act had required the immediate unbundling of accounts and the creation of the so-called "Chinese walls" between the companies engaged in regulated and non-regulated activities.

Article 20 of the Electricity Act 54/1997 as well as additional secondary legislation implement the unbundling of account principles of the Directive. All electricity companies are obliged to disclose to the Administration all information required and especially the relevant financial statements, which must be checked annually by means of external audits.

1.1.4 Regulatory authorities

The regulatory responsibilities are split between the Ministry of Industry and Energy and the National Electric Regulatory Commission ("Comisión Nacional de la Energía, CNE"). The CNE is an independent body, which has been newly established by the Electricity Act. Additionally, for the support of the CNE the Electricity Act established a Consultative Council of the Commission ("Consejo consultivo de la Comisión").

The CNE exercises a broad range of functions, such as making proposals for tariff structures (ultimately to be approved by the Ministry), settlement of the costs of the transmission and distributions activities, solve any disputes in network access questions, and various control, supervision and advisory functions.

1.1.5 Public Service Obligations

The Spanish legislation shifts from the principle that the electricity supply is a public service (Royal Decree of 12 April 1924), to the direction of an open and fully competitive market, where the public service obligations should in principle be imposed onto the regulated activities, namely onto transmission and distribution.

However, the current Spanish law recognizes and imposes such obligations, when pursuing objectives as security and quality of electricity supply, safeguarding of safety
conditions, promotion of the universal service and protection of the environment through supporting renewables and "Combined Heat and Power -CHP-" plants.

With regard to security of supply, Article 10 of the Spanish Act 54/1997 states that in some cases, which are exclusively mentioned in the Act, the Government may adopt measures, such as temporary limitations or modifications imposed on the electricity market; etc.

Finally, as regards universal service, Article 12(1) provides for the obligation to connect all consumers at reasonable prices. Activities for the supply of electricity taking place in island territories outside the "Peninsula" (i.e. Ceuta, Melilla, Baleares, Canarias) may be subject to special regulations taking into account the specific conditions arising from their location.

1.1.6 Transitional regimes

Spanish Stranded Costs

The Spanish Act provides in its 6th transitional disposition for a transitional regime referred to as "Costes de transición a la competencia" (competition transition costs - CTC-).

The objective of the CTC regime is to provide over a maximum of 13 years a partial compensation to each electricity generating plant due to an expected decrease of the electricity price in the wholesale spot market to estimated 6 Pta/kWh. The total initial, ex ante calculated, maximum compensation is Pta 1.988 billion (approx. Euro 316 billion). The main portion, i.e. Pta. 1.693 billion is designed as "technology compensation" covering the income gap of each of the 4 generating companies. A smaller portion, i.e. MMPta. 295 is designed to cover a fixed premium of 1 Pta per kWh electricity produced from indigenous coal. Recently the "technology compensation" was reduced by a new Law to 1,441 billion Pta.

The ex-ante calculation sets the maximum amount of compensation. The actual yearly compensation is calculated on the basis of the real development of the spot market prices. If the market price remains higher than the assumed 6 Pta per kWh, the compensation payments will be reduced proportionally. If the market price falls even below the estimated 6 Pta per kWh, the yearly compensation will be increased, but not the total compensation. This means that the transitional period would end before the scheduled 13 years, namely at the time when the maximum compensation amount has been used up.

The cost of the CTC regime is yearly recovered in the regulated tariff and transmission fees. The respective charges are collected by the distribution companies and transferred to the electricity generating companies under control of the regulator (CNE).
Other costs: Remuneration of capacity reserves (security of supply)

The Spanish legislation also foresees a capacity-reserve remuneration regime to be paid to electricity companies for ensuring that their utilities are ready at any time to cope with whatever demand of electricity. Electricity companies will receive during the year 2000 Pta 1.15 per kWh produced as capacity reserve.

A charge to compensate electricity companies for the abandonment of nuclear plants was also introduced by the Government.

**Support mechanisms to renewables, CHP and demand side management schemes**

The Spanish law lays down certain economic incentives to promote CHP, renewable electricity and demand side management schemes. Bonuses are established on the tariffs and fees.

**1.2 Results observed from the liberalized electricity market**

The analysis of the results for the liberalized electricity market in Spain is quite positive along its first three years and a half concerning its technical aspects: all the mechanisms designed are functioning correctly, utilities are making their decisions based on the market signals, demand has been covered satisfactorily, with power plants producing mostly based on their economic costs and the eligibility is enlarging very rapidly.

However, other changes expected: lower electricity prices, more competition, and change in technology, have not been realized yet. This may be due to several factors which to a certain extent are characteristic of the Spanish electricity sector, and which are described below:

- the large degree of concentration of electricity production, with two firms producing around 80% of all the electricity in Spain, may cause market power situations, and this may in turn cause that prices will not be reduced, but rather increased, moreover given the large increase in demand experienced these years.

