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ENERGY:
CURRENT SITUATION AND TRENDS. FROM GLOBAL TO LOCAL

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1. INTRODUCTION

First, I would like to thank the organizers of the 71st World Foundry Congress, in particular to IK4-Azterlan, Research Alliance and to Mr Xabier González Azpiri for having invited me to address this Congress. I feel much honored to address this distinguished audience and I hope the approach and context of it do not fall short of possible expectations.

The purpose of this paper is to examine the current situation and trends in energy, from a global point of view to a local one.

First, I will refer to some aspects that can characterize the energy situation and then try to gather some insights from the scenarios and trends of different Institutions or Companies.

Given the scope of this presentation, I will try to deal with some specific issues that, in my view, can be more relevant to this Congress. In particular, I shall refer to the issues of energy and competitiveness.

Nevertheless before approaching the issue of competitiveness and taking into account the importance of regulation in some domestic markets, I will deal with some related issues of regulation and energy-related-policies focusing in Europe and Spain.

This document will end with some conclusions and suggestions that will try to summarize its content.

2. AN OVERVIEW OF THE CURRENT SITUATION

In a context of lower than expected growth, some paradigms are beginning to change, among others, that energy demand growth could be lower than foreseen in the past, and that increasing demand would come from areas in which economic growth would be stronger, in particular Asia and the Middle East.

Climate change continues to be a paramount issue but other topics such as competitiveness and a renew interest in industry have become priorities at the top of the agenda.

The black swans in energy, in which we can include the shale gas developments in USA, are having profound effects in energy business and have reinforced the need for more competitiveness at global level.

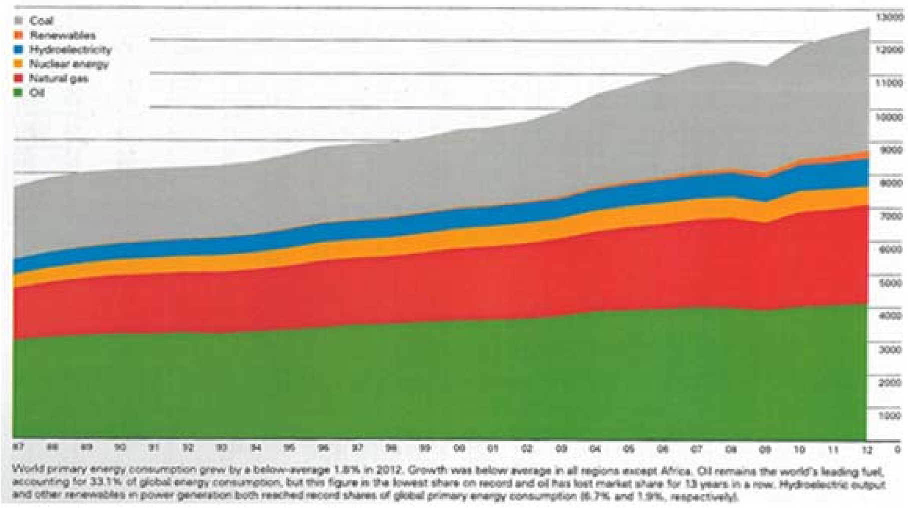
Low economic growth and the continuous emphasis in energy efficiency are influencing decisively CO_2 emissions, at least in Europe and in some countries like Spain.

In this section I would like to introduce and stress the idea that complexity in the world of energy is increasing and that nowadays we have an additional task of including, analyzing and interpreting numerous and diverse range of factors. Then examining the current situation and trends is not an easy task.

2.1. About world energy demand

In terms of world demand, primary energy consumption grew by 1.8% in 2012, well below the last ten years´ average of 2.6%. Regionally, the greatest contribution to growth took place in emerging economies, in particular China and India, which explains 90% of the increase in global energy consumption, whereas consumption in the OCDE fell by 1.2%.

GRAPH 1. Energy world consumption (million toes)



Source: BP, (2013)

A continuous growth can be noticed in total energy demand, while hydrocarbons and fossil fuels continue to have significant share in the total structure.

Oil consumption increased by nearly 900.000 barrels per day (bl/d) or nearly 1%, below the historical average. Oil production increased by more than 2%; and international trade raised by 1.3%.

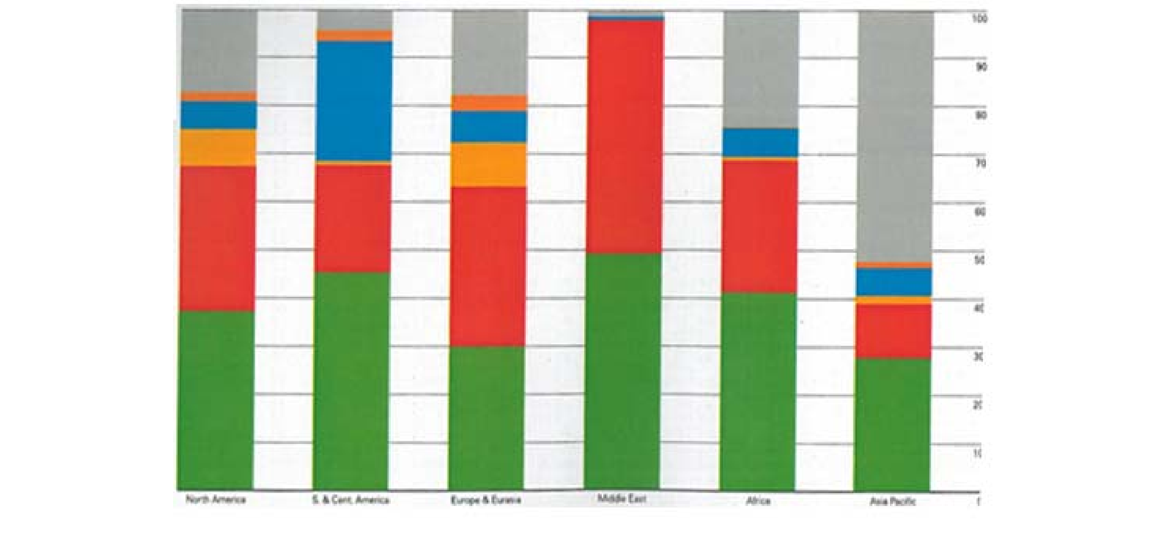
Natural gas consumption increased 2.2%, again below the historical level of 2.7% but greater than the increase of oil. Gas production grew by nearly 2%. Global trade practically experienced no growth for the first time. In Europe there was a clear drop in net LNG imports, not being offset by the increase of Asian imports. The growth of Qatari exports did not compensate the decrease of Indonesian exports.

Coal consumption grew by 2.5% far from the historical average of 4.4% and wind energy increased by 1.8%, (China experienced an increase of 35%). A decrease in biofuels consumption was also experienced.

All in all, at worldwide level renewable energies account by 2.4% of global energy consumption and 4.7% in global power generation.

However regionally there are very substantial differences. As it can be seen in the graph below Middle East consumption is dominated by oil and gas. Coal prevails in Asia Pacific, and there are more diversified portfolios in Europe and North America, with significant shares of nuclear and renewable energies.

GRAPH 2. Regional consumption pattern 2012 (percentage)

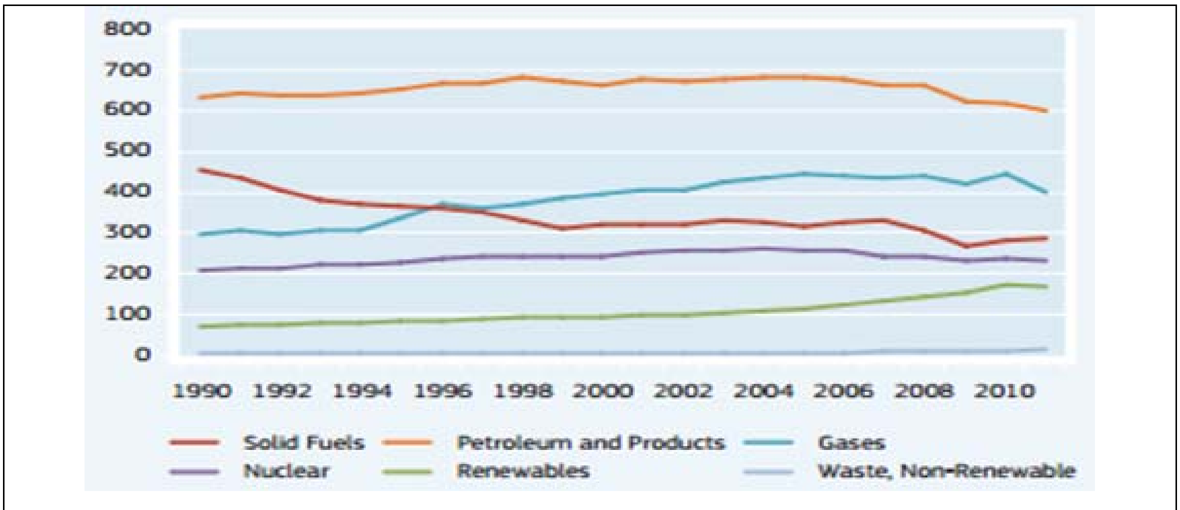


Source: BP, (2013)

2.2. Europe

Looking at Europe, gross inland consumption increased by 3.3% in 2010, compared to 2009. Crude oil and petroleum products continued to dominate the energy mix, although their share dropped from 36.6%, in 2009, to 35% in 2010 as a result of a decline of consumption (from 623 Mtoe to 617 Mtoe).

GRAPH 3. Gross inland consumption evolution by fuel 1990-2011, EU-27 (Mtoe)



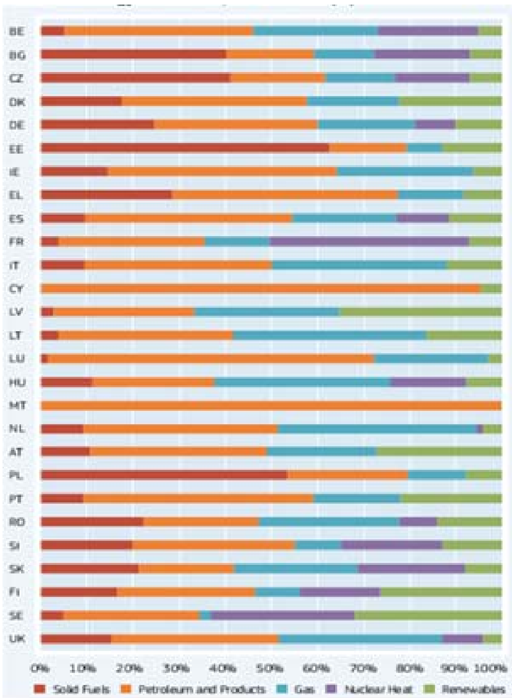
Source: European Commission, (2013)

Between 1999 and 2010, there was a gradual decline in the share of solid fuels. Nevertheless crude oil and petroleum products, as well as nuclear energy share remained quite stable. On the contrary, there was an increase in the share of renewable energy sources and natural gas. The combined share of crude oil, petroleum products and solid fuels fell from 56.9% of total consumption in 2000 to 51.0 % in 2010.

