

Review of the History of the electric supply in Spain

from the beginning
up to now

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Introduction

The first reference of Electrical practical application in Spain is from the year 1852, a pharmacist from Barcelona illuminate his pharmacy. Twenty years later in 1873, the Industrial Engineers School imported a Gram me machine to learn more about it, and as a result of this in 1875 another bigger dynamo was brought to Barcelona, and installed in Victoria Frigate, connected to the steam machine which it uses to work.

In 1881, the first electricity supplier was created, Spanish Electricity Society. It was the sixth entity in the world, that started producing and selling energy, after London, Berlin, Saint Petersburg, Chicago and New York. On September 1881 the first public street lighting installation and the first also opened in Spain, was turned on. Some arc lamps were placed in Comillas. (Cantabria).

In 1901 the first official statistics is published, about the 859 power plants that existed in Spain, totalling 127,940 HP, 61% of this power was thermal origin while the remaining 39% using hydropower. In this new century, with the alternating current, recently invented, things started to change. In the late twenties, compared with the early century: the generation capacity has been multiplied by 12, reaching 1154 MW, but the most interesting thing is that by 1929, 81% of the production was from hydroelectric.

After the Spanish Civil War up to 1959, the electric capacity production in Spain wasn't enough to fulfil demand. These times were characterized by several electrical constraints and frequent power cuts. The causes of this situation can be found in both, the supply and the demand.

In the early fifties the liberalization of Spanish economy began, which results in a significant increase of national income. In addition, it starts the international release, mainly from the USA President visit to the country. Some of the first foreign loans, most of them from USA, were used precisely for the purchase of electrical equipment urgently needed.

Between 1960 and 1973, the supply/demand balance was restored, and with higher quality, even in wet years export electricity to France and Portugal, due to the interconnections built during this period. Definitively there was an important increase in installed capacity, 6.750 MW by the end of 1960 to 23.207 MW in 1973. This allowed power generation quadrupled 76.272 GWh. The generation structure also changed substantially: hydroelectric source was 84% by 1960 and decreased to only 39% in 1973. Jointly with coal plants, also fuel plants increased, in a *low oil prices* context. Many of the plants built between 1955 and 1973 still in service and are among the more powerful ones in the Spanish electricity park.

The year 1973 was a very important year to the energy sector of all industrialized countries. A dramatic oil price rising started and will not stop its upward path until 1983. Between May 1973 and the next year, the oil barrel price multiplied itself nearly six times, starting with \$1,62 to \$9,31, particularly was called the "First Crisis". After several year of new price increases, in 1979 came the "Second Crisis". The barrel went from \$13, 5 in June 1979 to \$35 in January 1981. As oil was the main primary energy source (about 44% of final consumption). The world economy entered in a difficult period of crisis, forcing the industrialized countries to adopt measures to hold the energy consumption.



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By 1983, the oil substitution to alternative energy sources, efficiency savings and the application of a pricing policy which includes all the variations had been the basic axes of the energy policies in developed countries. This strategy was one of the fundamental pillars of Spanish economic adjust, in the process of convergence with the European economic systems, members of the EC, which Spain would join since 1985.

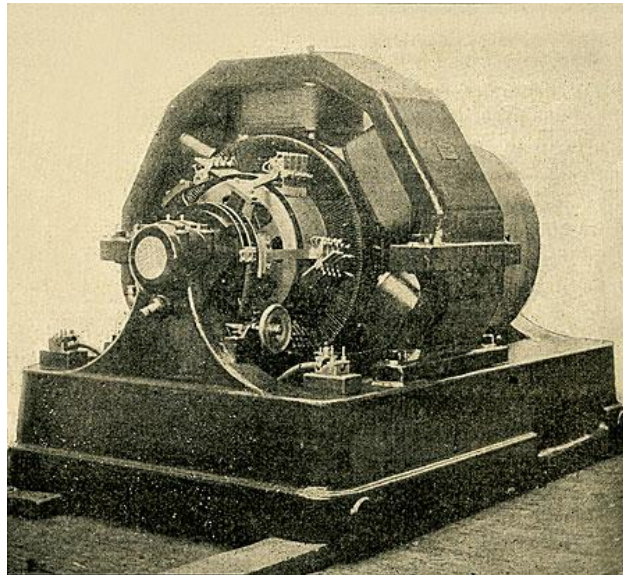
Since 1990 with the publication of the Directive 90/547/EEC on the “Big Scale Transit of Electricity Networks” and, above all, until 1996, Directive 96/92/EC on “Common Rules for the Internal Market of Electricity”, when really started the sameness in the treatment of electricity, developing the new Single Market of the EU.



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1. The XIX Century.

The first reference of Electrical practical application in Spain is from the year 1852, a pharmacist from Barcelona illuminate his pharmacy. He used some type of galvanic battery, made up by himself. In the same year, in Madrid, the Congress was also illuminated. Twenty years later in 1873, the Industrial Engineers School imported a Gram me machine to learn more about it, and as a result of this in 1875 another bigger dynamo was brought to Barcelona, and installed in Victoria Frigate, connected to the steam machine which it uses to work. This Frigate was anchored a couple of kilometres from the coast, and working from there, they could illuminate the Ramblas, Boquería market, Montjuic castle and also Gracia hills.



Dynamo type Gram me (1)

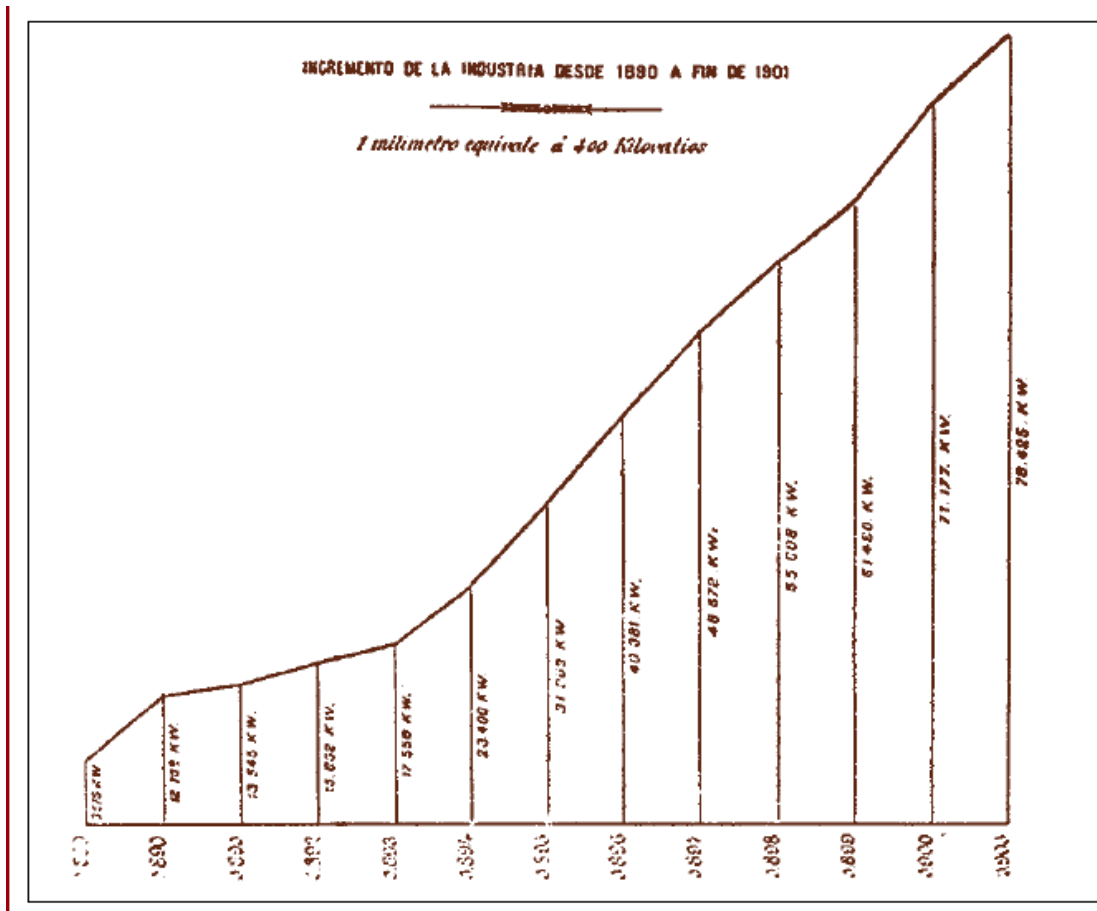
Then, many Spanish engineers as Narcís Xifra Masmitjà, Francisco de Paula Rojas Caballero-Infante, Lluís Muntadas Rovira o Josep Mestre Borrell start to push up the industrial electrification. In 1877, two years later every thing had changed, the first electrical lift was installed in Madrid, the level of electrification grew a lot, “The Land and Maritime Engineer” is considered the first entity that signed a power supply for the city of Barcelona. Step by step, Barcelona and Madrid, as the largest cities, started to illuminate all the important places and streets, replacing oil lamps.

