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Energy, Utilities and Chemicals | the way we see it

European Union Climate Change Objectives

Point of View by Colette Lewiner

Contents

Introduction

In March 2007, the European Union Ministers asked Member States to commit to energy consumption and Green House Gases[1] (GHG), mainly CO_2 emissions, reductions of 20%, as well as a portion of 20% of renewable energies in their energy production. The horizon of this "three times 20% objective" is 2020. The underlying assumption is of course an improved security of energy (and electricity) supplies as well as a growing European economy with sustained tertiary and industrial employment.

These objectives were articulated to respond to the present Climate Change issues by avoiding an increase of our Planet's temperature beyond 2 to 3 degrees.

In the US, the current government has recognized that CO_2 is an issue and has begun to take action, issuing a number of executive orders to reduce emissions. This follows a ruling by the US Supreme Court on CO_2. It may be that what is happening in Europe will be a model that the US will follow.

These different objectives are interlinked and each European country is in a different situation. Moreover, 2020 is a relatively short time horizon compared to the lead time for construction of large plants such as nuclear plants. It is also a short time frame for the industrialization, at reasonable costs, of carbon sequestration equipments, for the renovation of a significant portion of the existing buildings and houses, and for the switch of the present car fleet to electrical cars. More than 20% of the cars bought in 2007 will still be on the road in 2020. More than 80% of the refrigerators bought in 2007 will still be in operation in 2020, and less than 1/3 of the industrial and utility infrastructures in place today will be renewed by 2020.

It is even shorter at the Research and Development time scale to find and industrialize new energy savings devices or low energy consumption and low carbon emitting equipments.

One important question is also the net cost linked to these objectives that has not been evaluated today. The measures that will be taken should not jeopardize EU's competitiveness compared to other regions of the world.

The purpose of this Point of View is to put these different interrelated issues into perspective in order to identify the main factors in this complex equation.

[16] To make this document easier to read we will refer to CO_2 emissions, generally encompassing all the GHG.

To avoid a deterioration of the EU member's electricity security of supply, the construction of new infrastructures has to be accelerated

Capgemini's European Energy Markets Observatory, 8th edition, has shown that the real generation capacity margin of the UCTE (Union for the Co-ordination of Transmission of Electricity) countries in Europe has decreased below the critical threshold of 5%. The main reason for this risky situation is the decrease of Utilities investments in generation plants from 2000 to 2004 linked to low electricity prices and to overcapacity.

During that period, old fossil fuel plants have also been mothballed in an attempt to restore higher prices. In 2005, Utilities have started to increase again their investments and have upgraded coal or fuel fired plants in order to meet the new environmental regulations and to put them back into operation.

We stressed in this Observatory the urgent need to invest, during the next 25 years, 700 billion euros in new power plants in order to:

Meet the electricity consumption increase

Electricity consumption increase in Europe was on an average of 2 to 3% per annum at the end of the nineties and the annual growth of the present decade is expected to be lower than 2% (France is forecasting 1.3%). In 2006 the need for electricity has increased by 1.4% in UCTE countries.[2] This covers contrasted situations: an increase of 2.5% in Spain[3] and a decrease of –0.8% in France[4] (mainly due to the large nuclear enrichment plant - Eurodif- lower consumption) and of –0.1% in the UK.[5]

This overall European increase results from the combination of domestic customer net increase (after taking into account energy conservation measures) and a more contrasted view for industrial activities that are sensitive to the economic situation, the delocalisation of heavy industries towards developing countries and of course to energy conservation measures. However, according to the 2006 EU green book, vigorous conservation measures resulting in 20% energy savings could offset this growth. In this case, the 2020 electricity consumption could be equal to the present one.

[2] UCTE, April 2007.

[3] World Nuclear Association (2007): Nuclear Power in Spain; May 2007.

[4] UCTE, April 2007.

[5] GNN (2007): Energy Statistics – Statistical Press Release; March 29th, 2007.

Replace aging plants

The power plants life time extension and capacity increase that are currently programmed or implemented by many Utilities will not be sufficient to meet the electricity requests. Programs for aging plants replacement have to be launched. The situation is particularly urgent for nuclear plants with long approval and construction lead time (8 years in average[6]) and very large investments (more than 3 billion euros for the new EPR 1,600 MW plant).

Only Finland and France have engaged in new nuclear programs by building a 3rd generation nuclear plant (EPR) each.

Other countries such as the UK are facing more urgent investment decisions as old technology nuclear plants (Magnox and AGR) have to be closed between 2009 and 2023 (see Figure 1). This is why the British government stated in a recent white paper, that there is a need to build between 25 and 30 GW of new electricity plants in the next two decades, equivalent to about one third of the existing capacity. This situation, combined with the fact that the UK has become a net gas importer, explains why the UK is taking the decision of re-launching a nuclear program.