During that period, the relative importance of natural gas rose by 2%, to achieve 25.1% of the EU-27's gross inland consumption in 2010. The biggest change in the energy mix refers to the progressive growth of renewable energies; whose share in primary energy increased by 4.2% between 2000 and 2010, to reach 9.8%.

When looking to the different member states, great differences can be observed among energy mixes, for instance, from Poland to Finland or Cyprus among others.

GRAPH 4. EU energy mix in 2011, national data (%)



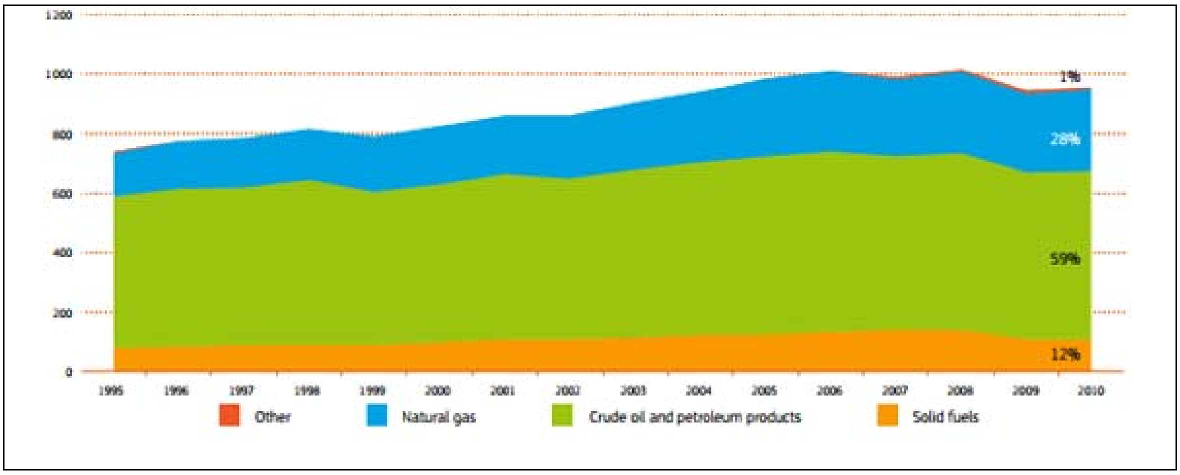
Source: European Commission, (2012)

After years of decline, EU energy production picked up again in 2010, albeit to a level lower than in 2008 (837 Mtoe vs. 855 Mtoe). The decrease of recent years is primarily due to lower levels of fossil fuel production. Renewable energy production grew by 12% between 2009 and 2010. During the same period, moderate increases were recorded in the production of natural gas (2%) and nuclear energy (2.5%), while the production of crude oil and petroleum as well as solid fuels both fell (by 7% and 1%, respectively).

Although natural gas production remained stable in 2010, the declining trend from earlier years is foreseeable to continue. Between 1995 and 2010 the reduction reached 18%.

Regarding imports, after a period of increases, energy imports fell sharply in 2009 by 7%, to 941 Mtoe, which was close to 2004 level. This decrease is in line with lower energy consumption and electricity generation during the economic recession. When recovering the economic activity, net imports increased by 1% in 2010.

GRAPH 5. EU-27 net imports of energy (in Mtoe) (1995-2010)

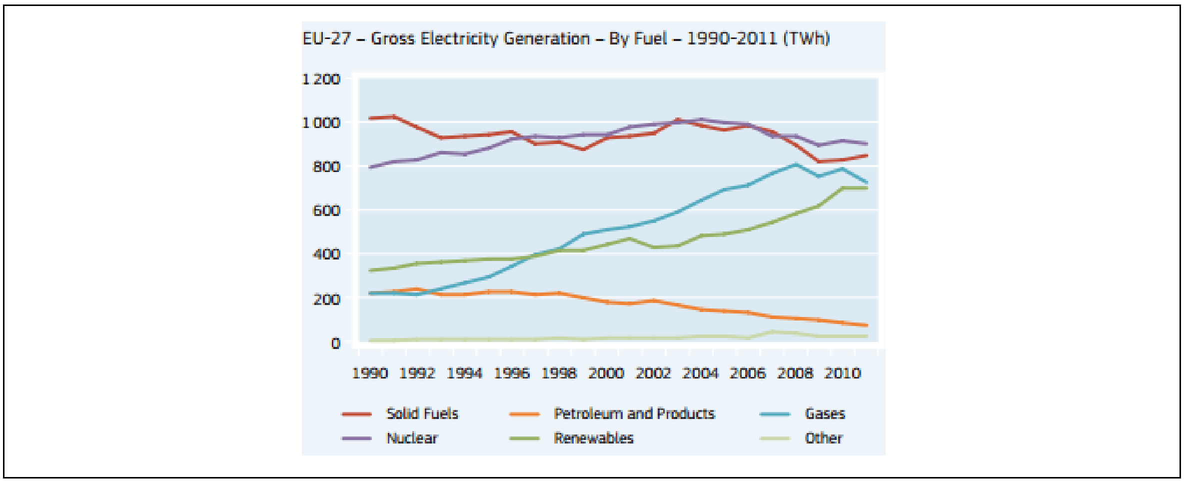


Source: European Commission, (2012)

Then the overall energy import dependency of the EU fell slightly between 2009 and 2010, due to the reduction of import dependency registered in solid fuels and natural gas. In 2010 it was 52.7%, compared to 54.6% recorded in 2008.

Last but not least, it is important to mention that total gross electricity generation in 2010 was 3.346 TWh, i.e. 4% higher than in 2009, similar to 2003 level, when it contracted due to the economic slowdown.

GRAPH 6. Gross electricity generation by fuel, 1990-2011 (TWh)



Source: European Commission, (2013)

It can be observed that renewable energies experienced the highest rate of growth, up to 13% between 2009 and 2010. In addition, the share of natural gas has been rapidly increasing since 1995 due to the significantly greater importance of gas in some Member States to provide the necessary back-up supply for the intermittence of renewable generation.

Additionally, crude oil and petroleum products continued to register a negative trend, and it is likely that they will become more marginal in the future. There has also been a "slow" decrease in solid fuels share during that period.

2.3. Spain

Primary energy consumption in 2012 was 128.8 Mtoe, with a decrease of 0.4% over 2011. This decline, which was lower than the decrease of final energy consumption, was mainly due to the change in the electricity generation structure.

Coal consumption was 15 Mtoe, with an increase of 22.1% between 2011 and 2012, primarily the consequence of a higher electric generation with this fuel.

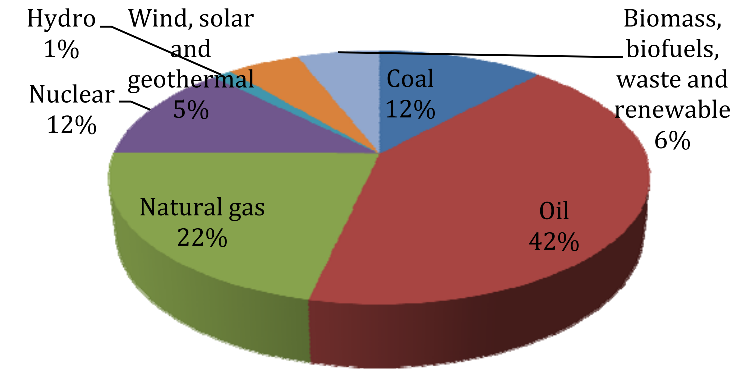
Total oil consumption was 54 Mtoe, with a decrease of 7.5% compared to 2011, which is similar to the reduction in final petroleum products consumption, owing to the fact that their consumption in electricity generation is low.

The contribution of renewable energy, excluding hydraulic, has grown significantly continuing previous years' trend. This contribution is due to the consumption in direct end uses, especially biomass and biofuels, as well as to wind, solar and biomass for electricity generation. Moreover, nuclear generation grew by 6.5% in 2012.

Total natural gas demand was 28 Mtoe, which implies a decrease of 2.6% compared to 2011, reaching a 21.9% share of total energy consumption. Natural gas consumption increased significantly since 1999, even if combined cycle operation hours decreased, because there was an increase of natural gas end users.

In terms of primary energy, oil has the greatest share (42%) followed by natural gas (22%), nuclear and coal (12% each) and renewable (12%), as it can be observed.

GRAPH 7. Primary energy consumption in 2012 (not including power balance)



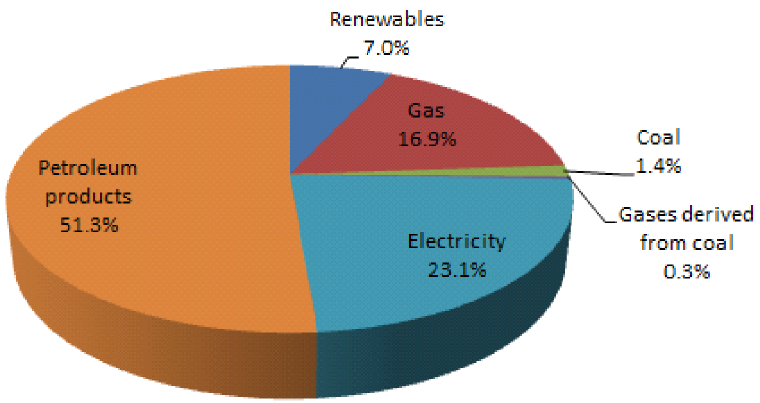
Source: Own elaboration based on MINETUR, (2014)

Spanish final energy consumption in 2012, including consumption for non-energy uses was 89 Mtoe, 4.2% lower than in 2011. This evolution was due to the economic situation, along with the different climatic conditions and working patterns.

By sectors, there has been a decline in industrial energy demand as well as in the residential and tertiary sectors, as a consequence of a lower activity, although climatic conditions in 2012 have been more extreme than the previous year. Transport demand has continued to fall, following the same trend since 2008.

The highest share of the final energy mix corresponded to oil and petroleum products (51.3%), followed by electricity (23.1%) and natural gas (16.9%). Renewable energy represented 7% of the total final energy consumption bearing in mind that in electricity there is a great percentage of renewable generation as it will be seen later.