- this same possibility for market power, as well as the existence of competition transition costs which "protect" to a certain extent existing firms, have contributed to the fact that no new firms have currently installed power plants in Spain (although several of them have already applied for that).

- the capacity of international interconnections is very small compared to the total capacity. Therefore the electricity exchanges with foreign companies are very reduced.

- the only major change has been the large increase in the special regime production, what is not really a consequence of liberalization, but rather a result of maintaining a regulated fraction within the electricity sector.
As a result, what can be said is that, for a very large fraction of the market, its technology structure and power plant merit-order remain the same as before the liberalization, and prices are also more or less stable. This can be observed in the following figures, in which the installed power and the electricity produced for each type of technology in the last years may be seen.

![Installed power (MW)](image1)

![Energy produced (GWh)](image2)

As many be seen, there has been a significant amount of the installed power and energy generated, following the large increase in demand (5% yearly for the past 2-3 years). However, most of this increase has been covered by special-regime energy, that is, cogeneration and renewables, which are considered "must-run" facilities for the dispatch. Therefore, there has been no space left for new investments in combined-cycle power
plants, and this space has not been created either by the retirement of other power plants, which have not yet reached the end of their lifetime.

2. Identification of the major aspects of the liberalization process which may affect the environmental impact of the electricity system

There are some aspects of liberalization processes in general which are expected to affect the environmental impact of electricity systems, be it negatively or not. The most significant are those affecting generation, since this is the part of the electricity production cycle more likely to cause significant environmental impacts. Some are listed below:

- change in risk allocation, which in turn produces an accelerated investment in new technologies and an increase in discount rates;

- change in dispatch and planning criteria, generally focusing only on economic costs and short-term returns,

- change in the role and capabilities of the regulator.

Basically, what the two first changes produce is a change in the technology portfolio, which is directed towards low-private-cost, less-capital-intensive technologies, such as natural gas combined cycles, while rejecting high private cost technologies such as renewables and demand-side-management (unless customers are allowed and willing to make their choice for these technologies) and capital intensive technologies such as nuclear or hydro.

The third change, in turn, is the one which may alter the effects of the former two, by acting accordingly on regulation to promote different technologies depending on the national energy policy.

Therefore, a liberalization process does not always have to induce the changes in electricity generation technology cited above, depending on the regulation adopted.

One change which is certainly expected is that demand will probably increase, because of the lower prices induced by competition. This may probably worsen the environmental impact of the electricity sector as a whole, although its specific impact on a per kWh basis will depend on the changes in the technology portfolio, which are not clear:

- if combined cycles enter the generation market, as expected (as happened for example in England with the "dash for gas"), they are most likely to replace old coal power plants, and therefore the specific environmental impact will be improved, in terms of CO₂, SO₂ and NOₓ emissions.

- if they replace nuclear, what would happen if the fixed costs of nuclear have not yet been paid off, or if nuclear is phased out (what actually has nothing to do with
liberalization), they will certainly reduce the environmental impact of radioactive waste, but at the expense of higher CO₂ and NOₓ emissions.

- if they replace hydro, what might happen in the long term, again atmospheric emissions would increase, although the physical space required for power plant construction (and thus affected) would be smaller.

- if external costs are not internalized, natural gas combined cycles will have a large cost advantage over renewables, and thus the environmental impact of the electricity system will get worse.

Therefore, it seems that in the short term, the specific environmental impact of electricity systems will improve, while the general impact of the sector will get worse. In the long-term, however, liberalization may worsen even the specific environmental impact, both by substituting hydro (and nuclear) with natural gas combined cycles, and by preventing an increase of renewable energies (or other clean technologies) because of their high capital costs.

All of this, of course, unless specific regulation is issued to internalize social costs into electricity operation and planning, such as support policies to promote renewables or clean technologies, environmental taxes, pollution permits, etc. If these environmental policies are implemented, then the environmental impact of the liberalized electricity system will depend more on the specific regulation issued in each country or region than on the influence of the liberalization process itself.

In Spain, the major aspects of the liberalization process which may affect the environmental impact of the electricity system are:

- the installation of new natural gas combined-cycle power plants, although these plants have not yet been installed because of reasons cited before;

- the maintenance of old coal power plants because of CTCs and subsidies to national coal, although these are limited in time;

- the maintenance of hydro and nuclear, which are being paid-off totally by CTCs, and therefore are very competitive, given their low variable costs.

Concerning the internalization of social costs, Spain has a support scheme for CHP, renewables and demand side management schemes, which was explained in the past section.