Figure 1 Active Nuclear Plants in the UK (2006)

Source: Figaro / Nuclear Industry Association

[6] EDF (2007): EPR Project Flamanville 3.

Match the "peak load" demand

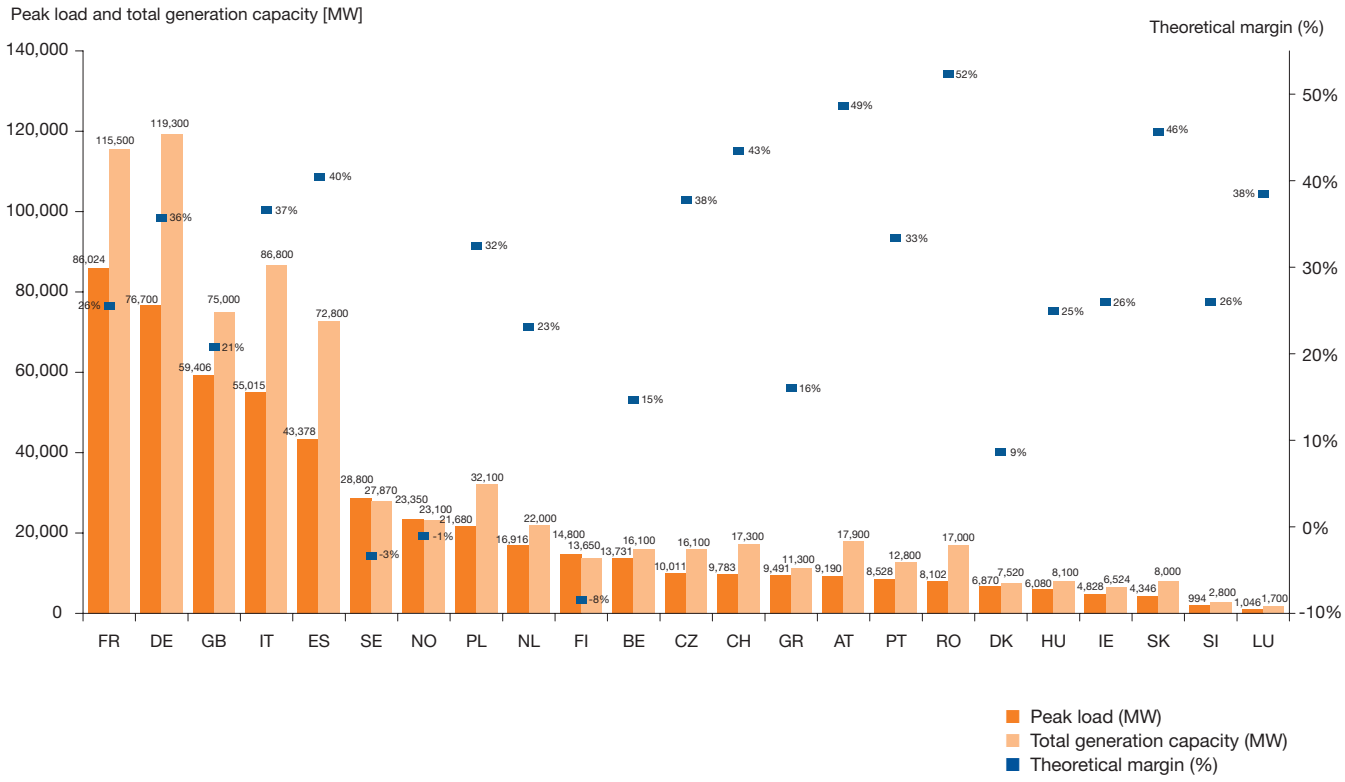
Exceptional climate events are increasing the electricity needed during peak loads (as shown in the following Figure 2). Moreover, in very hot summers constraints on river temperature increases are limiting the output of nuclear plants with open cooling systems situated on rivers. This contributes to make the problem even more acute.

In France there is a need to invest in peak load plants and in extreme peak load plants (that are programmed to operate only a few hours a year). As for 2009, RTE has estimated that 800 MW of new generation capacity per year has to be connected to the grid.[7]

Only gas fired plants having a relatively low investment cost are economically viable. However these plants have a high and volatile fuel cost, are CO_2 emitters and are contributing to increasing our dependence on Russian imported gas.

A better solution avoiding at least partially these investments and the related gas importations and CO_2 emissions, would be to give incentives to the end customers to reduce their consumption during these hours in order to "shave" the peak. (See following paragraphs).