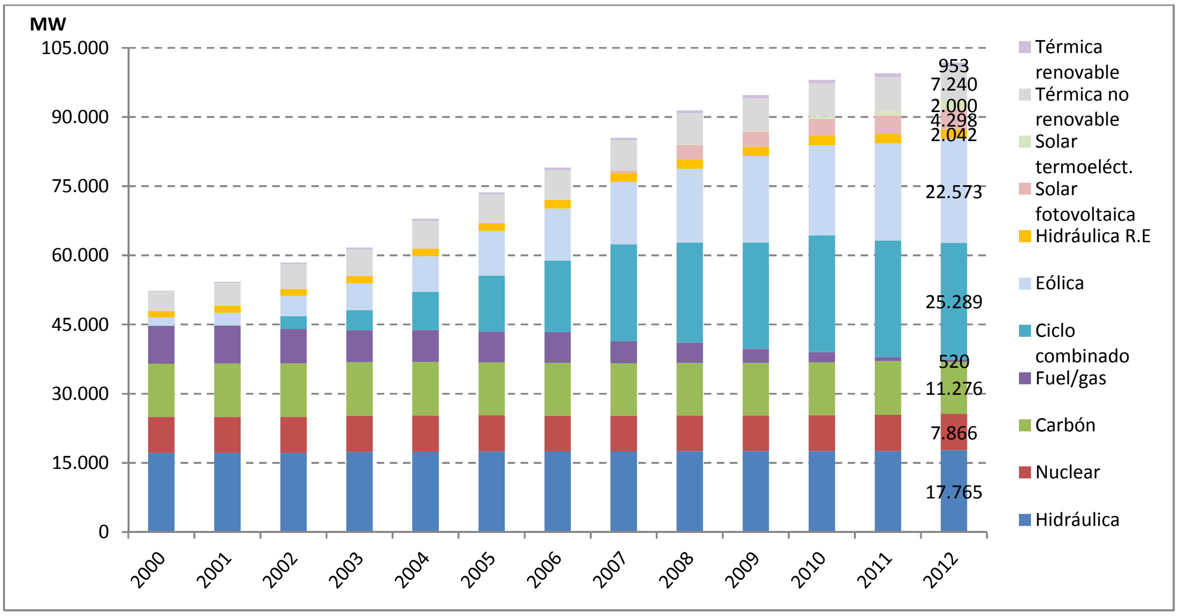
GRAPH 8. Final energy consumption in 2012



Source: Own elaboration based on MINETUR, (2014) In electricity profound changes have been taking place since the beginning of the liberalization process in Spain in 1997. With the entrance of new agents, and new remuneration rules, renewable technologies have increased dramatically (as the next graph shows) especially wind energy that in 2012 represented around 22% of total installed capacity which represented 54% of renewable electricity, and 13.9% of total electricity generation.

Along the past decade, natural gas combined cycle power plants were also built, in a context with increasing electricity demand and low coverage ratio for the peak demand; being the total installed capacity around 25 GW in 2012 as it can be observed in the following graph; 14% of total electricity production.

GRAPH 9. Electricity power evolution (MW)



Source: Díaz et al., (2013)

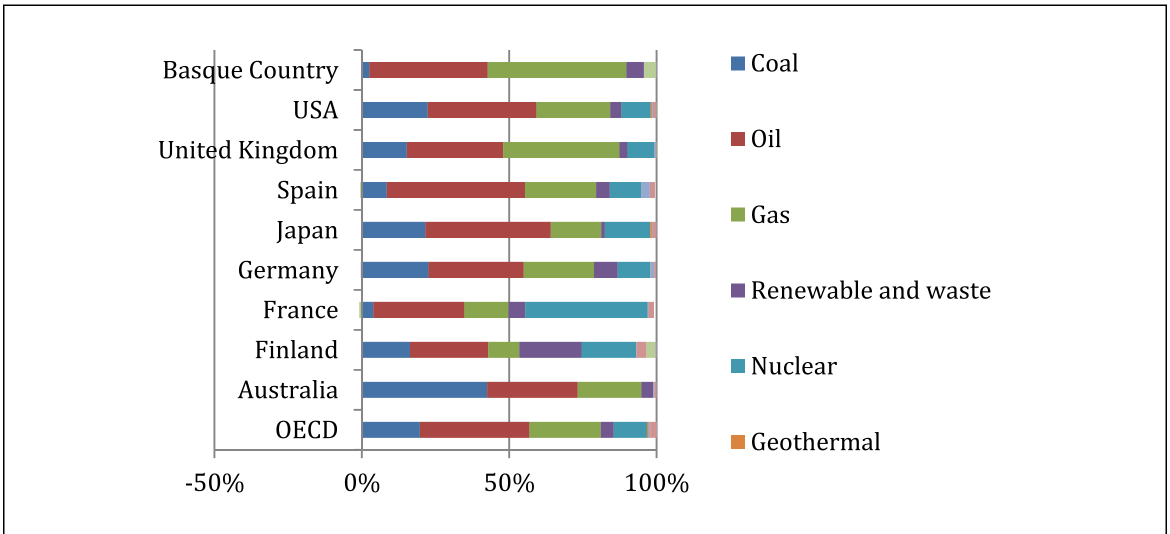
Therefore in 2012 over 56.4% of total generation capacity was CO_2 free (renewable energy + nuclear), that represented 54.1% of electricity production. In terms of renewable the installed capacity represented 48.7% of the total and produced 31.8% of the electricity.

The increase of new capacity with a great proportion of renewable energy with technically low operating hours took place along the last decade. However, since 2008 Spain experienced a dramatic drop in electricity demand, which is increasing the effect of excess of supply that makes more difficult to solve the problem of the tariff deficit that will be explained in chapter 4.

2.4. Basque Country

I would refer briefly to some relevant aspects of energy in the Basque Country. In terms of energy demand, the growth slowed from 2008 due to the crisis and high energy prices. The most used energy sources are oil and gas which have an important weight in transport and in power generation and in industry.

GRAPH 10. Primary energy consumption (2009)

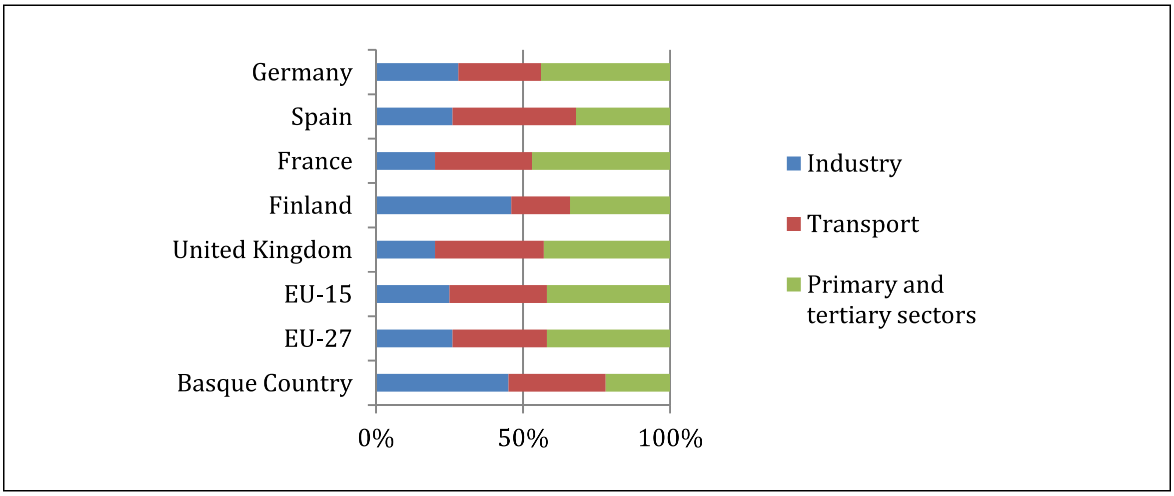


Source: Álvarez Pelegry et al. (2013)

It should be noticed that in the energy mix there has been a growing role of natural gas and renewable at the expense of oil, coal and electricity imports.

Attending to the consumer sectors, industry has a fundamental weight on consumption (42%) although transport sector supposes roughly one third (35.5%).

GRAPH 11 . Energy consumption by sector (2009)



Source: Álvarez Pelegry et al. (2013)

The main energy strategies in the Basque Country have focused in the increase of gas and renewable energy, the reduction in the use of coal and oil and the stress on the improvement of energy efficiency in industry and transport. This situation paves the way for the future to focus on energy efficiency on the demand side, in sectors such as building and services.

3. ENERGY SCENARIOS AND TRENDS

3.1. Scenarios

Although it is impossible to predict the future, there can be signals that could guide the stakeholders´ decisions. For the World Energy Council (WEC) the result of trying to forecast the future is a scenario, which funnels a range of different options with a probability space, acting as an upper and lower bound. The reality is likely to be somewhere in between.

The WEC scenarios approach identifies five different areas namely, economics, finance and trade; resources availability and access; energy systems and technologies; consumer behavior and acceptance and government policies, which include in total 29 issues.

For Shell the scenarios are part of its strategic thinking and help to grapple uncertainties, employing alternative outlooks as a core of strategic tool. For this company a scenario analysis focuses on four main areas: economics, geopolitics and sociocultural issues, energy and environment. All of them try to help to understand how consumers, governments, energy producers and regulators are likely to behave, to respond and to change in the decades ahead.

The International Energy Agency (IEA) in its World Energy Outlook (WEO) considers three types of policies in order to examine the future trends in energy namely current policies, new policies scenario and the 450 scenario that implies complying with the 2ºC average increase in temperature and the CO_2 emissions related to this objective. Exxon and BP also develop scenarios which are also important references.

Given the numerous issues to consider and the uncertainty of the future, some scenarios analyses try to express views with some kind of 'images' for their 'visions' of the future. These images are 'Symphony' and 'Jazz' for the WEC or 'Mountains' and 'Oceans' for Shell (Shell, 2013). Next the reader will find some issues regarding these scenarios, which may give at least a preliminary framework of the future of energy.

First in all the analysis of the future of energy there are two common drivers that appear as fundamental: population growth (its distribution and urbanization) as well as economics. The following map shows that in 2040, more than 75% of the population will live in cities and that by that date there will be a substantial increase of cities with more than 10 million inhabitants.

MAP 1. Global urbanization and major cities in 2040

Source: ExxonMobil, (2014)

It is likely that world's population would be nearly 9 billion. OECD countries annual future growth would be 2.0% while non OCDE countries´ would probably be 4.4%. However it must be said that under those premises, OECD would keep its importance in terms of GDP, and even increase it; representing in 2040 around 60% of world GDP (ExxonMobil, 2014).

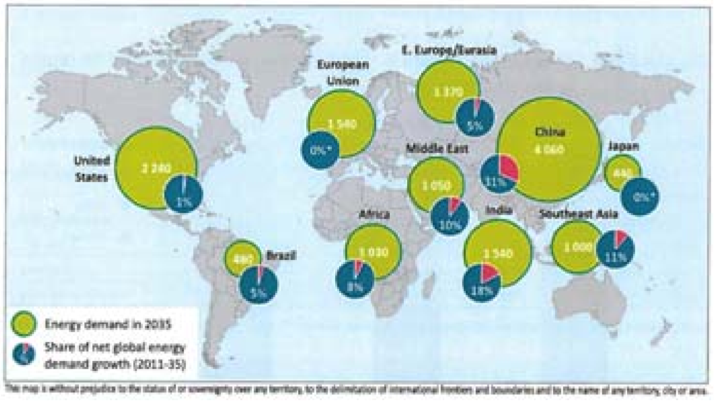
In other scenarios the world´s population growth would be between 1.7% and 2.3% annually, with a breakdown from 1-1.3% for developed countries and from 3.2-3.9% for the developing countries, WEC (2013).

Future economic growth shifts from developed countries to developing and economics transition, in particular, in Asia. For the WEC (2013) in 2050 nearly half of the economic growth (measured in terms of production of GDP) will happen in Asia. This will have implications in the energy field.

For instance Asia weight on total primary energy consumption will increase from 40% in 2010 to 45% in 2050. By 2050 Europe and North America (including Mexico) will suppose about 30% of total global primary energy consumption, Africa 15% and South America around 10%.

Another way to visualize this profound change in the world energy landscape is to look at the following map, in which the sizes of the circles offer a clear idea of the importance in primary energy in 2035 and in particular the rate of energy growth in different regions which confirms the previous statement about the shift in energy demand to the "emerging economies", particularly, China, India and Middle East.