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Also this society, paid the rights of Gram me machine for five years, so they started to build and sell them, they did the same with Maxim, Weston, Nystem, and Lane Fox, Maxim and Nickols incandescent lamps. At the same time, the built the first power plant, a steam machine with 140 HP, which supply the first consumers. Because of the demand, by the end of the year, they had to expand the plant, now with 1200HP. By 1882 they started to expand along the country; Matritense Electricity Company from Madrid was founded. And so, with many other cities as Valencia, Zaragoza, Oviedo, Seville, Santander and Malaga, but they also participate in Cuba and Philippines.

The next step for the SES, was the street lighting. Once the industries had it, they offered the major, without any cost, some streets lighted up. This was made with 12 lamps. The reports from the city engineer and architect were approved, it has to be placed 10 meters above the floor, and 20 centimetres under the wall lines. On September 1882 the first installation public street lighting and the first also opened in Spain, was turned on. 15 arc lamps were placed in Colon path, 50 meters between each other at a height of 6 meters. Then, experiments with transportation of electricity started, they were able to run an 8 HP electric motor within 2,2km distance. It was the first test in this regard in Spain. The success achieved opened new expectations in the SES.



(2)



Old document from 1900, the increase of power supply between 1890 and the end of 1901. Starting with around 5000 Kw in 1890 and 78000 Kw by the end of 1901.

However, this electrical development encountered with a significant hurdles, electricity was generated as direct current continuous and could not be transported for a long distance. Consequently, the location of plants built in the nineteenth century was strongly affected by the proximity of a consumption centre. This fact was not too much 120 units in the case of thermal groups, it was important to use water resources, as could only be exploited those resources which were close to consumption centres, so location of water resources make some industries locate near.

The actual situation of the Spanish economy, during the economic recession started in 1882 following the grain crisis, not at all favoured the implementation and consolidation of new industrial sectors such as electricity.

Around 1894 the SES, has two different types of clients, the street lighting demand, managed by the City Hall and other 120 policies of particular supply. The most important one, were the incandescent lamps. At that time was Edison Type, a glass bulb with a carbon filament inside that emitted light from overheating. Remember that until 1911 the tungsten filament inside inert gas bulbs was not used, which means low light lamps, and the amount they need for each supply policy. Consisted in banks, shops, jewellers, cafés, restaurants and big companies, all together were 1096 lamps. The totals of incandescent lamps were 7096, even if they seem too many, the power of each of them is 15 watts, which does not worth enough. The low demand with the situation of no trust in the economic management, involved the bankrupt of the company.

2. The first three decades of the XX Century.

In 1901 the first official statistics is published, about the 859 power plants that existed in Spain, totalling 127,940 HP, 61% of this power was thermal origin while the remaining 39% using hydropower. In this new century, with the alternating current, recently invented, things started to change. The possibility to transport electricity over long distances was new. This carry out the hydropower development, thanks to the great water resources that Spain has.

New hydro electrics construction of a certain size during the first decades of the twentieth century used an unusual economic resource up to now. To deal with this economic and financial challenge many companies were created; engaging electricity production and distribution, some of them still exist today.



Bronze wheel from Seira hydroelectric plant.(3)

In the first decade of the twentieth, Spanish water policy began to set targets, the watersheds management. In the first the river Ebro, and after analyzing the results, in the second decade the river Duero was also taken. In the late twenties, the Spanish structure of electrical generation had changed radically, compared with the early century: the generation capacity has been multiplied by 12, reaching 1154 MW, but the most interesting thing is that by 1929, 81% of the production was from hydroelectric resources. The following years until 1936 there was a moderate increase in electricity consumption, 5% per year, so that at the beginning of the year installed capacity was 1491 MW with a little excess in production capacity.

Spanish civil war from 1936 until 1939, destroyed many of the new plants, also most of the infrastructure. The power supply started to decrease, because of clients disappearing or plants destroyed. After the war in 1944 a great drought hit the country, so all those hydraulic resources that survived the war could not be exploited.

3. Post-war period and UNESA's born.



Unidad Eléctrica S.A.



the Spanish
to 1959,

capacity production in Spain wasn't enough to fulfil demand. These times were characterized by several electrical constraints and frequent power cuts. The causes of this situation can be found in both, the supply and the demand.

After
Civil War up
the electric

(4)

Restrictions were mitigated with small mobile plants, as this floating one, made inside a ship, called “Our lady of light” ENDESA.

From the supply side, during the war many generators were destroyed. In the next years, building new ones was very slow. Two important reasons were behind, the lack of incentives for investment that implied a policy of freezing of tariffs in a context of high inflation, and the international blockade, so was difficult to bring equipments for new plants, and also to repair or for the maintenance of those already working.

This extremely delicate situation pushed the Government to make something, so in 1944 through the INI (National Institute of Industry), Endesa (National Electricity company) was created, and also in 1949 Enher (Ribargozana National Hydroelectric Company) started. Whom effort was added to the small private companies that were already working, giving a strong impulse to the electric development.



Spanish Transport network, (1944) (5)

(1950)

So, in the forties the electrical system development tripped with great difficulties. The electricity was sold with an established price and in the high inflation context; companies were facing serious economic difficulties, prompting a gap between the construction of new power plants and growth in demand, so that the deficit for the year 1944 became chronic until the end of the decade. In the other hand, the demand was having a 7% increase annually. To counteract, the government constituted some public companies around the country, which came to join the effort that had been made by private utilities. This gave a strong impetus to the development of electricity.

In this context, was the electric sector itself which showed the need to carry out a more efficient operation, also a coordinate, rational production and transport of electricity.

Year	Power (MW)	Demand(GWh)	Annual Increase of demand.(%)
1943	1.818	4.940	5,1
1944	1.827	5.271	6,7
1945	1.876	5.643	7,1
1946	1.937	6.051	7,4
1947	2.112	6.567	8,3
1948	2.334	6.922	5,4
1949	2.481	7.331	5,9
1950	2.553	7.891	7,6
1951	2.660	8.735	10,7
1952	2.963	9.884	12,9
1953	3.302	10.556	7,1
1954	3.436	10.987	4,0
1955	4.103	12.284	11,8
1956	4.722	13.853	11,1
1957	5.510	14.885	9,0
1958	6.073	16.755	12,2
1959	6.384	17.707	5,6

Supply-demand in Spain from 1943 till 1959(6)

This initiative was reflected in the creation of UNESA, an union between the 17 major utilities from the sector. The work for UNESA was the promotion of interconnection between the different regional power systems and also with the power plants that were necessary to complete the transport grid. They created “Central Dispatching” where they operate the whole National Network, deciding which plants had to work and which electricity tradings have to be made to ensure the supply.