Figure 2 Peak load, generation capacity and theoretical margin (2005)



Source: UCTE, Nordel, National Grid, EirGrid

[7] RTE France: The electricity supply - demand balance in France, RTE's generation adequation report 2005 edition; October 2005.

Increase the generation capacity

Restart mothballed plants: Following the 2003 blackouts, Italy has engaged into a dynamic program to repower its old plants (often fuel oil fired) and convert them to coal or gas. The new capacity amounts to 7,750 MW.[8] Part of it is now operational and part should be connected to the grid this or the following year. In France (Cordemais), a mothballed coal plant has been reopened in 2007. Others could follow as these mothballed plants and their sites are interesting many small generators who are pushing the Authorities to auction them in order to allow competition on reshuffling them and/or on reusing the sites to build new ones.

Nuclear plants life time extension and uprating: In many European countries, nuclear plants life times designed initially for 25 years have been extended to 40 years and extension to 60 years is underway. Operators are also investing in uprating their plants in order to increase their output. These investments usually have a very good return on investment.

Figure 3 shows the planned and potential results of nuclear power up-rating and lifetime extension programs in selected European countries. In comparison the German "Atomkonsens" legislation based on a nuclear phase-out after an operational time of 32 years is

Figure 3 Planned and potential results of power uprating and Plant Lifetime extension programs for LTO in selected countries

Country	Capacity Uprating	LTO
Belgium	Yes	Phase-out policy
Czech Republic	Planned	Planned to 40 years, potentially to 60 years (4 units)
Finland	Capacity increase of 18 MWe completed in 2005 for Olkiluoto unit 2, completed in 2006 for Olkiluoto unit 1	Planned lifetime of 60 years for units 1 and 2, and for unit 3 (EPR) at Olkiluoto planned lifetime for Loviisa (2 units) raised to 50 years
France	No	Lifetime of 40 to 60 years (58 units)
Germany	Yes	Phase-out policy
Hungary	Under way for 4 units, capacity increase of up to 150 MWe	Planned to 50 years (4 units)
Slovenia	Yes	Lifetime of 40 to 60 years
Slovak Republic	Under way for 4 units, capacity increase of up to 220 MWe	Planned to 40 years, potentially to 60 years (4 units)
Spain	Completed for 8 units, capacity increase of up to 220 MWe	Planned, possibly to 60 years (8 units)
Sweden	Under Way for 8 units, capacity increase up to 1,296 MWe	Planned, up to 60 years or more (8 units)
Switzerland	Yes	Lifetime of 40 to 60 years
United Kingdom	No	Planned to 35 years (5 plants) or 30 years (2 plants), further extension possible

Source: Nuclear Energy Agency, Newsletter No. 24.2; 2006: P. Kovacs: "Impacts of Nuclear Power Plant Life Management and long term operation".

[8] Platts: PiE's power plant project tracker (May 2007).

preventing life time extension. Utilities are even conflicting with the regulators on transfer of lifetime production from one plant to another. A good illustration is the recent conflict of EnBW with the Authorities on an application to transfer lifetime production rights from Neckarwestheim-2 to Neckarwestheim-1. The Utility was obviously hoping that when the closure time of Neckarwestheim-2 would arrive it would be such an absurd decision to close a recent reactor that it would not happen and also perhaps that, by that time, the German law would have changed.

Encourage investment: In 2005, Utilities restarted investment (see Figure 4). In 2006, we saw an acceleration of investment announcements. In France for example, EDF, the historical operator, has committed to put into operations 5,000 MW of new capacity (1/3 nuclear and 2/3 fossil fuel) and the new entrants should add a capacity of 8,000 MW (mainly fossil fuels).

This example is a good illustration of the situation in Europe where new investments are mainly in gas or coal fired plants with some in wind mills. While good for the security of supply, these investments do not obviously go in the direction of the CO_2 reduction objective.