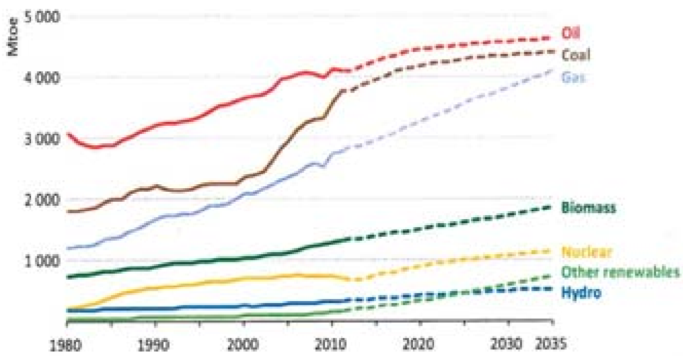
MAP 2. Primary energy demand in selected regions and their share of global growth in the New Policies Scenario (Mtoe)



Source: WEO, (2013)

In terms of global energy supply and demand, a continuous growth is expected in all types of primary energies but, as it can be seen in the following graph, gas and renewable energies will have a greater growth.

GRAPH 12. World primary energy demand by fuel in the New Policies Scenario

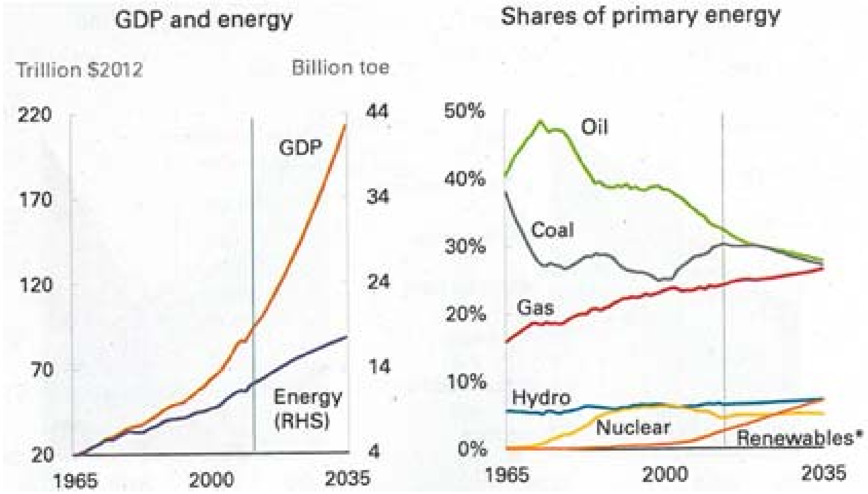


Source: WEO, (2013)

Taking into account the weight of different primary energies, with a historical perspective, a drop in oil and coal can be observed with a continuous growth of gas. Next graph shows a projection for 2035 where the gas quota in primary energy will equal oil and coal ones; while renewable energies will only account for a 5% share.

In the graph it can also be observed the future increase in energy and the greater increase of economic growth measured by GDP, and therefore how energy efficiency is going to play a greater role.

GRAPH 13. Decoupling of energy from economic growth



Note: includes biofuels (*)

Source: BP, (2014)

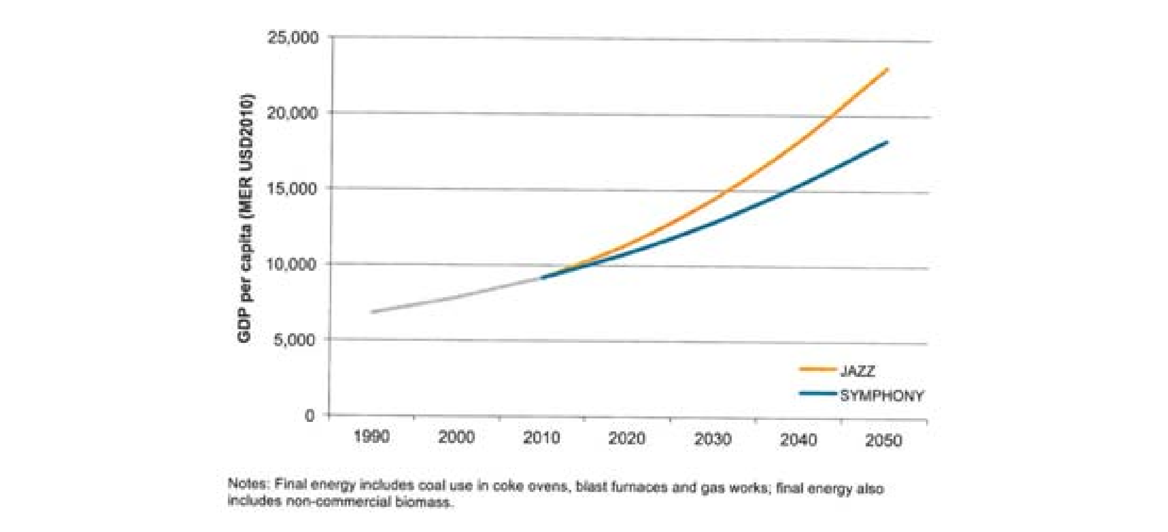
For the WEO (2013) global demand for renewable energy grows by nearly 80% in the new policies scenario. Demand for traditional forms of bioenergy declines, while demand for modern renewable energy (including hydropower, wind, solar, geothermal, marine and bioenergy) rises almost two and a half times from 2011 to 2035.

OECD countries collectively represent 40% of the global increase in the use of renewable energy, and renewable technologies account for nearly half of the net increase in global electricity generation. Then their share in the generation mix increases, from one fifth in 2011 to closer to one third in 2035.

3.2. Electricity

The electrification of the final energy mix is a trend that seems clear, as well as the improvement in energy efficiency, as it has been said. Electrification in terms of share of electricity in final energy will increase ranging from around 10.000 USD (2010) (Market Exchange Rate-MER) in 2010 to around 20.000 USD (2010) in 2040.

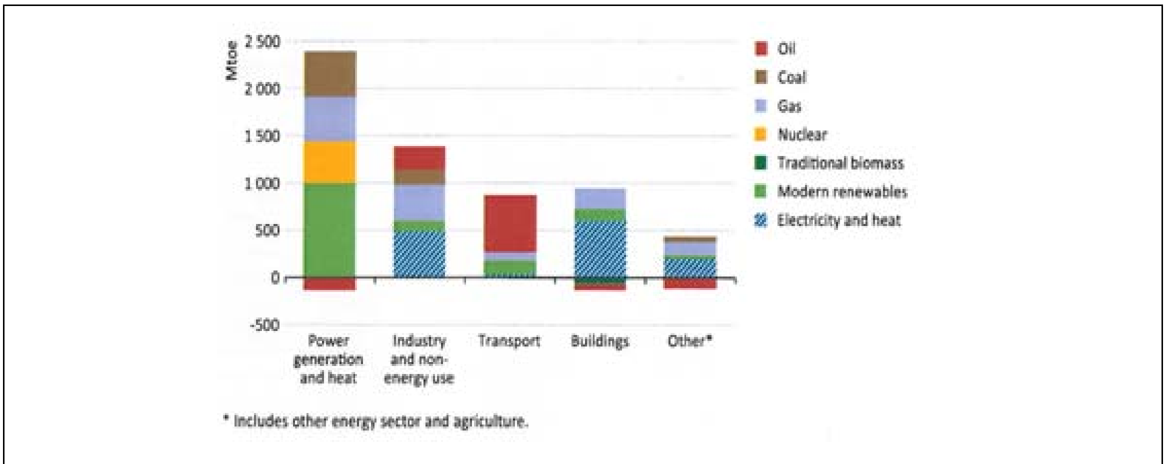
GRAPH 14. Electrification: share of electricity in final energy (excluding non-energy uses)



Source: WEC, (2013)

This shall be driven by the greater use of electricity in industry and buildings.

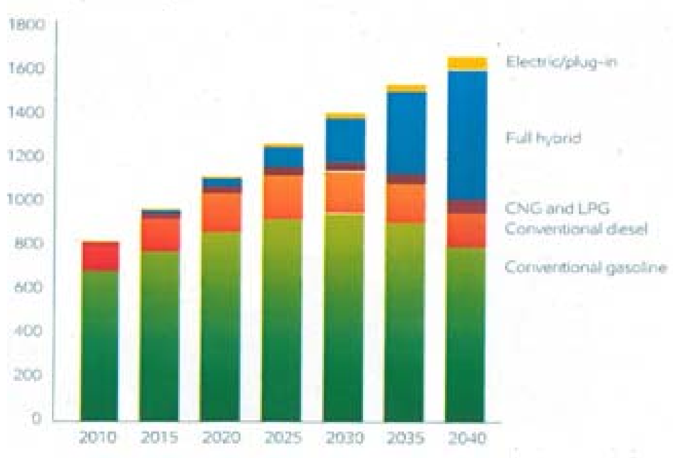
GRAPH 15. Change in energy demand by sector and fuel in the New Policies Scenario, 2011-2035



Source: WEO, (2013)

Penetration of electricity in transport will probably be slower. In terms of number of cars, the greater penetration should be fully hybrid and electric plug-in being accompanied by the compressed Natural Gas and LPG. This would lead to a substantial increase in the share of conventional gasoline at worldwide level.

GRAPH 16. Light-duty fleet by type (million cars)



Source: ExxonMobil, (2014)

Demand growth will be driven by non-OECD countries, especially China and India. Although efficiency improvements should limit growth in energy demand in transport to non-OECD states, demand will rise by “only” 82% (BP, 2014).

Global electricity generation is expected to increase. How much and with which type of technologies will be different depending of the scenarios. In this respect WEC Scenarios Jazz and Symphony can be useful.

As it has already been mentioned, WEC considers two scenarios, Jazz and Symphony. Jazz has a focus on energy equity where the priority is the access and affordability of energy.