(7)

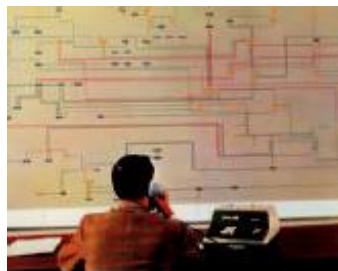
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3.1 The fifties

In the early fifties the liberalization of Spanish economy began, which results in a significant increase of national income. In addition, it starts the international release, mainly from the USA President visit to the country. Some of the first foreign loans, most of them from USA, were used precisely for the purchase of electrical equipment urgently needed.

In 1951 Spanish government wrote a new decree, that definitively talk about a General Spanish Power Grid and established a fare system called “Unified limited rates” which unified prices in the whole country, setting rates with a maximum prices, and periodically adjusted basing on the general prices. This system encourages construction of new plants, which make a rapid decrease in production deficit, erasing the electrical constraints in 1958.



RECA office (1954) (8)

In 1953 this office changed the name to RECA. The requirement of unit operation of the whole network in most of the European countries led to the nationalization of the sector, but Spain was organized in a unique way: trough the coordination of private companies promoted by themselves.

The decree established and regulated the General Spanish Power Grid (composed by the electrical systems of the utilities that produced or distributed at least 25 GWh per year). Companies in this network were required to make the transport and energy exchanges ordered by the administration, based on the public utility. As we mentioned earlier this decree also established the “Unified limited rates”. The electricity price was increased by a percentage “surcharge-r”, which OFIL took. The OFIL intended to compensate the higher cost of thermal energy production, the higher cost of plants constructed from 1939 and some special supplies that the rate would generate losses.

Thermal energy utilities owners had two ways of working. Formula “A” only compensates the fuel costs and left the company managing the operation. Formula “B” guaranteed payment of all operating expenses justified, plus 6% of capital invested in the installation, but this way the operation of the plant was run by the RECA, as a reserve plant. In either of its two ways, compensation the costs of the thermal energy was essential to keep that unified national and coordinate operation.

The compensation that the administration established for new hydraulic construction pushed up the utilities to oversize them, but that gave our generation a great flexibility, and allowed to meet demand when conditions were critical.

In summary, by the end of the 50's the Electric Park a major expansion giving optimism in those times of economic expansion.

4. Years of development (1960-1973).

Although it had already initiated some economic recovery, statistics agree that the ultimate economic policy change did not occur until the Stabilization Plan of 1959 was established, the results have already been noticeable from 1961. With this plan starts the development of tourism, but the most important thing was the openness of our economy, facts that make economy rise up with very high rates. One consequence of this new dynamics the significant increases in electricity demand. The new energy situation clearly showed the advantage of having an extensive network interconnected to meet the increasing demand, allowing secure supply to the costumers and maximize total power output. Between 1960 and 1973, the supply/demand balance was restored, and with higher quality, even in wet years export electricity to France and Portugal, due to the interconnections built during this period.



Transport network and connexions (>100KV) with France and Portugal, 1970. (9)

Definitively there was an important increase in installed capacity, 6.750 MW by the end of 1960 to 23.207 MW in 1973. This allowed power generation quadrupled 76.272 GWh. The generation structure also changed substantially: hydroelectric source was 84% by 1960 and decreased to only 39% in 1973. Jointly with coal plants, also fuel plants increased, in a **low oil prices** context. Many of the plants built between 1955 and 1973 still in service and are among the more powerful ones in the Spanish electricity park.

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Hydroelectric		
San Esteban	265 MW	1957
Saucelle	285 MW	1956
Aldeávila	718 MW	1963
Mequinenza	324 MW	1964
Puente Bibey	285 MW	1966
José M ^a Oriol	915 MW	1970
Villarino	540 MW	1970
Fuel		
Escombreras	858 MW	1968
Santurce	936 MW	1972
Castellón	1083 MW	1973
Coal		
Compostilla	612 MW	1972
Soto de Ribera	322 MW	1967
Guardo	155 MW	1964
La Robla	270 MW	1971
Nuclear		
José Cabrera	150 MW	1968
Vandellós I	480 MW	1971
Santa María de Garoña	460 MW	1972

(10)

By the end of 1973 the electric power industry closed with a fleet of 23207 MW. Since 1955 the RECA had a strong expansion of activities, so that the whole National Electric System worked in a unified way with a considerable increase on the capacity of the system, because of all of the new plants added to enhance the National Network.



(11)



4.1 UNESA Role: National Electrical Plans.

On 1969 the first National Electrical Plan borned, which schedule generating facilities for the next years. Another important fact to note, was the great impetus given to rural electrification, which helped to a large electrical universalization service in Spain. The coordinating role of UNESA was strongly needed. Working areas were numerous, apart from the normal activities of the RECA:

- Electricity pricing.
- Economic and financial analysis.
- Placing bond issues.
- Technical studies of national demand.
- Optimizing international trade.

In addition, as a supplementary work in the RECA, the cash settlements for energy exchanged daily between the companies. To carry out these studies and the statistical section, UNESA had daily telephone contact with the utilities, collecting information on:

- Fuel consumption
- Gauging river hydro.
- Daily load curves.

It was an important groundwork and allowed the development of Sector statistics. On the other hand, UNESAs work achieved a great importance coordinating the plans to build new plants, transmission and distribution lines, taking into account the huge investments needed. As we can check in the next picture, the investments in the electricity industry from 1953 to 1968 were 261000 millions of Pesetas, but for the year 1968 the year preceding the first National Electric Plan, 40000 millions of Pesetas were used, an amount truly significant if we consider that was nearly 2 % of GDP that year.

Year	GDP (million Pesetas)	Electrical Investments	
		Amount	% out GDP
1953	489.508	4.963	1,0
1954	515.630	5.535	1,1
1955	533.434	6.237	1,2
1956	565.879	6.732	1,2
1957	605.312	10.406	1,7
1958	633.432	9.125	1,4
1959	654.895	10.742	1,6
1960	679.188	9.320	1,4
1961	777.522	9.490	1,2
1962	905.972	13.776	1,5
1963	1.069.196	16.431	1,5
1964	1.208.794	20.056	1,7
1965	1.402.135	26.924	1,9
1966	1.626.756	33.800	2,1
1967	1.842.059	38.137	2,1
1968	2.079.659	40.010	1,9

(12)



In any case, these figures clearly show the great effort made by the financial sector, especially from the fifties. The first National Electric Plan was created as the optimal plan for these investments.

When UNESA was ordered by the Administration to create the National Electric Plan, some objectives were established:

- A projected demand over all the Plan period.
- A nation-wide optimization of power that must be installed to meet projected demand, from Hydro, thermal or nuclear supplies.
- An optimized energy balance forecast.
- Forecasts of the plants to build in accordance with the previous studies.
- A forecast of the primary system for distribution and transport.
- Anticipating the necessary investments.
- Provision of primary fuel required.

In addition to achieve these objectives the Administration recommend taking into account the economic and technical criteria as follows:

- The optimization criteria is based on the cheapness of solutions, from the cost of energy supplied to the centre of consumption.
- Effort to use the maximum national resources.
- It will seek the maximum possible utilization of power plants currently installed, placing on the basis of the load diagram nuclear and coal power plants.