Therefore, following liberalization, it is expected that the environmental impact of the Spanish electricity system will follow the general trends outlined before, although the support scheme for renewables will allow them to participate more in the system, and therefore to improve its environmental performance to a certain extent.
3. Review of the environmental policy applied for the Spanish electricity sector

3.1 Description

There have not been major changes in the Spanish environmental policy applied to the electricity system since its liberalization, except for some changes in the renewable energy promotion scheme. This environmental policy is basically composed by three types of instruments:

- command and control legislation
- economic incentives
- indicative planning

3.1.1 Command and control legislation

These have been traditionally the most used instruments in Spain to regulate the environmental impact of electricity systems. There are basically two types:

- emissions control, based on the EC Large Combustion Plants Directive, it requires all large power plants in Spain to comply with certain SO₂ and NOₓ limits. This has required some power plants to implement emissions control technology.

- inmission control: regional and local authorities require that inmission limits are not surpassed, their level depending on the area affected. As one of the responsible for these levels, power plants must also have these restrictions into account.

In addition, nuclear facilities must fulfill all their safety and environmental requirements, as stated by specific legislation.

3.1.2 Economic incentives

There are two major economic incentives within the Spanish electricity system. Both attempt to internalize external benefits into the price/cost of certain technologies, thus promoting them against traditional, more polluting ones.

CHP and renewable electricity

Electricity produced in CHP and renewable power plants under 50 MW is entitled to perceive a bonus over the electricity market price, depending on the technology and the energy source used (solar, wind, biomass, waste, small hydro or cogeneration). In
addition, the legislation guarantees that all the energy produced in these plants has to be bought by distribution companies.

The funds for these incentives come from electricity tariffs, which carry a surcharge of about 5% due to this reason.

The advantage of this instrument is that funds are clearly earmarked for financing this technologies. Besides, it has shown to be very effective in promoting renewables in Spain (specially wind). Its disadvantage is that regulatory risk is quite high concerning the determination of the incentives, since the mechanism is slower than technology development.

**Demand side management schemes**

These incentives were scheduled in the electricity tariff as an extra of 0,25%. The objectives were to promote new efficient technologies of electricity consumption (low consumption lamps, heat pumps, systems to regulation of electric motors, etc) and teaching consumers. They achieved quite positive results, but they were discontinued in 1999, although they may appear again sometime in the future.

3.1.3 **Indicative planning**

Within liberalized electricity systems, traditional planning is discontinued in most cases, since power plant installation is usually only subject to an authorization procedure (although in some countries such as France planning is still compulsory due to the tendering process required). However, planning has many positive aspects for regulators, since it can help them:

- provide all market agents with homogeneous information for the middle- and long-term at no cost, thus removing partially the problem of asymmetric information,

- detect market inefficiencies in the middle- and long-term, thus having the possibility to anticipate possible consequences of different policies.

Therefore, Spain has kept an indicative planning as an indirect instrument to detect the guarantee of supply and the efficient assignment of environmental and economic resources in the electricity system.

3.1.4 **Other instruments**

New power plants to be installed must carry out an Environmental Impact Assessment. This applies also to some of transmissions lines and renewable energy power plants.

Already existing power plants may negotiate voluntary agreements, such as those covered by the EMAS legislation.
3.2 Adaptation to the liberalized framework

In principle, none of the environmental policies currently in use in Spain interfere with the development of the liberalized electricity system, although none of them (except indicative planning) were designed specifically for this purpose.

However, changes are expected in order to further adapt environmental policy instruments to the new liberalized conditions: for example, the renewable energy support policy is expected to evolve to a green certificate mechanism.

3.3 Success of the environmental policy

Both the command and control and the economic incentives measures have had a significant success in Spain, as will be seen in the next section. Specially the renewable promotion scheme has made Spain one of the world leaders in wind energy installation, with its consequent benefits on the environmental performance of the electricity system.

As for indicative planning, it may still be too early to evaluate, given its short life and long-term objectives.

4. Trends detected in the environmental impact of the liberalized electricity sector

In spite of the large increase in electricity demand, and to certain periods of drought (which reduced the contribution of hydro to the system), atmospheric pollutant emissions from large power plants have decreased globally.

Concerning SO$_2$, emissions have largely decreased as a consequence of the measures adopted to reduce emissions, such as the utilization of low-sulfur fuels, new technologies, and desulphurization plants. As for NO$_x$, emissions have been lightly variable, due to the different level of annual hydro electricity. CO$_2$ emission levels, while increasing, are still well below European averages.
Therefore, it may be seen that the improvement of the environmental performance of the Spanish energy system is not derived from the liberalization process, but rather from the maintenance of command and control measures and to the large success of the renewables promotion program, that is, to country-specific reasons. This corresponds roughly with the expected effects described in section 2.

Since the liberalization of the electricity system is quite recent in Spain, it may be expected that more changes will happen in its environmental performance in the future, since the market is fully developed. Changes might also be expected from modifications in the environmental policy (e.g., the change to green certificates to support renewables which is envisaged in the near future).