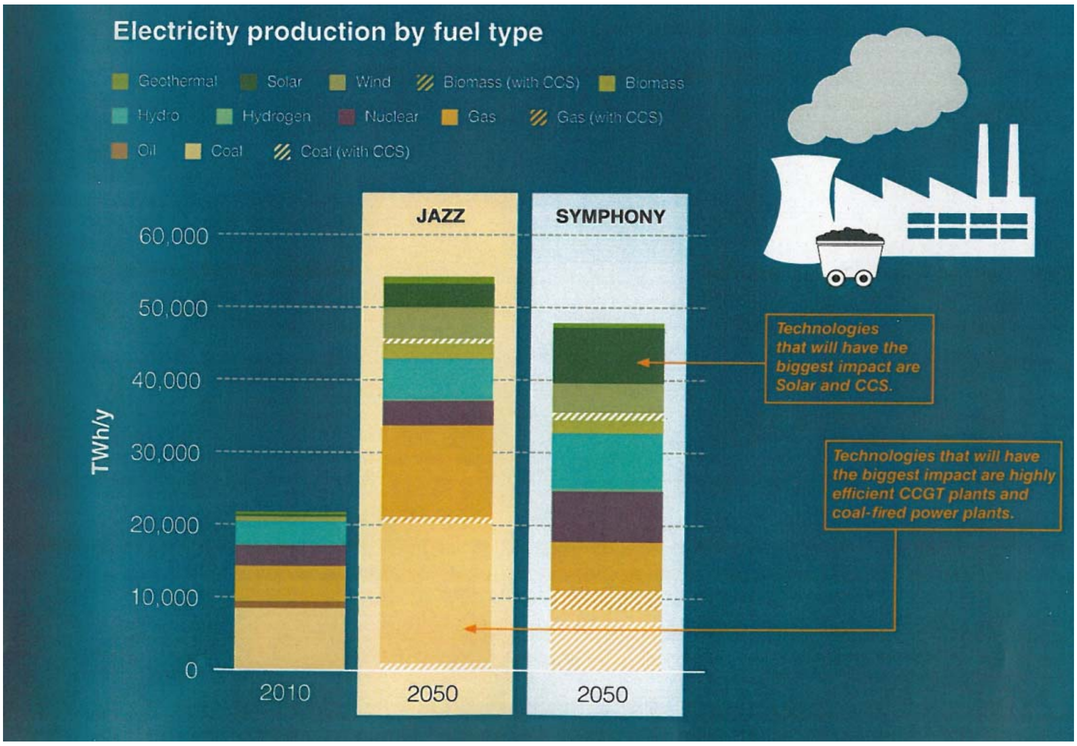
In a Jazz scenario competitive cost solutions are determined by the free-play of market forces, which allocate capital without altruistic motives. Technology choices and developments are driven by competitiveness based on cost and reliability. Governments should facilitate achieving economic growth through the use of best available energy sources.

As energy sources will compete on the basis of price, quality and availability, and since there is less government support for low-carbon energy technologies; governments will facilitate the role of the private sector to drive competition and lower prices even further e.g. for factor input and capital cost to boost investments.

A Symphony scenario represents a world where government reaches a consensus on driving environmental sustainability through the corresponding policies and practices. Governments begin to develop national regulations, which support the development of low-carbon technologies, as renewable energy and carbon capture use and storage projects (CC(U)S). As a result governments play a more proactive role in this scenario.

In 2010 global electricity production was 20.5 TWh/y. In a Jazz scenario it is expected to increase by 150% to 53.6 TWh/y by 2050 and in Symphony, the increase is about 123% to 47.9 TWh/y. Then it is expected that the electricity generation mix in the future will be subject to tremendous changes up to 2050. (See the following figure).

FIGURE 1. Electricity production by fuel type



Source: WEC, (2013)

As it can be observed in the figure above, generation mixes are quite different in the Jazz and Symphony scenarios. One of the reasons of the differences is the role of government and markets. In the Jazz Scenario energy choice is based in free markets and in the Symphony one government supports nuclear, large hydro, and renewable energies.

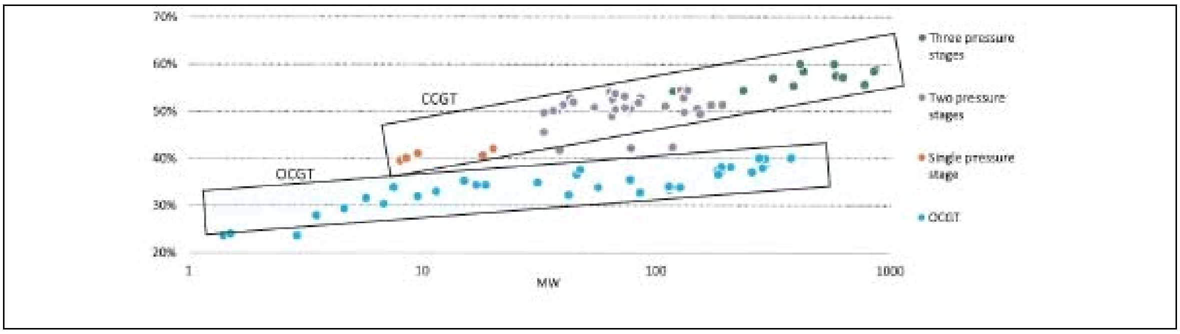
3.3. Technologies

Having been asked to deal also with technology, I would like to focus on some electricity technologies, which are related to the two main drivers that are going to gain importance in the electricity systems: flexibility and efficiency.

Flexibility supposes a power system that can modify electricity production or consumption in response to variability. Combined-cycle gas turbines and the opencycle gas turbines, with start-up of 40-60 minutes and less than 20 minutes respectively, are the more appropriate technologies.

In terms of efficiency all technologies are in a permanent search for their improvement, i.e. looking for working with higher temperatures (ETP, 2013). This fact, along with the increase in size (see the following graph), has resulted in a continuous development to raise efficiency up to around 63%.

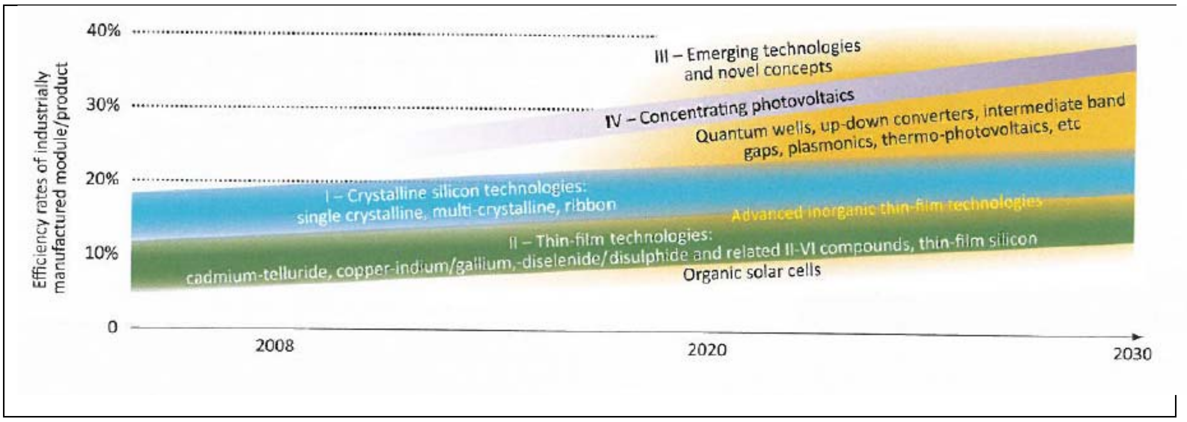
GRAPH 17. Efficiency ranges for OCGT and CCGTs



Source: ETP, (2013)

The search for greater efficiency together with the lower generation cost is a common rule to technologies such as solar.

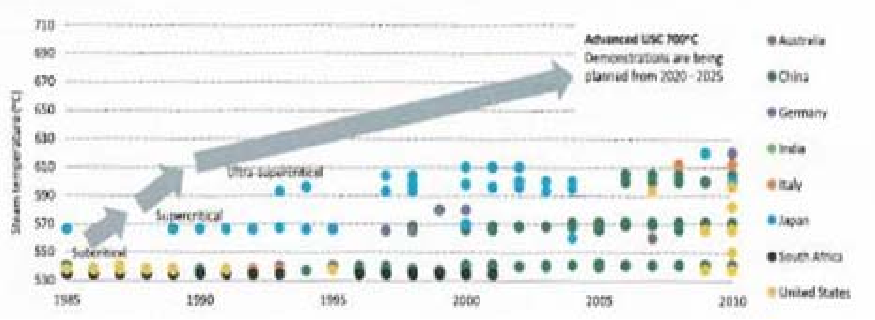
GRAPH 18. Technology milestones



Source: ETP, (2013)

This trend can also be found in the development of pulverized coal fired power stations. Some countries have advanced more in the incorporation of higher efficiencies in their plants. Ultra-supercritical plants are already in operation (Japan, Korea, China, etc.) (ETP, 2013).

GRAPH 19. State of the art steam conditions and future perspectives in PC plants



Source: ETP, (2013)

In the WEC scenarios it is stressed that carbon capture and storage is necessary to comply with a lower CO_2 emission target, as fossil fuels are going to be the predominant energy source. Three technically possible technologies are considered: post-combustion, pre-combustion and oxy-combustion CO_2 capture.

In terms of costs, applying CCS to a power plant is expected to increase the LCOE by between one-third and two-thirds, depending on the type of plant: however, the LCOE and CO_2 avoided costs are competitive with other alternative low-carbon electricity generation options.

In any case the issues of transport and storage of CO_2 must be solved to implement these technologies. But, as it can be seen, the estimation of generation cost of the different technologies is lower than other like thermal solar.

TABLE 1. The average cost and performance impact of adding CO_2 capture in OECD countries

Capture route	Post-combustion	Coal Pre-combustion	Oxy- combustion	Natural gas Post-combustion
Reference plant without capture	**PC**	**IGCC (PC)**	**PC**	**NGCC**
Net efficiency with capture (LHV, %)	30.9	33.1	31.9	48.4
Net efficiency penalty (LHV, percentage points)	10.5	7.5	9.6	8.3
Relative net efficiency penalty	25%	20%	23%	15%
Overnight cost with capture (USD/kW)	3808	3714	3959	1715
Overnight cost increase (USD/kW)	1647	1128 (0)	1696	754
Relative overnight cost increase	75%	44% (0%)	74%	82%
LCOE with capture (USD/MWh)	107	104	102	102
LCOE increase (USD/MWh)	41	29 (0)	40	25
Relative LCOE increase	63%	39% (0%)	64%	33%
Cost of CO_2 avoided (USD/tCO_2)	58	43 (55)	52	80

Notes: PC= pulverized coal, LHV= low heating value, LCOE= levelized costs of energy

Source: ETP, (2013)

4. REGULATION AND ENERGY RELATED POLICIES

4.1. European Union

European current energy policy is mainly based on the 20/20/20 targets, set by the EU in March 2007, which were developed within the "Energy/Climate Change Package", adopted in 2009 (European Commission, 2014b).

The measures taken to achieve those targets have delivered the following results: reduction by 18% of GHG emissions in 2012 compared to 1990 emissions; 13% of renewable energy[1] in 2012, that, predictably, will be 21% in 2020 and 24% in 2030; decrease of energy intensity of the European economy by 24%, 30% in the industrial sector from 1995 to 2011 and the carbon intensity reduced by 28% in the same period (European Commission, 2014a).

The European Commission is now preparing the roadmap for the following period from 2020 to 2030 that should be based on the complete implementation of the 20/20/20 targets, on a real commitment to reduce GHG, the design of a low carbon transition according to each country, simplification of the EU policy framework, for developing a sustainable, competitive and secure energy system.