Together with its affiliates, UNESA submitted to the Ministry of Industry its proposal for the First National Electric Plan, which covered the period from 1 January 1972 until 31 December 1981, establishing the forecast demand and generator equipment needed.

Year	€/kWh
1959	0,005998
1960	0,005938
1961	0,005908
1962	0,005872
1963	0,005896
1964	0,005908
1965	0,00598
1966	0,006341
1967	0,006563
1968	0,006815
1969	0,00693
1970	0,007525
1971	0,008138
1972	0,008216
1973	0,008877

Prices for kWh (13)



5. The Energy Crisis and its aftermath (1973-1982)

The year 1973 was a very important year to the energy sector of all industrialized countries. A dramatic oil price rising started and will not stop its upward path until 1983. Between May 1973 and the next year, the oil barrel price multiplied itself nearly six times, starting with \$1,62 to \$9,31, particularly was called the “First Crisis”. After several year of new price increases, in 1979 came the “Second Crisis”. The barrel went from \$13, 5 in June 1979 to \$35 in January 1981. As oil was the main primary energy source (about 44% of final consumption). The world economy entered in a difficult period of crisis, forcing the industrialized countries to adopt measures to hold the energy consumption.

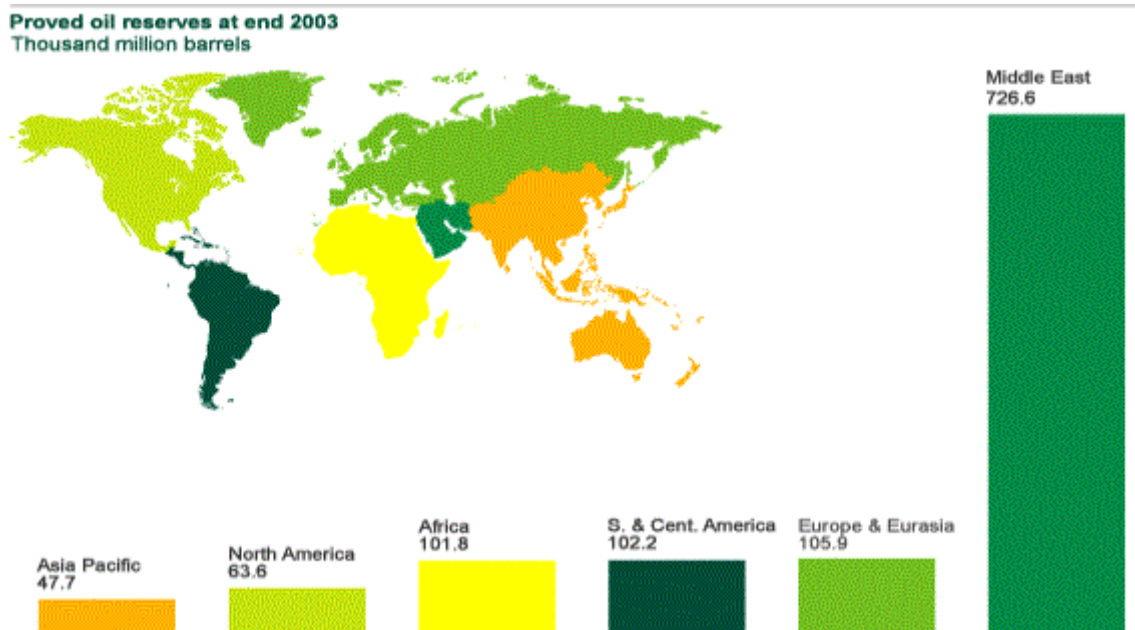
Date	Price per barrel. \$
1973-January	1,62
1974-March	9,31
1975-March	10,14
1977-July	12,70
1979-June	13,50
1979-July	18
1980-July	30
1981-April	35
1982-January	35
1983-October	29
1984-January	29

(14)

It was the end of an age. Until then, mankind had lived as if energy was a good that would be available in large quantities at cheap prices. The reports of the Club of Rome, made in the early seventies, warned of a possible physical exhaustion of various raw materials if world consumption continued growing in a disorderly manner. The creation of OPEC and the “First Crisis” showed that a new era of expensive energy had began, due to limitations imposed on production, under international political pressure and the risk that eventually the world run out of reserves.

All the industrialized countries including the United States, were supplied by imports from crude producing nations. Nations trying to make money quickly, supported by belonging to OPEC. Countries on the other hand, located in geopolitical zones of high instability: Recall, for example, that the war between Iran and Iraq was one of the triggers of the “Second Crisis” of oil. In this situation, the EEUU Secretary of State, Henry Kissinger promoted the creation of the IEA, based in Paris, in order to promote energy policies in developed countries. The idea was to replace the use of derivatives of oil by other energy raw materials, promoting the use of indigenous sources and also the most diversifying supplies from abroad, taking account raw materials as coal, gas, uranium, etc.. And the countries of origin.

It should also be remembered that there was a significant oil exploration effort around the world in order to achieve new production areas and high investments in the development of new extraction technologies. Some significant producing areas were discovered, such as the North Sea, Alaska, Brazil, Malaysia, Egypt and others increased their production like Mexico, Middle East, Indonesia, etc. Most of these new areas had been found earlier but were considered not exploitable, because of depths and weather conditions and the low prices expected before for oil, as Alaska, Siberia or the North Sea.



(15)

5.1 Energy diversification and oil substitution.

In the economic field, the “oil crisis” brought on developed nations and in a particular way in Spain, a large price increase in energy raw materials, which led to a widespread inflationary process accompanied by stagnation or economic recession, high unemployment and large deficits in the balance of payments.

For the Power Sector, the new situation brought a price increase in the most used fuel, that is why from 1974 the fuel consumption was diversified, pushing to decrease the oil reliance. Between 1955 and 1973 Spain had relied its electric park expanding in the commissioning of power plants consuming fuel oil. But our country was not an exception: many of the power utilities of the developed countries relied also in plants that consume petroleum products, that up to then were cheap and easy to transport. Therefore, most of the electricity sectors were highly dependent on oil and, consequently, of the exporting countries.



International experts stressed the importance of minimizing that dependence, mainly with these two evident reasons: first, to avoid compromising the necessary energy supply, on the other, reducing the consumption of oil products, to relieve pressure in the crude market, because with the information available at the time, the oil reserves were planned to last for three or four decades more.

This fight for energy independence by diversifying and use of domestic energy sources, should be accompanied, as experts, with two general measures: promote energy efficiency, avoiding all waste and achieving a rational and efficient use of existing resources. As regards the first of these two measures, the objective was, in other words, reducing the elasticity of energy demand from economic growth, reducing energy consumption per unit of product GDP generated. As for the second, was to implement what is known as “actual pricing policy for energy”. Until the oil crisis 1973, the trend was approving subsidized prices for raw energy materials, below their cost of production, believing that stimulating the consumption of energy increased the rate of economic activity.

With the “oil crisis”, the scenario changed dramatically and international experts insisted that, to encourage rational use of energy and achieve a proper allocation of economic resources, it was necessary that energy prices collect all the production costs.

- First, replace the use of derivatives of oil in electricity production, alternative energy sources were promoted, as coal or nuclear power.
- Second, applying electric rates that would allow the resulting price for kWh corresponded to the actual cost of supply.
- Third, ensure a rational use of electricity.