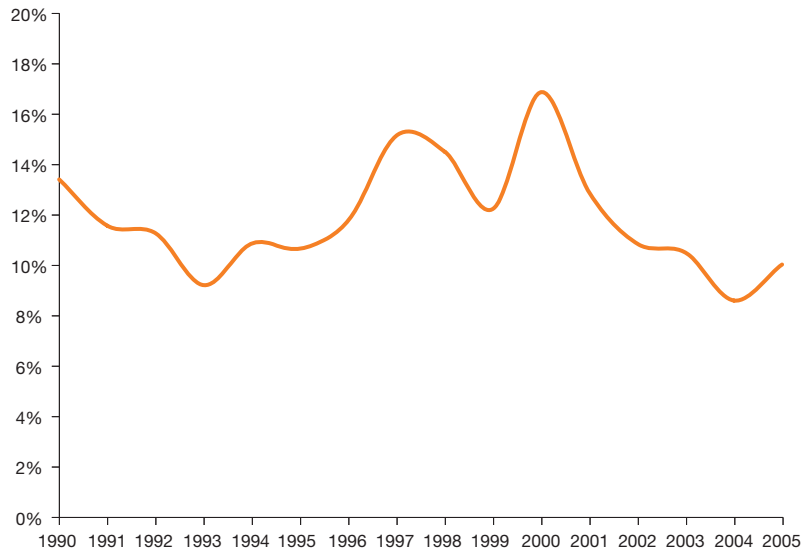
The investment risks for the Utilities have been increased with deregulation notably through the volatility of demand linked to customer switches and to the volatility of prices linked to wholesale markets instead of tariffs. Also, the public request for more information and the opposition to new infrastructures have significantly increased the construction time (the nuclear plants construction time has nearly doubled in 20 years!).

In order to encourage new investments by decreasing the related risks, Governments and the EU should create long term stable legislative and regulatory plans. These plans should include:

- An agreement on a "post- Kyoto" long term scheme for CO_2 emissions reductions as well as on the mechanisms to implement them. At minimum, the Emission Trading Scheme (ETS) should be modified and CO_2 rights allocation (National Allocation Plans) rules should be clearer and more consistent with the overall objectives. This framework would allow utilities to compare the return on investment of each type of generation plant, to define their own energy-mix and to build new profitable plants.
- A simplified set of administrative and regulatory measures for design and site approvals in order to shorten the lead time between construction and operations and to decrease the related financial risks.

Let us now look at what additional measures to these investments could help to re-establish a secure electricity supply in Europe and make it possible to follow the recent EU recommendations.

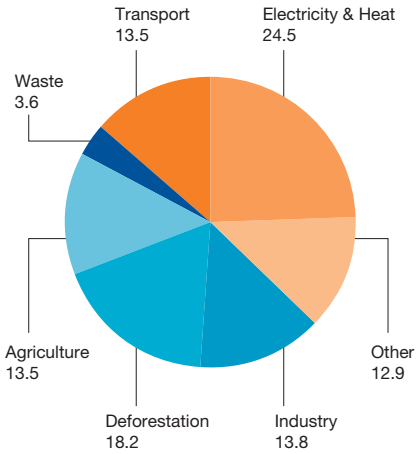
Figure 4 Main utilities investments in % of their revenue (1990 – 2005)



Source: SG Equity Research / Capgemini

Energy conservation is a key factor to improve security of supply and to reduce CO_2 emissions

Figure 5 **Something to work on**
World greenhouse-gas emissions by sector 2000, %



Source: World Resources Institute

The European Union has asked its member states to reduce their energy demand by 20% in 2020 compared to the present forecasts (as described in the EU 2006 Green book). These forecasts already include energy savings that have amounted to 0.9% per annum over the past 10 years. This comparison shows how ambitious this new EU recommendation is as the 20% savings have to come **in addition** to the present projections.

For the first time, energy conservation will have to outstrip growth in demand. A 20% reduction on today's consumption will require a reduction of more than 37% off the current trend for electricity consumption (annual average projected rise is 1.2% for the EU) by 2020. Thus before reversing this trend, we have first to stop it.

The portion of electricity in the final energy consumption varies from one country to another from 23% in France to 12 % in Luxemburg and 50% in Norway.[9] In France, transportation accounts for roughly the same amount (27%) as electricity.

Our analysis shows that electricity is a key vector for energy conservation because equipments are easy to regulate, they benefit from improvements in electronics as well as other innovations. However, efforts need to be done in other sectors such as transportation by decreasing the car's weight and hence the individual consumption and by taking advantage of new possibilities of working remotely offered by internet.

Moreover, transportation uses imported oil, thus contributing to Europe's vulnerability to foreign producers, and it is a big CO_2 emitter.

To reach this 20% reduction in energy consumption, strong action plans need to be launched both at the EU and at country levels. They should include:

- Regulatory measures that could be combined with trading mechanisms,
- Public information campaigns and rewarding mechanisms for energy conscious individuals or institutions,
- R&D and innovation funding followed by regulations to accelerate the usage of new energy technologies and devices.