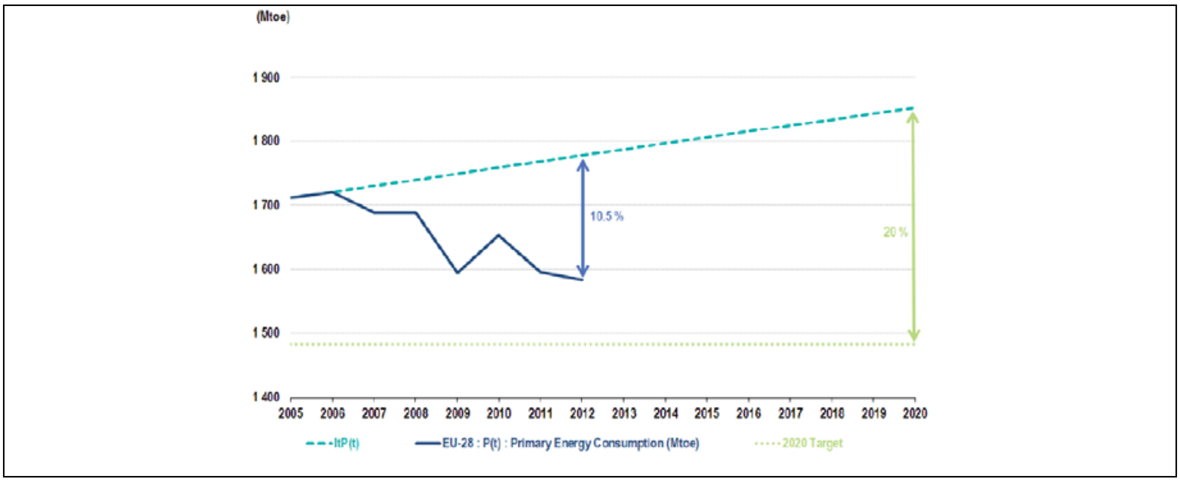
The main key elements of the new energy framework for the near future are seven (European Commission, 2014a). The first one is the achievement of a new GHG emission reduction target of 40% in 2030 relative to 1990´s emissions, which supposes a continued effort not only from the EU-ETS sectors but from non EU-ETS sectors too, such as transport and building.

The second element is the role of renewable energy that should be fostered from 21% to at least 45% in 2030 in the electricity sector for the EU with no national objectives, letting flexibility to each member state. The recent development of this energy has been due mostly to national support schemes, however the new proposal considers that renewable energies development should be market driven, and consider not only questions related to environment and security of supply but to competitiveness and technological matters too.

The third element is energy efficiency that should be improved according to the Energy Efficiency Directive whose deadline is June 2014. Next graph shows the energy efficiency improvement, by 10.5%, during the last years, especially in the industry. This means that half of the objective for 2020 has already been achieved. Even if industry and transport have made an important effort and have still a long way to go, there is also a vast potential in efficiency in buildings, which will require very significant investments and information to encourage consumers to acquire more efficient equipment, among others.

[1] 44% of world´s renewable electricity in 2012 (excluding hydro) was developed in the EU.

GRAPH 20. European energy efficiency evolution and objective



Source: Sáenz de Miera, G. (2014)

In any case, the Commission considers that it is possible to achieve 25% of energy savings by 2030, taking into account that the objective of 40% emissions reduction would lead itself to a 27% of renewable energy.

The next element is the reform of the EU-ETS due to the surplus of allowances as a consequence of the economic crisis. In 2012 the European Commission tabled a draft amendment to postpone the auctioning of 900 million allowances from 2013-2015 (back-loading proposal) (Álvarez Pelegry, E.; Larrea Basterra, M.; 2014). The objective of this proposal was to reduce the volume of EUAs auctioned in the following periods' amendment proposal document.

The Commission considers that the best way to achieve CO_2 market stability is by creating a stability reserve for the fourth phase, which would be employed to offer or move away allowances depending on the market situation, giving flexibility to the EU-ETS.

The fifth element for the new framework tries to ensure competition in integrated markets where cost signals must be appropriated with no distortive impacts. According to the Commission, state aids for mature energy technologies including renewable energies should disappear by 2030, remaining available subsidies to those renewable energies less developed.

To some extent, the following and sixth element is related to the previous one, achieving competitive and affordable energy for all consumers, domestic and industrial ones. This is especially important for those industries that have high share of energy costs and that compete in international markets, even if carbon leakage measures have been successful and big energy consumer companies have made improvements in energy efficiency.

The last element that the Commission considers is the promotion of security of supply. Raising imports of energy increases the vulnerability of the EU facing price shocks as well as supposes considerable expenses (in 2012, EU´s oil and gas import bill represented more than 400 million €, 3.1% of the EU GDP).

In this regard the development of renewable energies and the exploitation of own resources are instruments that can help. Cooperation among member states to diversify energy supply and competition, with the development of transport infrastructures and improvements in energy efficiency would lead to a better security of supply.

When discussing about energy policy there are other elements that should be taken into account, especially the relation among energy policy and industrial, environmental and R&D policies.

Even if, probably as a consequence of the economic crisis, the main focus now is the competitiveness of energy prices as a key element for some industries, big energy consumers and, subject to international competition, environmental matters continue playing an important role in energy. It cannot be ignored that environmental policy is one of the oldest policies that have a closer relation to the energy policy because of transport and energy generation emissions.

As far as R&D policy is concerned, this one is not clearly focused on specific technologies or countries. On the contrary, it looks for promoting alternatives without targeting to those which are closer to be cost competitive that is with a “push approach” and not market driver. At the same time, there is a tendency to diminish investment on R&D. In the specific case of energy R&D, it should be stressed that at European level, it is below 1980´s level.

At present, the European Union industrial policy tries to accelerate industry adjustment to structural changes, fostering initiative, companies’ development and cooperation as well as to improve industrial potential of innovation, research and technological development (Parlamento Europeo 2011).

Overall, industrial policy is made up of measures towards the development of the internal market, foreign trade, social and regional policies, competition policy, R&D and European companies’ cooperation.

It can be seen that the EU continues to focus in the aims of a reduction of GHG emissions, more renewable energy and continued effort for improving energy efficiency. However this objectives are now accompanied by considering and taking into account other related policies such as maintaining and increasing the weight and the importance of industry in the economy and the cost competitiveness, not only in terms of trying to decrease the costs of energy intensive industry but also in the decrease of subsidies for renewable energies.

4.2. Spain[2]

4.2.1. Until 2013

Although energy is not only electricity but also oil, coal and other energies, this section will focus on the electricity sector[3].

Spanish regulation on electricity since the Electricity Sector Law 54/1997[4] has let liberalization advance. As a consequence, generation and commercialization activities are liberalized, while transport and distribution continue being regulated activities. In any case it could be said that the liberalization process is not fully completed because there are still consumers, domestic ones, that can pay electricity according to government rules.

The liberalization has been accompanied by the proliferation of rules and regulation that has complicated the energy framework, whose main objective is to respond to the problems that appear at each moment. Next figure tries to offer a general overview of the main rules and regulation, referred mainly to renewable energy (RES), capacity payments, distribution and self supply and distributed energy.

[2] Mainly from Mosácula, C.; Álvarez, E; Díaz, A.C.; Larrea, M.; Castro, U. (2013)
[3] For a more comprehensive analysis see Álvarez Pelegry, E.; Larrea Basterra, M.; (2014).
[4] This regulatory model has also extended to the natural gas sector with Law 34/1998 of Hydrocarbons sector.

FIGURE 2. Main rules developed in the electricity sector

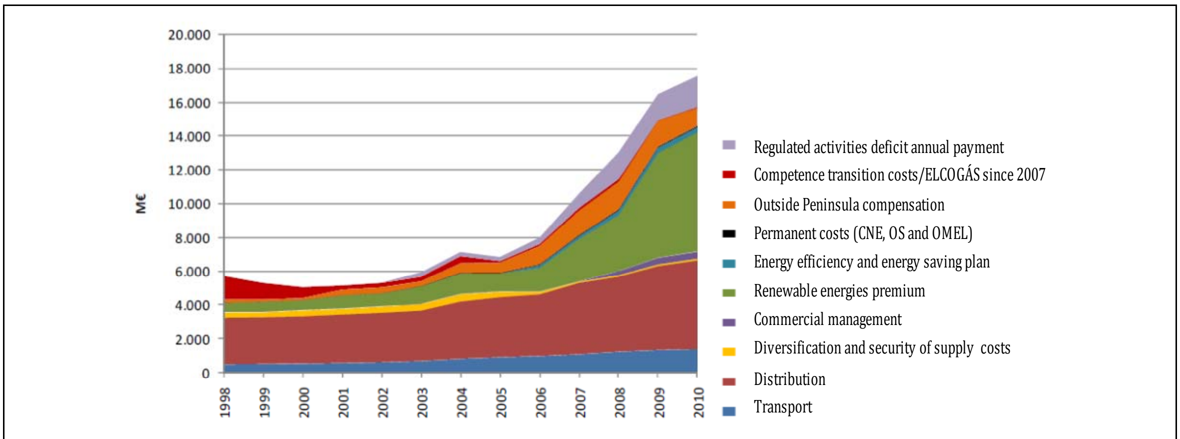
	1997	...	2004	...	2007	2008	2009	2010	2011	2012	2013
Special regime (RES)		RD 2818/1998	RD 436/2004 Retribution framework		RD 661/2007 Developme nt of RES RD 616/2007 Developme nt of cogeneratio n	RD 1578/2008 Changes in PV payments	RD-Ley 6/2009 Creation of register for RES	RD 1565/2010 RD 1614/2010 RD-Ley 14/2010		RD-Ley 1/2012 Suspension of RES power allocation Ley 15/2012 Sustainable energy taxes	RD-Ley 2/2013
Guarantee of capacity	Law 54/1997		RD 2351/2004		ITC/2794/2007 Developme nt of capacity payments			RD 134/2010 Security of supply restrictions solution	Orden ITC/3127/2011 Availability service		RD-Ley 13/2012
Electricity distribution		RD 2819/1998				RD 222/2008 Development of a base for retribution				RD-Ley 13/2012	RD-Ley 2/2013 RD-Ley 9/2013 Reductions of the retribution
Self supply and distributed energy									RD 1699/2011 Grid connection		
Other					RD 1261/2007 Coal subsidies		RD 40/2009 Nuclear waste	RD 1202/2010 Review of access tariffs			

Note: This figure is for illustration purposes and does not fully cover all the regulation of the sector.

Source: Own elaboration

The main issue in Spain, as the following graph shows, is the regulated costs increase in Spain, contributing to a large tariff deficit that must be solved as soon as possible, to avoid negative consequences for the electricity sector. In fact this has been the main driver for the electricity reform.

GRAPH 21. Evolution of the regulated costs of the system



Source: CNE (2012b)

In fact, the increase of regulated costs has not been moved to electricity consumers, contributing to the increase of the tariff deficit. In addition the financial costs of the tariff deficit makes the situation worse together with the decrease of electricity demand, which generates fewer incomes.

It can be observed that when regulated costs began to increase, more regulation was developed, especially in the renewable energy field. Most of the new regulation related to remuneration had as objective its reduction, however as electricity production from renewable sources increased, even if electricity demand fell, the electricity bill got bigger.

It should be noticed that in 2014, around 40% of the costs included in the tariff will be related to other policies, such as environmental or social policies, that the government should consider moving away from the electricity tariff. These policies are related to the special regime, the Spanish coal situation or the extra cost for the electricity supply in island and outside mainland territories.

This complex situation urged the government to engage in a reform process of the electricity sector that was proposed on July 2013 and began with the RDL 9/2013, for the adoption of urgent measures to ensure the financial stability of the power system.

4.2.2. The electricity reform

As it has been said, the reform proposal of the electricity sector tries mainly to solve the tariff deficit (that supposes approximately 2% of the GDP) minimizing the impact on electricity consumers.