In Spain, because of the previous policy, were newly built, modern and efficient fuel plants of over 8000MW. The application of these criteria for energy policy in Spain is reflected in the National Electric Plans and in the establishment of new pricing policies for electricity consumption. Here it can be set the root cause of the previously analyzed change from Unified Rates Caps to Integrated Electric Billing (SIFE) held in 1973 that allowed more rational electricity rates. This rates policy implementation was delayed more than desired, especially compared with the other developed countries.



5.2 National Energy Plan 1975: Concerted Action of Electric Sector.

The first National Energy Plan was approved by the Spanish Parliament in 1975, with some delay on what was desirable, especially for the heavy Spanish dependence on oil (68% of primary energy consumption in 1974). However, political and social circumstances that surrounded the country did not give too much leeway to the government and appear this delay in the implementation of corrective measures and containment of consumption, having to absorb a significant portion of the petroleum increase costs by the Government. While most industrialized countries were preparing to implement practical energy policy criteria mentioned above, reducing oil consumption, replacing oil by other sources, actual pricing policy for energy, etc.. In Spain between 1973 and 1977, after the “first crisis” of oil, the consumption increased from 19455 thousand tonnes of oil equivalent (toe) to 47353 thousand toe.

Also measures to bring the price of electricity to the actual costs of production experienced significant delays.

5.3 National Energy Plan 1979: Energy Conservation Law.

The energy crisis became worse as a result of the “second crisis” of oil, from now on the development of a second National Energy Plan was recommended, and it was set for 1979-1987 period. The PEN 1979 was approved by the Congress in July 1979 and began to be successful soon, after 1980 oil consumption was gradually reduced in the energy sector.

Year	Thousands Toe Consumption
1973	39455
1974	42095
1975	42230
1976	47353
1977	45714
1978	47389
1979	49134
1980	50070
1981	46439
1982	44393
1983	43712
1984	40907

(17)

As we see in the table, the oil decrease consumption for electricity production arrived late. Only after the approval in July 1979 of this National Energy Plan II, really began to set up a real strategy of diversification and oil substitution.

The PEN-1979 was complemented by the development of standards regulating numerous aspects related with the energy sector.

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Among these rules highlights the Law of Conservation of Energy 88/1980, still in order, and had three objectives:

- Reducing dependence on oil in our system.
- Promote energy conservation.
- Promote renewable energy sources.

Pursuant to this law, was enacted R.D 1217/1981 to promote small hydro plants, which provided a simplification in the procedures for concessions and benefits, soft loans and tax exemptions for facilities with less than 5000 kW, increasing the total power amount in 1400MW since its enactment until 2000. Also was approved R.D 907/1982 promoting self-generated power, defined as that made by agents of the system, without being the primary purpose of their business the production of electricity, but now they can generate on their own, using energy products or another method that improves the efficiency of energy consumption. This rule set finally the guidelines for the promotion of cogeneration and renewable, most of the technologies that are currently integrated in the “Special Regime” power generation, and they are:

- Right to interconnect the plant to the distributor network.
- Obligation from the distributor to purchase all the electricity excess.
- A price set by regulation that encourages their development.



Narcea coal plant(18)

5.4 The reduction of fuel oil to produce electricity: Coal Accelerated Plan.

In the specific field of electrical activities, energy policy pursued as in the other developed countries, promoting construction and connection to the network, new coal and nuclear technology plants. Also continue as far as possible with water sources.

The efforts made by the utilities in this area are shown with the following: between 1980 and 1986 five nuclear reactors were connected, over 4500 MW.

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Plants as:

- Almaraz 1 and 2, 1900MW.
- Ascó 1 and 2, 2060 MW.
- Cofrentes 990 MW.

And fourteen coal plants, with more than 5000 MW, seven of them belonging to the Coal Accelerated Plan.

- Narcea III, Robla II, Soto de Ribera III and Guardo II with 350 MW each.
- Aboño II 543MW
- Carboneras I and Barrios I (imported coal) with 550 MW each.

As a result of this expansion of generation, fuel consumption was reduced much higher than in other economic sectors. In fact, it decreased from 9 million tons in 1980 to just under 2.8 million in 1984 and even in 1986 fell to 1.5 million tons, in the other hand coal consumption changed from 26 million tonnes to 39 million in the same period.

It is important to notice that at the end of 1986, coal was the 45% and nuclear energy 30% had already become the main energy sources for electricity production, while in 1973, during the beginning of the energy crisis, only represented 18% and 8% respectively.

Fuel consumption of thermal power plants						
Year	Soft Coal (T)	Anthracite (T)	Lignite (T)	Total	Fuel Oil (T)	Gas(*) (millions m3)
1973	3555	2244	2949	8749	5994	541
1974	3308	1774	2388	7172	7078	163
PEN 1975						
1975	4401	1967	3137	9506	7576	1348
1976	4233	2047	3574	9854	10092	1383
1977	5295	1951	5907	13154	5411	1143
1978	5415	1965	7469	14851	6732	1310
1979	5446	2203	10051	17701	6299	1801
PEN 1979 and Coal Accelerated Plan						
1980	7250	2197	16131	25578	9026	2206
1981	8068	2431	20473	30973	8547	2406
1982	9278	3641	22998	35918	6912	2517
1983	9698	4763	24282	38743	5781	1657
1984	10314	4112	24280	38707	2797	1889

(*)Natural gas + Blast furnace gas (19)



In 1973 the Peninsular Transport Network reached 30197 km, in the next seven years it grew up more than 30 %, in 1980 almost had 40000 km. There was a variety of lines:

- 21% (8517km) U=380kV,
- 35% (14124km) U=220kV
- Remaining 44% (17323km) U=110/132 kV

Obviously all this had been possible, because UNESA utilities made a big investment effort. Between 1980 and 1986 about 3000 million Euros were invested. Not to be overlooked that an action of this nature and scale originated significant financial problems.

5.5 Effect on electricity prices

Foreign currency loans started to rise up, derived from international economic crisis, joined with the inadequacy of the revenue from the sales of electricity, both as a result of the slowdown in consumption growth and because sale rates were not increased enough.

Electricity prices in Spain were completely governed. Was in force a system of shared tariffs for all utilities and areas, whose amount was determined by the government from time to time, usually every year. Although since 1973 the international experts insist that electric fees should reflect the full costs of kWh production, the Spanish electricity prices did not follow that path. Government understands that in those years the priority should be containing inflation. As a result, and despite the fact that between 1973 and 1983 several rate increases were approved, these were insufficient to cover the actual cost of kWh production and involved only with rising oil prices.

Year	Δ% fares (1)	CPI (2)
1973 – Mayo	5,00	14,65
1974 – Marzo	15,85	17,62
1975 – Febrero	15,00	(3)
1975 – Noviembre	16,50	14,23
1977 – Marzo	13,80	(3)
1977 – Julio	5,36	26,30
1979 – Julio	21,19	15,43
1980 – Enero	17,00	(3)
1980 – Julio	19,50	15,4
1981 – Enero	19,17	(3)
1981 – Abril	7,68	14,55
1982 – Enero	12,60	13,92
1983 – Enero	7,50	(3)
1983 – Octubre	6,00	12,33
1984 – Abril	8,75	8,97

(1) Average electricity fares increase.
 (2) Increase CPI in the year.
 (3) Can not be compared.

(20)



The situation was really difficult and disturbing. On one hand the industry should fulfil the commitment, made through the PEN-1979, the implementation of an urgent policy of diversification, as a result of national energy policy, with the construction and operate numerous expensive facilities, and on the other hand was forced to get loans in foreign currency, also more expensive because of the continuing appreciation of the dollar. The sector saw their incomes from sale of power not increased in the amount required, so the utilities situation was delicate and had leaked to the public. So the only way to overcome this situation was the big effort made with the financial restructuring of the companies.