Let us give some examples:

Regulatory measures

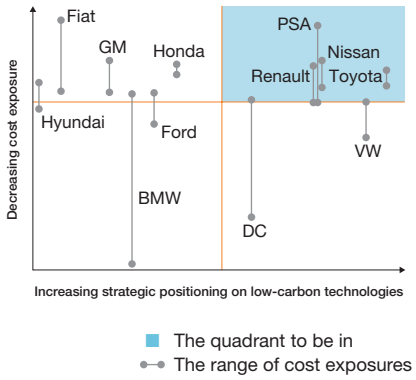
Rules should be taken on the energy and CO_2 "content" of certain equipments. These rules could be made compulsory for equipment manufactured inside the Union. In order to not penalize the European manufacturers some politicians are suggesting a related importation tax for foreign products.

Reinforced insulation norms should be made compulsory for new houses and buildings as well as for their refurbishment and should be assessed in any sales transaction.

The CO_2 emission reduction is a highly strategic question and governments and the EU have to show a strong will to overcome national/sectorial interests.

[9] Eurostat : Energy and Electricity Consumption (as to 2005).

Figure 6 How car companies fare in a cleaner-energy future



Source: WRI and SAM Research

White certificates have been imposed in UK and France. Each year, Utilities have to acquire a certain amount of these certificates relating to the end customers electricity savings that Utilities have initiated and are accountable for. This mechanism could be expanded across all EU countries. These certificates could even become tradable (as for CO_2 Emission Right).

Moreover a similar mechanism could be thought of for CO_2 savings achieved by end customers (this will be discussed later).

Public information and rewarding mechanisms

It is extremely important to give the customers the right price signals and reward them for their energy conservation behaviour. In recent years, the energy consumption elasticity to prices has increased. For example, a survey showed recently that 45 percent of European consumers use their vehicle less because of rising fuel prices.[10]

One important point is to let Utilities set prices that reflect the supply and demand situation. This implies eliminating artificial tariffs that are, at the end of the day, managed by country governments attentive to political considerations.

For countries that have tariffs for certain segments of customers, there is probably a need for a transition period and also a need to protect the poorer citizens against sudden price increases.

The French December 2006 Energy law, which allows for a return to tariffs for eligible customers that had chosen market base prices, is the result of compromises that politicians are sometimes pushed to.

The end game is to have customers aware of the present energy situation and to give them the right tools and incentives to enable them to contribute to the energy conservation objectives.

In countries such as Sweden and in certain parts of North America (e.g. Ontario and California) the legislator has imposed that all meters be replaced by smart meters. This new generation of meters allows the end customer to access their hourly consumption load curve and enables them to have a proactive energy saving attitude. Smart meters also enable Utilities to offer prices that give incentives for consumption decrease, particularly during peak hours and thus contribute both to the energy savings and CO_2 savings objectives as peak hour electricity is generated with fossil fuelled plants. The related investments are important (3 to 4 billion euros for 30 million meters replacement in France) and should be rewarded appropriately by the electricity network regulator. In addition, remote management of devices in the home enabled by smart meters is well accepted by customers and has led to tangible results in North America (e.g. Florida Power & Light).

[10] AC Nielsen (February 2007)

With such tools, the customers should progressively become smart energy users. Some may invest in decentralized energy production equipment to generate part of their electricity requirement. It is clear that the customer care and billing information systems have to change in order to make these evolutions possible.

Let us also stress that at the 2020 horizon it is possible to convert a large portion of meters to smart meters whereas it is highly improbable that many new nuclear plant or large clean generation plants could be completed.

R&D and innovation funding to discover or industrialize new energy saving processes (in the chemical industry for example) or devices

When these new devices are at maturity stage, the legislator should enact appropriate legislation to boost their deployment. Progress has been made in smart metering functionalities and their manufacturing costs have sharply decreased. It is time now to deploy them on a massive scale.

Heat pump and air conditioner efficiency have increased and their manufacturing cost has decreased. Combined Heat and Power units offer efficiencies of more than 90%, but are too expensive a capital investment today for most residential and professional users. Again incentives to boost the deployment of efficient devices should be given.

As another example, the electronic industry is making a significant effort to reduce the energy consumption of their chips. IBM is launching a family of processors that have double the speed compared to the previous generation while using the same amount of energy. Some computing companies have reported 80% energy savings after consolidating applications run in different data centres onto a "virtual" machine. In addition, major computer companies have created a green computing alliance in order to launch energy and CO_2 saving measures, even if the electricity consumption of these devices represents only a few percents of the total electricity consumption.

Light Emitting Diodes (LED) have reached the industrial level, have a long life time and allow a reduction in electricity consumption in the order of 85% as compared to incandescent lighting bubbles. Their performance should increase and their price decrease as typical in this industry. Today the low consuming fluorescent (or gas discharge) lamps already allow 80% savings but are expensive because of their high voltage gas discharge based technology.