Initially the cost of the reform was supposed to be borne by firms, consumers and public budget but in reality the main burden of the costs will be supported by the electricity companies.

This reform proposal, indeed started a few months earlier, in the second mid of 2012, when the government proposed a new law that became Law 15/2012, on tax measures for energy sustainability.

This new rule created several new taxes and updated other ones that already existed such as the tax on hydrocarbons. Perhaps one of the most controversial one is the tax on the electricity production value, which supposed an increase of 7% of the final price of electricity. With these taxes, the government foresaw an additional income of around 2,800 million €, that would cover some of the expenses of the sector, reducing the tariff deficit, or at least avoiding it to increase.

In 2013, the RDL 9/2013 concerns urgent measures to ensure the financial stability of the power system was published. It describes a structure of fixed / variable income to which most of them are fixed. So consumers will pay a higher proportion of fixed costs than variable, which is, to some extent, decouple price of energy from the consumption level.

The publication of this RDL[5] has been accompanied by numerous pieces of legislation, known as the reform proposals. Among the proposals the draft law of the electricity sector (current Law 24/2013) can be outlined, as well as; RD's proposal on the methodology for calculating the remuneration of the activity of electricity transmission; RD's proposal on the methodology for calculating the remuneration of the electrical distribution; the new referral memory of the Order that reviews the access tariffs of electricity and the proposed RD on renewable sources, cogeneration and waste.

In addition, there are other proposals as the RD on self consumption or the RD´s proposal that fixes the capacity and hibernation mechanisms.

This reform aims to provide a stable and predictable investment framework to balance the costs and revenues of the system and prevent the generation of new tariff deficit, offering stability and balance in the electricity sector and ensuring the supply to the consumer. It also tries to end the tariff deficit.

Energy projects suppose big investments and as there are still regulated activities in the electricity system, those investments need stability and predictability. Besides, changes in remuneration should be subject to a transparent process, preferably discussed with the agents that participate in the sector.

This reform establishes new questions that can have an important impact not only on the sector agents but on consumers, whether industrial or domestics, such as relating the remuneration of regulated activities to Treasury Bonds +200 or 300 basis points and not the WACC. This is particularly relevant for the electricity distribution.

Risking to make a not very rigorous summary, it may be said that the electricity reform increases taxes for generation, decreases the remuneration of regulated activities, such as distribution and does not transfer the whole costs to the domestic consumers, who can be still subject to a regulated tariff as mentioned before.

Furthermore it does not face the important fact that there are costs not strictly related to electricity generation, transmission and distribution activities. This could really be the main driver to decrease electricity prices. In fact, Spanish electricity costs are competitive; however the addition of those non related costs provokes damages by increasing electricity prices to consumers.

[5] In Spain there are different kinds of regulation that can be laws, Royal Decrees (RD) or Royal Legislative Decree (RDL) among others. A RD is a decision of the Council of Ministers, approving general provisions and which is signed by the king and a RDL is a rule with the power of Law, typical in countries with a parliamentary monarchy, emanating from the executive branch that is given in case of extraordinary and urgent need.

5. COMPETITIVENESS AND ENERGY COSTS

5.1. From comparative to competitive advantage

The classical theory began to attribute the benefits to compete at an absolute advantage in production costs. In the typical example, a manufacturer or a country would have an advantage if their costs were less than the competitor´s one.

The absolute advantage would be the case where a company or a country can produce a good at an absolute cost lower than another company or country.

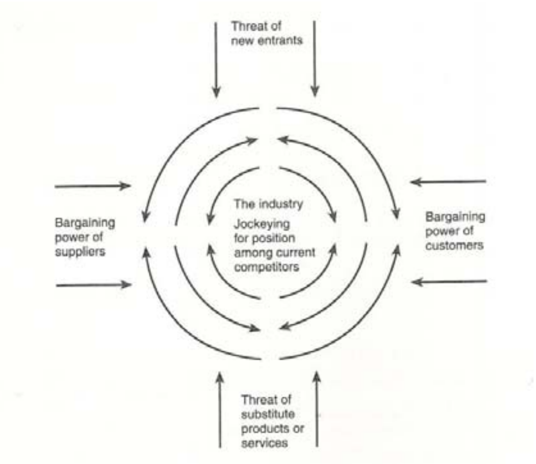
The concept of comparative advantage is that while a company or a country is more efficient than another in those products having absolute cost advantage, then it will be interested in producing those products in which it has a relative or comparative advantage.

As an example two countries A and B produce two products I and II. Country A employs two units of input for product I and one for product II. Country B needs ten input units for product I and two for product II. Country A has an absolute advantage in the cost for the two products (2<10 and 1<2), however the advantage of country A is higher in the production of the product I as 2/10 is less than 1/2 (0.2 <0.5).

Moving to the concept of competitiveness it is necessary to refer to Porter´s competitive advantage as well as to the term “competitiveness” of the IEA.

It is easy to view competition too narrowly and too pessimistically according to Porter. Customers, suppliers, potential entrants and substitute products are all competitors that may be more or less prominent or active depending on the industry. Therefore, the state of competition in an industry depends on five basic forces, which are shown.

FIGURE 3. Forces governing competition in an industry



Source: Porter, (1998)

Operational effectiveness (OE) and strategy are both essential to achieve better performance, which, after all, is the primary goal of any enterprise. Nevertheless they perform in different ways.

A company can outperform rivals only if it can establish a difference that can be preserved. It must deliver greater value to customers or create comparable value at a lower cost, or do both things. Ultimately, all differences between companies in cost or price derive from hundreds of activities required to create, produce, see, and deliver their products or services.

OE means performing similar activities better than rivals and it is from this point where issues related to energy efficiency and the influence of cost of energy in competitiveness may be included. In contrast, strategic positioning means performing different activities from rivals´ or performing similar activities in different ways.

Finally, referring to the IEA´s definition of competitiveness (WEO p. 262), `*international competitiveness refers to the ability of both firms and economies to compete internationally, and industrial competitiveness would be the ability of the industry (particularly in energy-intensive sectors) to compete internationally.´*

The term of industry in some academic literature is simply the manufacturing industry. For the European Commission industry includes the automotive, machinery and pharmaceutical, chemical and aeronautic equipment. It also refers to a broader set of activities including mining and energy.

5.2. Manufacturing and the relevance of energy cost

The European Commission has recently published a Communication `For a European Industrial Renaissance´[6] which sets out the Commission´s key priorities for industrial policy, and recognizes that the EU firms face higher energy prices.

The recognition of the importance of manufacturing has been also pointed out in various studies[7], which have also shown that large developing economics are moving up in global manufacturing as it can be seen in the following figure.

[6] European Commission (2014d)

[7] - Industry as a growth engine in the global economy.
- Manufacturing the future: The next era of global growth and innovation + BCG.

FIGURE 4. Top 15 manufactures by share of global nominal manufacturing gross value added

Rank	1980	1990	2000	2010
1	United States	United States	United States	United States
2	Germany	Japan	Japan	**China**
3	Japan	Germany	Germany	Japan
4	United Kingdom	Italy	**China**	Germany
5	France	United Kingdom	United Kingdom	Italy
6	Italy	France	Italy	Brazil
7	**China**	**China**	France	South Korea
8	Brazil	Brazil	South Korea	France
9	Spain	Spain	Canada	United Kingdom
10	Canada	Canada	Mexico	**India**
11	Mexico	South Korea[1]	Spain	**Russia**[2]
12	Australia	Mexico	Brazil	Mexico
13	Netherlands	Turkey	Taiwan	**Indonesia**[2]
14	Argentina	**India**	**India**	Spain
15	**India**	Taiwan	Turkey	Canada

1 South Korea ranked 25 in 1980.
2 In 2000, Indonesia ranked 20 and Russia ranked 21.
NOTE: Based on IHS Global Insight database sample of 75 economies, of which 28 are developed and 47 are developing. Manufacturing here is calculated top down from the IHS Global Insight aggregate; there might be discrepancy with bottom-up calculations elsewhere.

Source: HIS Global Insight in (Mckinsey & Company, 2012)

In Europe the share of manufacturing in the economy can be look at from different dimensions such as employment, labor compensation, value added, total exports, innovation expenditure or R&D expenditure among others (Consult GmbH, 2013).

But manufacturing is diverse. For some analysts five different groups can be identified in accordance with the characteristics of intensity in R&D, labor, capital, energy, trade and value. Having into account these parameters a group of energy resource intensive commodities emerge, in which the basic metals industry is included as it can be observed in the following table.

TABLE 2. Classification of industries depending on costs, innovation and tradability

Group	Industry	R&D intensity %	Labor intensity	Capital intensity %	Energy intensity %	Trade intensity %	Value density
Global innovation for local markets	Chemicals	25	10	50	5	42	1
	Motor vehicles, trailers, parts	16	14	32	2	39	8
	Other transport equipment	25	19	29	1	42	8
	Electrical machinery	6	17	30	2	46	7
	Machinery, equipment, appliances	8	18	32	2	48	8
Regional processing	Rubber and plastics products	3	21	33	5	21	3
	Fabricated metal products	1	23	28	3	14	3
	Food, beverage, and tobacco	2	23	40	4	15	1
	Printing and publishing	2	19	33	3	4	3
Energy-/resource-intensive commodities	Wood products	1	31	35	7	13	0.5
	Refined petroleum, coke, nuclear	1	6	56	10	21	0.4
	Paper and pulp	2	18	37	10	24	1
	Mineral-based products	3	20	39	11	14	0.1
	Basic metals	1	14	41	14	26	1
Global technologies/innovators	Computers and office machinery	25	15	41	1	91	72
	Semiconductors and electronics	33	15	38	1	60	
	Medical, precision, and optical	35	17	40	1	57	
Labor-intensive tradables	Textiles, apparel, leather	2	35	31	5	50	5
	Furniture, jewelry, toys, other	2	30	33	1	69	4

Note:

High
Upper-middle
Lower-middle
Low

Source: HIS Global Insight; OECD; ADM, 2010; US 2007; McKinsey Global Institute Analysis in (Mckinsey & Company, 2012)

This table suggests that, to identify the importance of energy consumption for the different types of industries, there should be differences among energies namely electricity or gas, the weight that energy has in total cost or in other ratios so to allow to quantify the importance of the energy cost for the competitiveness.

It is also important to note that the structure of the manufacturing cost has been changing not only in terms of the weight of energy over time, but also in terms of the services in the added valued.

TABLE 3. Change in the structure of acquisitions (%) from the manufacturing Industry

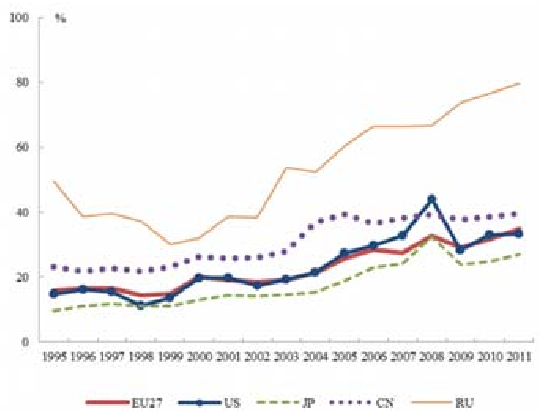
Year	Energy	Manufactures	Services
1980	16	61	23
1995	7	56	37
2005	10	48	42

Source: Own elaboration based on (Mas, M. et al, 2010)

The relative importance of energy costs in some subsectors of energy intensive industries is also a key element (European Commission, 2014). There are notable differences in cost in the different subsectors of the iron and steel industry from the manufacture of basic iron and steel and ferroalloys (C241) to the casting of iron, steel, light or non-ferrous metals (C2451, C2452, C2453, C2454).