6 The protocols and the legal stable context: a period of significant changes (1983-1990)

The oil substitution to alternative energy sources, efficiency savings and the application of a pricing policy which includes all the variations had been the basic axes of the energy policies in developed countries. This strategy was one of the fundamental pillars of Spanish economic adjust, in the process of convergence with the European economic systems, members of the EC, which Spain would join since 1985.

At the beginning of this period, in 1983, the Spanish electricity sector was in a situation that could be summarized as follows:

- The high rate of increase in electricity consumption recorded until 1980 had moderated, the result of a slower economic activity in the country.
- The sector's debt level was high, as a result of the investments made in the previous years to meet the oil substitution.
- The continued devaluation of the peseta (national currency before euro) against major foreign currencies had a negative effect on the interest paid on foreign loans. In addition, expectations for further devaluations were even worse.
- It was necessary to continue the investment, in the expansion of new generation facilities and in the transmission and distribution. The installed power in 1982 was 30949 MW, while planned for 1987, according to the PEN-1979 was 44738 MW. Investments required to meet this increase of power was estimated are around 2.8 trillion pesetas, most of it to the new nuclear plants that were on construction.
- Spanish inflation had to be reduced to European countries level. The increase of CPI in 1982 was 14, 4%, but still far from those in the EC 9, 5%.

The situation of the sector was complex and sensitive. The strategy from UNESA was the only possible: a major financial reorganization effort in a constant dialogue and negotiating with the Administration. By the end of 1982, the political situation changed, socialist took possession. They changed some aspects about from the electrical sector: review of PEN-1979, changing the organization of some utilities also proposals to establish remuneration system more stable and transparent pricing.



6.1 The First Electrical Protocol

In may of 1983 and as a result of long meetings between government and UNESA as a representative of the Minister of Industry and Energy and the presidents of major companies in the sector signed First Protocol agreement, which contained very important aspects for electrical development, among which was the establishment of a public Society, to manage the electric network and also the most appropriate procedures to review the National Energy Plan (PEN-1979).

-It also established principles relating to the implement of a pricing policy that allows to the utilities to ensure a return on capital and adequate allocation for depreciation.

-This Protocol pushed to the nationalization of the High Voltage Transport Network.

-Different criteria about the medium term development were collected, particularly those relating to the expansion of Electronuclear Park and measures necessary to achieve adequate profitability.

6.2 National Energy Plan 1983 (PEN 1983)

Approved after the corresponding process, by the Ministers Council in March 1984. The new PEN started making a new forecast of power demand growth, 3.3% per year over the period from 1983-1992. The consequences of this forecast, 1.5% less than the previous PEN were:

- The investment decrease of 500000 million of Pesetas from 1982 during the term of this new Plan.
- It established the nuclear moratorium, which affected 5 groups whose construction had already been started and were duly authorized.
- To the mainland system the Plan established the connection of the seven groups that formed the Accelerated Coal Plan developed and implemented in 1980, mainly to make replacement of oil faster after the “second crisis”.
- Also lunched one more reactor in Compostilla plant, and seven nuclear units, in late 1986 all of them were connected to the network: Almaraz 1 and 2, Asco 1 and 2, Cofrentes, Trillo, Vandellós1, except Vandellós 2 and Trillo 1 some months later.

Utilities connected to the network all thermal production facilities considered in the Plan to the period 1984-1992 within deadlines or even in advance.

- The strategy to reduce oil consumption for electricity generation had played virtually his roof; oil consumption was the minimum that the technical aspects permitted.



Vandellós I Nuclear Plant.(21)

6.3 Nuclear moratorium.

The Electronuclear Park had seven plants, as the PEN1983 said, together with the other three that were already in operation, sum 7600 MW provided to the network. However, by the time that the PEN was approved there were five other plants already in construction or development stage:

- Two groups in Lemóniz, situated in the Basque Country, almost ready to operate, but whose works were stopped in 1982 because they became targets of ETA (terrorism).
- Two groups in Valdecaballeros, whose construction was well advanced.
- The second group in Trillo, that was in initiation stage.

In total 4850 MW, the PEN-83 excluded operating this group during its life. Also the plan noted that if it was necessary and the demand rises the forecast demand, a revision could be made before 1992, the end of the PEN. Something that never happened, and those groups still not working nowadays, they are simply abandoned.

To fund the nuclear moratorium, the Ministry of Industry and Energy established an Order, in 1983, by which utilities have to increase until 2007, the electrical rates, by 3.9%. This allows the government and the utilities to settle the debt.



7 The pre-liberalization years: 1990-1997.



Single European Act assembly, 1986 (22)

During this years in almost all the European countries, kept the utilities as a basic element, regulated and intervened.

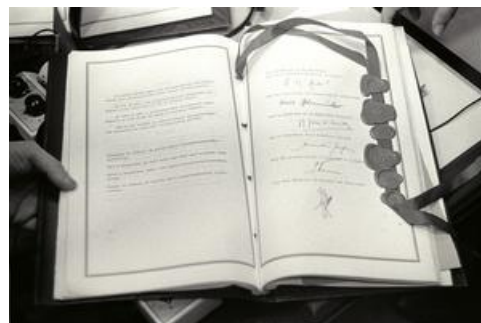
- First, the planning policies for generation and transmission facilities.
- The control of the electricity tariff.
- Also the model resulting, was vertically integrated, covering all the production, transmission, distribution and electricity supply.
- In most European countries was publicly owned.

This structural model which also ruled in Spain, although combining state-owned and private utilities, began to change in the early nineties. From the EU, the privatization of the public utilities, also the gradual generation activities and marketing of electricity liberalization. With the approval in February 1986, of the Single European Act, an internal EU market for electricity was set as a target to achieve in January of 1993.

“The Single European Act (SEA) revises the Treaties of Rome in order to add new momentum to European integration and to complete the internal market. It amends the rules governing the operation of the European institutions and expands Community powers, notably in the field of research and development, the environment and common foreign policy.”

This market was presented as a means for:

- The proper allocation of resources.
- The energy cost reduction.
- The contribution to supply security.



Single European Act text, 1986. (23)

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But there was an obvious lack of homogeneity between the different European electrical systems management models and taxes. Environmental legislation was also not common. After a complex process of discussion, the first attempt was unsuccessful, recommending to the Council of Energy Ministers to postpone the liberalization sector, inviting the Commission to revise its proposals, but not establishing a specified time for the single market.

Since 1990 with the publication of the Directive 90/547/EEC on the “Big Scale Transit of Electricity Networks” and, above all, until 1996, Directive 96/92/EC on “Common Rules for the Internal Market of Electricity”, when really started the sameness in the treatment of electricity, developing the new Single Market of the EU.

Making references to the Spanish industry, in the early nineties, a regulatory framework whose main characteristics can be summarized as follows:

- Centralized planning of new generation and transportation. Continue reviewing the National Electric Plan. This ensured providing a service considered strategic.
- Unified operating and centralized office, managed by REE, Red Eléctrica Española, (Spanish Electric Network), taking into account considerations of costs and fuel real costs. This public majority society was the only qualified agent to make international electricity exchanges.
- Marco Legal Estable (Stable Legal Framework), existence of uniform electricity tariffs all around the country, fixed annually and based on standard costs ensuring the whole cost of supply.
- The operating model was the traditional, also existing in most countries in EU, but it was limited. In 1994, LOSEN Ley de Ordenación Sistema Eléctrico, “Electric System Planning Law”, which represented our own first step in the liberalization of the system, but still held the substance of the earlier regulation.