The extended usage of these new devices would decrease electricity consumption for lightening, from around 19%[11] of the total electricity consumption, to around 2%. For a country like France, where lightening accounts only for around 10% of electricity demand, this would still

represent a savings of 50 TWh per year, equivalent to the output of 5 nuclear reactors. It is realistic to believe that around one third of these savings could be reached in 2020.

Moreover, thanks to their long life time, LEDs should rapidly be used in automobiles, thus decreasing their energy requirements (more miles per gallon).

Appropriate legislation could accelerate first the deployment of fluorescent lamps and then LEDs.

All these measures need to be implemented. However, the observed energy consumption trend shows that the EU objectives are still very ambitious. As an example, in Ottawa (Ontario), the annual reduction of consumption from monitoring the energy consumption of home and office devices with smart meters was only 0.41%. We are looking for more than 2% reduction per year.

[11] United Press International / International Energy Agency, June 2006; http://www.terradaily.com/reports/First_Global_Lighting_Study_Is_Released_999.html

The CO_2 emission reduction will benefit from the energy conservation achievements, however specific actions including the population mobilization, are needed to meet the European objective

The new European objective is to decrease the CO_2 emissions by 20% in 2020 compared to 1990, whereas the Kyoto protocol intended to limit in 2012 these emissions to 90% of the 1990 emissions. The new objective is set in order to control the planet's temperature increase and limit it to 2 to 3 degrees maximum.

According to the EU green book, compliance with the Kyoto Protocol is already difficult (as shown in Figure 7) and projections show that it could not be achieved without the CDM (Clean Development Mechanisms) that allow EU member states to benefit from CO_2 reductions linked to projects implemented in countries outside the EU.

This is to say that a lot has to be done to reach the new, tougher objectives. It is regrettable that the relevant industry sectors for the 2008-2012 period were not extended to the transportation sector or even part of it (as aviation) which are heavy CO_2 emitters. In France, this sector represents 26% of the total CO_2 emissions with a 22% growth since 1990. CO_2 emission reductions will come from:

- Modification of the primary energy mix,
- Better optimization of the CO_2 free nuclear plants fleet through Europe,
- Improvement of the present CO_2 Emission Rights Trading System,
- Organisation of the end users' CO_2 market and
- Energy conservation results. The latter point has been covered in the former paragraph.

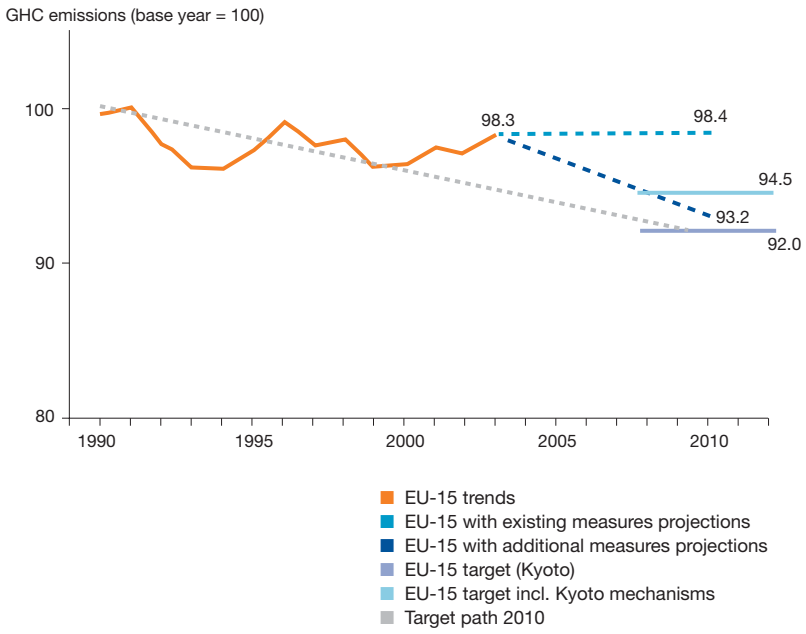
Modification of the primary energy mix

Utilities need to rethink their energy-mix policy. Two approaches can be combined:

- Reduction of the CO_2 content of the primary energy mix,
- CO_2 elimination or storage. Thanks to higher efficiencies, the so-called "clean coal" plants are emitting less CO_2 per kWh produced but are NOT providing carbon free generation. They would need to be combined with CO_2 sequestration equipments. Today, the latter technology is not proven and one cannot expect it to be implemented at industrial stage before 2020. Thus the only viable approach is to minimize the construction and usage of gas and coal fired plants. This represents a big change to the present utilities generation policy.