To compare energy cost globally and evaluate the role of energy in competitiveness, it is necessary to examine the interaction among energy costs, energy prices and energy intensity, and to analyze the evolution of the real energy cost unit, which measures the amount of money spent on energy sources needed to obtain one unit of value added. The next graph shows the evolution of the real unit energy costs in the manufacturing sector from 1995-2011 as percentage of the value added.

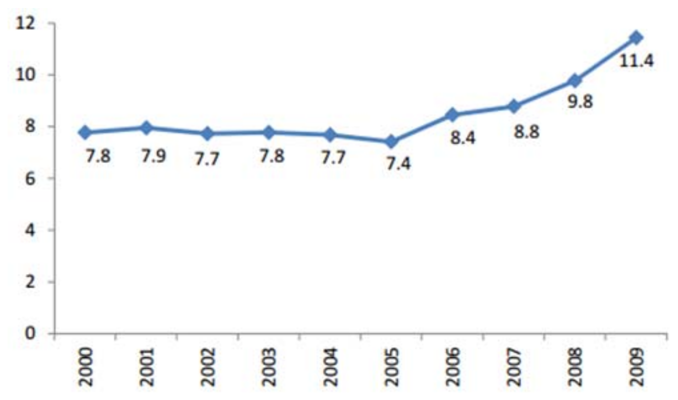
GRAPH 22. Evolution of real unit energy costs as % of value added, manufacturing sector (1995-2011)



Source: DG ECFIN, Energy Economic Development in Europe in (European Commission, 2014)

It can be seen that the EU manufacturing sector as a whole enjoyed some of the lowest real unit costs together with Japan and the USA and below China and Russia. But this figure related to manufacturing does not disclose the great differences in subsectors mentioned before. Going from the global to the local the following graph presents economic intensity of energy for the Basque Country.

GRAPH 23. The Evolution of economic intensity of energy (IEE) industry in the Basque Country: Energy expenditure/Industrial value added (cents of euro)

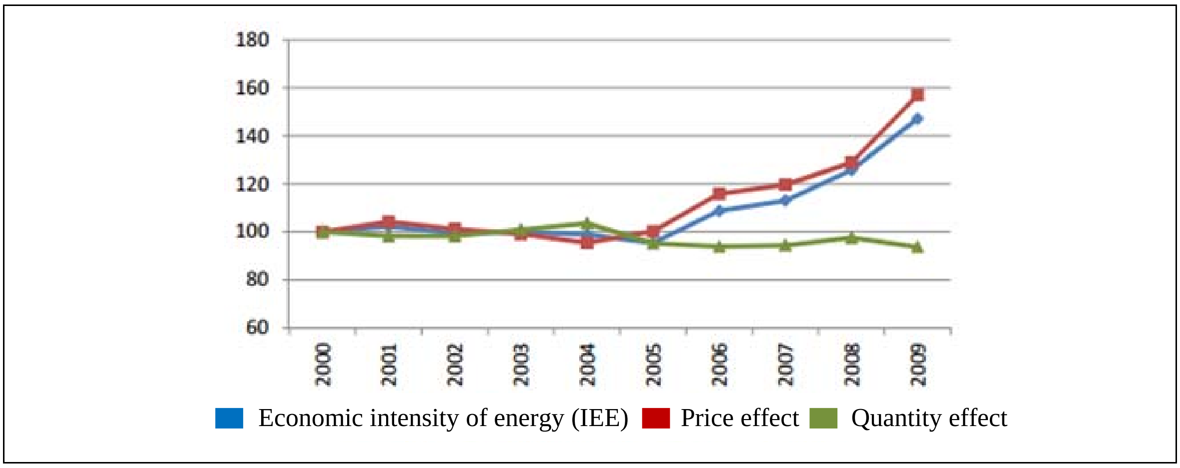


Source: (Diaz Mendoza; Arocena, 2012)

This evolution can be the consequence of an increase trend of energy prices, that in the Basque economy, rose from 360 €/toe in 2003 to 587 €/toe in 2009 (Diaz Mendoza; Arocena, 2012).

However, increases in energy prices could be mitigated by the improvement in energy efficiency, as it can be seen in the following figure, where the prevalent effect is that of the price increase. Then the final effect (blue line) is the result of the growth of energy prices that cannot be compensated by the improvement in energy efficiency.

GRAPH 24. Breakdown of the IEE in the Basque Country in its two main components. Cumulative change 2000-2009



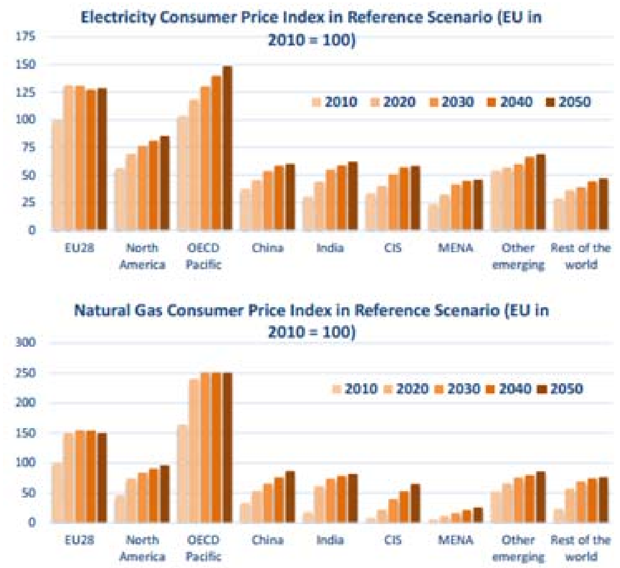
Source: (Diaz Mendoza; Arrocena, 2012)

5.3. Potential effects of energy prices increases

The European Commission has carried out an exercise of modeling for assessing the importance of energy prices in the European Union. This modeling assumes that international fossil fuel prices and electricity and natural gas prices should increase during the period 2010 to 2030[8], as it can be seen in the following graph.

[8] Oil: in 2010= 100, in 2015= 103, in 2020= 123 and in 2025= 145. (European Commission, 2014)
Gas: in 2010= 100, in 2015= 100, in 2020= 137 and in 2025= 168. (European Commission, 2014)

GRAPH 25. Electricity and gas consumer prices index projections in the reference scenario (based on PRIMES and PROMETHEUS models)



Source: (European Commission, 2014)

As it can be observed there are continuous differences in electricity and gas prices among the European Union, North America and countries such as China and India. So it is 'assumed' that the differences in energy prices are going to be maintained in the future.

The impact of loss of competitiveness on trade is significant for energy intensive products. The adverse effects are far more pronounced on energy intensive products which are more exposed to foreign trade, primarily on ferrous and non-ferrous metals, as the following table shows.

TABLE 4. Impacts on trade of energy intensive products in taxation case B21a (EU28)

EU28	% change of exports		% change of imports	
	2020	2050	2020	2050
Ferrous metals	-7.85	-9.05	6.42	7.49
Non ferrous metals	-5.75	-6.66	5.12	5.87
Chemical products	-1.96	-2.36	1.94	2.29
Paper products	-1.57	-1.81	1.37	1.56
Non metallic minerals	-0.81	-1.02	0.42	0.48
Entire economy	-0.22	-0.25	0.00	0.00

Source: GEM-E3 in (European Commission, 2014)

The European Union also considers scenarios of taxation of electricity and gas that increases gas prices and electricity ones. Besides that, another scenario considers higher prices for electricity, driven, in this case, by a generation mix not optimal with expensive investments in renewable energies that produces higher electricity prices.

The result of modeling these cases in energy intense industry is the decrease in the European production (1.43% in comparison with reference case).

TABLE 5. Impacts on production of energy-intensive industries (EU28)

(% change from reference cumulatively over 2015-2050)	Ferrous metals	Non ferrous metals	Chemical products	Paper products	Non metallic minerals
B21a-Taxation case	-2.69	-1.43	-0.97	-0.39	-0.61
B21b-Taxation case	-2.98	-1.73	-1.17	-0.59	-0.86
B22- Price mark-ups	-2.68	-1.42	-0.97	-0.44	-0.52
B24-Generation Mix	-1.34	-0.88	-0.67	-0.50	-0.41

Source: GEM-E3 in (European Commission, 2014)

Taking into account the historical prices and the projections for Europe, could it be possible to find policies to compensate or mitigate the increasing prices?

Let me give you my personal view of this issue. We should begin by recognizing that there is no way in which we can affect or influence international oil prices. However there are clear differences and margins among the whole shale gas prices in Europe, in UK and in the USA.

In this respect, the development of a gas hub, within the context of the development of the European gas target model, is an opportunity for the progress of gas-to-gas competition and for the improvement of the competitiveness of gas for Europe, for Iberia and for Spain. The initiative of the Iberian Gas Hub for the development of a gas hub in Iberia is therefore a positive one that should be supported.

6. SOME CONCLUSIONS AND SUGGESTIONS

In this section, let me finish with some conclusions and suggestions that, although do not fully reflect all the points dealt with in the paper, try to stress some relevant issues.

Recent growth in energy is lower than historical averages and lower than expected. Nevertheless energy demand will continue growing, as a consequence of the economic and population growth, and of the urbanization process.

Even if OECD countries remain the main energy consumers in the world, developing countries, among them India and China, will play a more important role, with considerable increases in energy demand.

Fossil fuels, especially oil and its derivatives will be important as well as coal that will keep on having a very significant role at worldwide level.

Natural gas and renewable energies lead the evolution towards a low carbon economy and will continue growing and increasing their share.

In electricity the development of some energy sources and technologies will depend much on the role that governments and markets have. Based on the relevant weight of the government or the market (Symphony or Jazz scenarios from the WEC), substantial different mix in technology will result as well as different costs of generation.

Flexibility and efficiency improvements will be key drivers in order to achieve costs reduction and better development of technologies.

Although there is a change in the focus of the European energy policy, energy efficiency, GHG emissions reduction and renewable energies still remain important, however including two old concepts, cost competitiveness and reindustrialization.

Therefore it is important to bear much in mind the concepts of 'competitive advantage', 'competitive in costs' and 'operational efficiency', which are essential. In this respect it is important to focus not only in energy efficiency but in decreasing energy costs. Some actual modeling forecasts that in Europe the trend should be for higher energy prices that could affect the competitiveness of the energy intensive industries and even the importance of these industries in Europe.

Gas prices are expected to remain high, as far as oil prices stay also high. As it has already been said, the role of gas in the energy mix will remain being important, increasing its share. The development of gas hubs, in particular the Iberian Gas Hub can be positive as it may improve competition.

Finally, in Spain, as far as electricity costs are concerned, there is a margin for improvement if costs concepts not strictly related to the electricity activities included in the tariff were moved away and supported by the correct policies; and if domestic consumers were urged to access to the electricity market.

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