So, we started to talk about Integrated Power System, was set as a new “Independent System” in free initiative system and competition.



Treaty of Accession to the European Community on 12 June 1985 at the Royal Palace, Madrid. (24)



7.1 Internal Energy Market.

The treatment of electricity as a commodity or service in the pursuit of Single Market did not really began until the adoption of Transit Directive 1990, on the principle of free access and use of European networks for purchasers and sellers of electricity outside the ownership of them. Which make an end of the exclusive right that their holders had, considering the grid as a physical support of commercial transactions, whatever the origin and destination of the energy involved.

In 1996, Common Standards Directive 96/92/EC was approved. Stating the role of the operators or managers of the transmission of each system, and introduced key concepts such as;

- Legal separation (unbundling) of the regulated activities (transmission and distribution) and unregulated (generation and marketing).
- Requiring Member Countries to adopt “necessary changes to ensure open electricity markets”.

A summary of the key regulatory principles of the directive:

- Freedom of new plants installation and construction of new lines. Allowing the establishment of new generating units and lines. By two options: first, formal authorization; second, context by tendering.
- Third party access Freedom to networks (TPA), the right of the agents or companies to access –By paying the toll for the grid- owned by a third, and another in the corresponding obligation of the owner to yield step, except in special cases or exceptional circumstances duly motivated, to any petitioner.
- The TPA did not exhaust this basic model to electric opening competition, countries were allowed to organize the access, through TPA (which could be negotiated or regulated), and through the recognition of a Single Buyer system (States Members designate a legal person as a Single Buyer. He publishes a non-discriminatory tariff and should allow the procedure for qualified clients to have freedom of contract), supported mainly by France.
- Independent management of the network. The transmission should have an independent manager of the companies that acted in it.
- Freedom to import and export of electricity.
- Accounting separation of the electrical activities of generation, transmission, distribution and marketing, to avoid cross-subsidization.
- Freedom to choice the supplier by costumers: setting gradual times.
- Finally, the promotion of international connections was one of the priority actions to accelerate the creation of the Internal Electricity Market.



8 The liberalization of the electricity sector: 1997-2003.

The change in the structural model of the Electricity Industry in the countries of the European Union, which began to be implemented in the eighties and especially in the early nineties, it was not an isolated incident in the geographical area of the Old Continent. In the last years, many developed nations around the world –USA, Canada, Australia, Norway, etc...- have taken the same way of liberalization and competition.

In Spain, the impetus came from the Popular Party victory in 1996, whose platform contained the liberalization of the electricity sector. The bases of the new rules were discussed with the sector, setting the Third Protocol, which the Minister of Industry and Energy and the Presidents of the companies UNESA signed in December 1996.

To implement the agreements of this Protocol, the Government prepared a draft of the Electric Sector Law, following parliamentary procedure, was approved on 27 November. This Act 54/1997 liberalized the sector and in most of the aspects went further than required by the Directive 96/92/EC on common rules of the Internal Electricity Market.

There was also another referent, the LOSEN, from December 1994. The practical development of the contains in the law were supposed to move from a strongly intervened system by the government, to a system in which electrical activities would be conducted on the bases of market criteria, limitations imposed by certain technical factors, environmental and economic, for transporting and distributing of electricity.

The new legislation has meant a radical transformation of the sector, introducing competition in generation and marketing activities, making a big change. Suffice it that since 1 January 2003, all Spanish costumers (Over 25 million) can choose their supplier if they want, or benefit from the regulated electricity tariff by the Administration.

The Sector is facing for the first time in history, competition in and because of the market. European directives and the increasing globalization of markets have led to make the competition outside the country, also with foreign companies.

8.1 Third Electrical Protocol.

The Administration considered appropriate to reach an agreement with major power system operators, in order to modify the existing regulatory framework, leading to greater liberalization, ensuring competition between the companies and trying to ensure a lower cost of electricity for the whole country. Therefore, the aim of this Third Protocol for the Establishment of a New Electrical System Regulation, agreed by the



Government with the Spanish utilities, was to establish operational bases in the different companies around Spain that would govern the operation system.

In the pact signed terms were defined measures and safeguards that should be implemented during the transitional period to achieve the objectives for the Electricity Market liberalization; it also established criteria for defining the Sector structure, ensuring competition among member companies. This regulation was to accommodate the interests of consumers, employees and shareholders, which together support the utility business.

The necessary rules for the development of the protocol were developed by Working Groups created in this regard, presenting its findings in March 1997. This work formed the basis of the policy Electricity Sector law 1997.

8.2 The Electricity Sector Law.

The new operating model of the Spanish Electricity Sector is based in the Electricity Sector law 54/1997, and the large regulation that develops. The elements of the new regulatory framework covering many aspects, such as operation of a wholesale market, the treatment of energy from self-producers, activities in our system for foreign electrical agents, a new methodology for calculating the inclusive rate, access rates, etc..

Already in the preamble, the new law made it clear that if their basic purpose answers traditional objectives, supply reliability and quality of it, at lower cost possible.

Key features of the process of liberalization and competition that developed this Act, can be summarized:

- Replacement of the concept of public services for basic essential service and universal with the explicit “guarantee of supply to all costumers” within Spanish territory.
- Exploitation of the national electricity system stop being State-owned, now ran by REE Red Electrica Española, which will lose its majority public ownership.
- The traditional state planning for the installation of new power plants disappears, being replaced by freedom of installation subject only by administrative authorizations. Only the development of transport network is under State planning and conditional binding by the urban demand and regional planning.
- It establishes the legal separation between “regulated activities” –transport and distribution- and unregulated –generation and marketing-.
- The operation of power plants ceases to be subject to economic management system. Instead, the use of such plants is on the owners hands, as part of the Wholesale Electricity Production. The remuneration from generation activities is no longer related on the standard values from recognized costs, based on market outcomes.
- The law establishes the principle of Third Party Access (TPA) to transport and distribution networks, which are treated as natural monopolies because of the efficiency in the existence of one network, available to all the utilities and costumers.



- The marketing activity is fully identified and singled in the new law, according to the principles of freedom about contract and choice supplier by the customer, but with gradual implementation.
- This period for the total implementation was 10 years, but then, shortened by the Government, finally by January 2003, all customers could choose their supplier.
- Freedom to buy and sell electricity to utilities and customers in other European Union members.

8.3 Key players in the system.

As a result of new regulatory model, the number of entities and companies that went to play a role in the functioning of the new system increased, because this model is characterized by:

- All consumers have choice of supplier.
- Freedom of installation for new plants.
- Creation of new management and regulation system.
- Liberalization of international trade in electricity.
- The separation of transmission and distribution (regulated) and generation or marketing (fully liberalized).

The officers from 1996 acting in the electrical system are mainly the following:

- The power producing agents, whose role is, of course, generate power to bid on the Wholesale Market, so they also had to build, operate and maintain the necessary facilities for it.
- “Special Regime” producer agents. They hold facilities not exceeding 50 MW output power, to generate electricity from systems as cogeneration, renewable energy, waste, etc..., which have specific rules. The energy from these facilities is excluded from the Market, because it has to be integrated mandatory in the system without having to go through the bidding system. Moreover, in most cases have a premium price to enhance their development. Between these agents are auto-producers, which are companies from other branches of industry that have production facilities to meet mainly their own needs. Must be authorized to deliver to the system the over generated power.
- The external agents, subjects from foreign countries that buy or sell electricity in the Spanish system, in the context of liberal international trade.
- The Distribution companies, utilities whose primary function is to distribute electricity, and must develop, operate and maintain facilities necessary for that purpose. They can also sell electricity to regulated rate customers or other distribution companies.
- Marketers. Companies responsible for selling power to final consumers who opt for suppliers in the liberalized market.
- Consumers. With the ability to choose their supplier and the fare.