During recent years 46,530 MW of gas fired plants and 3,550 MW of coal plants have been agreed and are under construction in Europe. An equivalent volume is planned and even more is being considered.[12] This is clearly adding to future CO_2 emissions and is leading to a stronger dependency on gas importation especially from Russia. Today Russia is providing 25% of the EU gas needs and its share should increase to 50% in

Figure 7 European CO_2 emissions



Source: DGTREN, Green Paper, March 2006

[12] Platts: PiE's power plant project tracker (May 2007).

2030. Contrary to previous periods, the Russian government is developing a nationalistic approach for its oil and gas assets and is using Gazprom as a political instrument. In these conditions this high dependency could become a real threat for the European Union.

Taking into account the above facts, free carbon generation is certainly a better option. Renewable energies contribute to carbon free generation and their characteristics are discussed in the following section.

Let us look at nuclear energy which allows carbon free generation but is not classified as a renewable energy source. It is an option that has to be considered even if at the 2020 horizon it would have little impact due to the long decision and construction lead time. It is the only carbon free source of energy that can generate significant amounts of schedulable energy. In the EU the old nuclear plant and the Soviet designed plants are being decommissioned and one can say that the nuclear fleet is operated safely.

Countries are taking the right steps to implement policies for the long life time storage of radioactive waste with two solutions:

- Reprocessing of used fuels allowing to separate fissile materials that are recycled and high radioactive wastes that are vitrified,
- Direct storage of used fuel in appropriate geological sites.

Uranium is abundant; the only question today is to reopen mines quickly enough to face the needs linked to the end of the Soviet cold war stock piles that were traded on the market and also to provide fuel for the new plants under construction or planned. Moreover, when nuclear fuel is reprocessed, it allows uranium and plutonium recycling (MOX fuel) thus saving fresh uranium. On the longer term, fast breeder nuclear reactors would decrease the need for fresh Uranium by a factor 100.

Countries such as Finland and France have taken the decision of building a third generation nuclear plant (EPR) and construction has started at Olkiluoto (Finland) and Flamanville (France). Many others – such as Slovakia, Lithuania, Latvia and Estonia – are seriously considering the construction of new plants.

In the UK there is a need to replace the aging plants (Figure 1). Although it used to be a net exporter of gas, in 2004 it became a net importer making gas a less viable fuel.[13] This explains why the vibrant debate that has been taking place over the last two years recently led to a green light for new nuclear plants construction.

The situation is blocked in Sweden and Germany for political agreements within the governing coalitions.

In the world, 40 reactors are under construction and 74 are planned (mainly in Asia) and we are witnessing a "nuclear renaissance" movement in North America.[14]

In the case of carbon free generation, substitution of fossil fuels for electricity usage helps reduce CO_2 emissions and should be pushed.

Establish a fluid pan-European electricity market

This would allow a better optimization of the existing power plant fleet operations and thus generate extra carbon free generation. For example, in certain periods of the year, French nuclear plants are lowering their output in order to follow the consumption requests. More fluid electricity exchanges within the European grid would allow exporting this extra electricity. This would provide around 70 TWh extra free carbon electricity for the neighbouring countries.

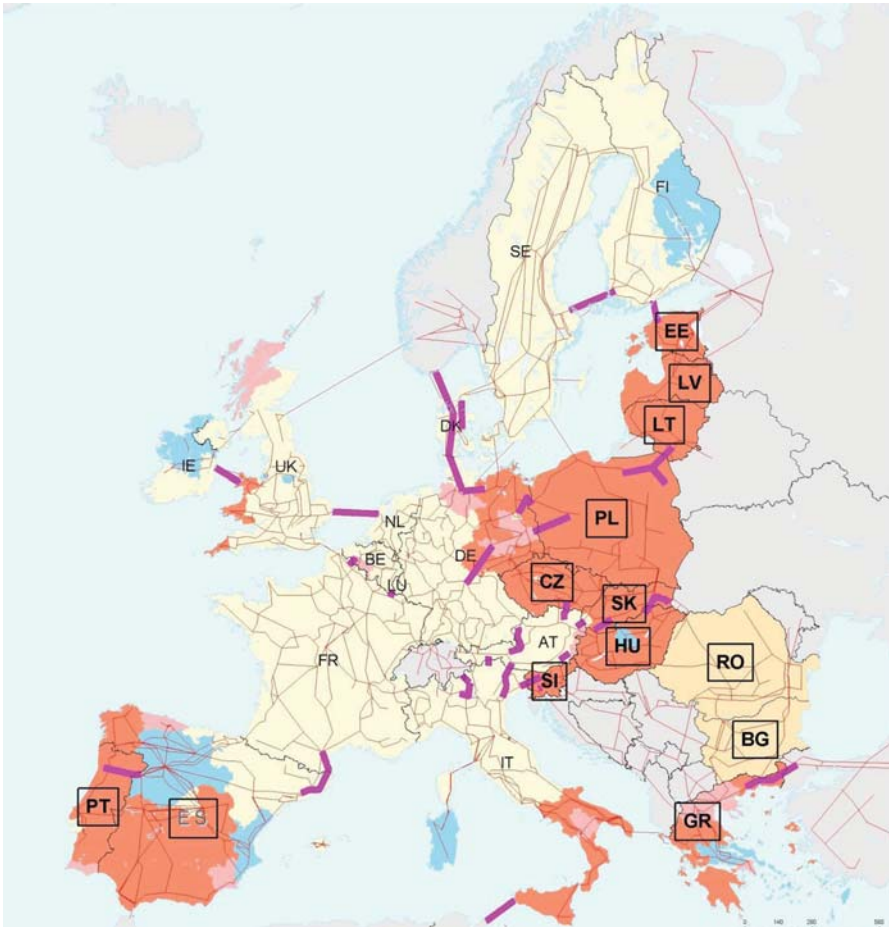
The original European transmission grid was the juxtaposition of national (or regional) grids with some interconnections used to exchange marginal electricity flows. It is evolving towards a real European grid with increased physical exchanges, decreased congestion points and better alignment on wholesale prices at least in certain regions (such as Nordic countries, Continental Europe and Iberia). However, a lot needs to be done to get to a real fluid pan-European grid.