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- The management bodies: the Market Operator and System Operator. Agencies responsible for economic and technical management of the system, respectively.
- Finally, the regulatory bodies of the system. Are essentially the Central Government and the National Energy Commission (CNE).

8.4 The current role of government.

From the executive point of view, the main responsibility for regulation was awarded to the General State Administration, through Ministry responsible for energy. Some of the most important responsibilities that Electricity Sector Law entrusted:

- Establish the basic regulation of electrical activities.
- To regulate the organization and operation of electricity Production market and markets that may result from it.
- Authorize the electrical installations when their use affects more than an autonomous community.
- Fix the regulated electricity tariff and tolls for the use of networks.
- Establish minimum quality and security requirements of supply.

On the other hand, the Central Government created a new agency, the National Energy Commission, to keep effective competition in the system and for its objectivity and transparency.

The new model recognized competence of great importance to the Autonomous Communities. Among them is the regulatory development of Electricity Sector Law in the jurisdiction of each community, the inspection of those installations that do not affect other autonomous community. They also have a high participation in the promotion of cogeneration and renewable energies facilities, saving plans and quality of service in its territory.

8.5 System Management bodies.

Under the previous organizational structure, the daily operation of Power plants was determined by Red Eléctrica España (REE) in accordance with energy policy criteria developed by the Ministry of Industry and Energy based in the optimization of the operating costs of electrical system. No one could send electricity to the network if it was not included in the programming of REE.

In the new system, the Electricity Wholesale Market is managed by the Market Operator; technical and safety corresponded to the System Operator.

8.5.1 Electricity market Operator (OMEL).



In the Electricity Wholesale Market, and from January 1998, operation facilities for electricity production are the result of “cassation” demand and supply. Carried out daily by the OMEL.

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The producers are required to communicate each day with free conditions, in quantities and prices, which are arranged to sell the electricity from its facilities in each of the next day twenty-four hours.

The operation of the facilities was carried out taking into account the prices offered for each hourly period, to meet the demand in that period and is paid as the marginal bid price. This allows developing the “basic daily schedule”. They must also take into account possible technical and safety restrictions of the transportation network, so they schedule is sent to the System Operator, so that with the least possible changes meets all requirements to provide adequate quality service.

The distributors, marketers and consumers have access to the Market. To be able to go to the market or set contracts with traders, it was recognized the free access of third parties to transportation and distribution networks, which are the only two regulated electrical activities.

Also, the Market Operator informs the agents of the settlements receipts and payments. It must also be available to agents all the information about supply and demand, in each hourly time; and publish in the national media all public general information on the market.

This Wholesale Market is a basic part of the new Spanish regulator scheme.

8.5.2 The System Operator.



Is responsible for ensuring the proper coordination of production and transmission system, to ensure the quality and security of supply. Operator functions mandated by the law to REE, also responsible for the functions of Network Operator, its management, planning for expansion and maintenance of facilities equal or greater than 220kV, as well as interconnections with other countries.

The System Operator prepares the daily operation from the “daily schedule” developed by the Market Operator. To do so, must take into account the technical problems, which may require making some small changes in “economic Cassation” between supply and demand. Based on all this and adjusting deviations, is made finally “program viable” of the system. It also manages the international exchange programs for electricity with other countries that are necessary to maintain or increase security and quality of supply.

This operator is obliged to:

- Inform the regulators about the transport and foreign connections needed.
- Analyze all new applications for connection and limit the access to it when there is not enough capacity.
- Establish in coordination with agents, plans to ensure the correct service in case of disruptions.



As can be easily deduced, the Operator and Market Operator must work with a great coordination to solve all the situations that may occur in the transmission or generation system.

9 Marketing Companies

Another of the main bases of the new system lies in the liberalization of the marketing, everything related sale of electricity to consumers. Market is completely liberalized, avoiding any type of monopoly.

However, the Act expressly prohibits an agent that performs operations within the scope of regulated activities (transport and distribution) also conduct (generation or marketing) regulated activities, must be executed by different legal firms. It does allows, that they could belong to the same holding company, and also the same company to work on both non-regulated activities.

The liberalization of the marketing activity enabled the creation of another type of business, companies that do not need to have generation or owned networks, are focused exclusively on supply electricity by contracting with generators and costumers, billing, conditioning supply, etc...

In addition, marketers should promote the rational use of energy and implement management demand plans. It also may require their costumers to maintain facilities so their use does not impair the quality of service to other costumers.

10 Conclusions.

With Spain in the EU, the Electric development process occurs as the other European countries, with some difficulties because of the oil crisis of 1973. In Spain the situation was always helped by our water sources, taking advantage of the hydroelectric plants.

Since 1996, the Single Act took part, and all the countries had to manage their electricity sector following the same base aspects. Creating an internal European Electricity Market, for all the EU members, and also a parallel National Internal Markets.

Graphics, figures and tables.

- (1) Dynamo type Gramme. Source: El Sector Electrico a través de UNESA, Unesa.
- (2) Increased power since 1890 to 1901. Source: Tesis Regulación y Eficiencia en el sector Electrico Español, Universidad de Barcelona.
- (3) Bronze wheel from Seira hydroelectric plant. Source: Seirapowerplant.blogspot.com
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- (5) Spanish Transport Network. Source: Tesis Regulación y Eficiencia en el sector Electrico Español, Universidad de Barcelona.
- (6) Supply-demand in Spain since 1943 till 1959. Source: www.unesa.es
- (7) Seira hydroelectric plant. Seirapowerplant.blogspot.com
- (8) RECA office. Source: www.ree.es
- (9) Transport network and connections (>100kV) with France and Portugal. 1970. Source: www.endesa.es
- (10) Power Plants opened in Spain. Source: Tesis Regulación y Eficiencia en el sector Electrico Español, Universidad de Barcelona.
- (11) José Cabrera Nuclear Plant. Source: www.elmundo.es
- (12) GDP and investments in the sector from 1953 to 1968. Source: El funcionamiento del Mercado Electrico Español bajo la Ley del sector Electrico, Natalia Fabra, Universidad Carlos III de Madrid.
- (13) Price per kWh. (14) Price per oil barrel.(15) Proved oil reserves by 2003. Source: . Source: Tesis Regulación y Eficiencia en el sector Electrico Español.
- (16) Transport and interconnection net, 1980 Source: www.mytic.gov.es
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- (19) Fuel consumption of thermal power plants. (20) Electric fares increase. Source: El funcionamiento del Mercado Electrico Español bajo la Ley del sector Electrico, Natalia Fabra, Universidad Carlos III de Madrid.
- (21) Vandellós I Nuclear power plant. Source: www.elotrolado.net
- (22) Single European Act, 1986 (23) Single European Act text, 1986 www.endesa.es
- (24) Treaty of Accession to the European Community, June 1985, Royal Palace.

Abbreviations.

USA United States of America.
EC European Community.
EU European Union.
SES Spanish Electricity Society.
INI National Institute of Industry.
ENDESA National Electricity Company.
ENHER Ribargozana National Hydroelectric Company.
UNESA Unidad Eléctrica S.A
RECA Repartidor de cargas. Demand distributor.
PEN National Electric Plan.
IEA International Energy Agency.
R.D 1217/1981 Royal Decree (law).
CPI Consumer Price Index.
90/547/EEC Year 1990, act 547, European Directive.
LOSEN Electric System Planning Law
SEA Single European Act.
OMEL Electricity Market Operator.
REE Red Eléctrica Española. Electric Spanish Network,