[13] A. Kemp/ L. Stephen (2005); University of Aberdeen.

[14] World Nuclear Organisation, May 2006.

- Develop interconnections: In its January 2007 energy package, the EU identified priority interconnections (Figure 8) and suggested measures to accelerate their construction. Among them, the most controversial one is unbundling. Indeed for the Commission there should be a conflict of interest between the TSOs and their vertically integrated mother company, preventing them to invest in interconnection lines. This assertive point of view is generally not shared by the Utilities that see no real proof. This is why the Commission has decided to launch a comprehensive study before elaborating a new directive.
- There is a consensus however that the increased risks of these projects linked to their long lead time and their unclear return on investment are one of the main blocking factors. At the European level, regulatory measures, similar to the priority corridors adopted in the US Energy Bill act, need to be taken.
- Beyond the physical links, market coupling (Figure 9) initiatives are contributing to a pan-European market implementation. Belpex (Powernext, APX and BelPex) was formed at the end of 2006. The future electrical connection between Norway and the Netherlands will open the opportunity for an extension to Nord Pool by early 2008. An extension to EEX (Germany) is under discussions and would be a key driver for the creation of an electricity market in Continental Europe.

Figure 8 Electricity interconnection projects in Europe



Source: Energy Packages, European Commission, January 2007

Improvement of the CO_2 present Emission Rights Trading System

Figure 10 shows that in the first period, National Allocation Plans were too generous as many countries have not used all their Emission Rights quotas while the overall Kyoto protocol commitments are very difficult to reach. NAPs II are more restrictive; however there is no guarantee that they will be sufficient to meet the Kyoto protocol criteria.

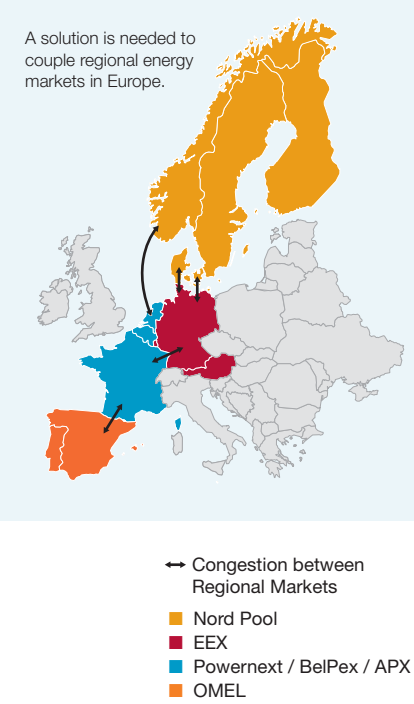
In May 2006, when the real 2005 emissions for the different EU Countries were reported, the traded Carbon price dropped from more than 30 Euros per ton to around 10 (Figure 11). These reports showed that countries did not use all of their allocations and that there would be an excess of Emission Rights on the markets, hence the drop in prices.

The existing mechanisms are such that the Operators are not allowed to carry their excess of Emission Rights forward beyond the end of the first allocation period (2007). This explains why the spot price is today extremely low (around 0.50 euros per ton) and does not provide incentives for Utilities to switch their energy mix towards less carbon intensive generation.

There is a clear need to rethink the mechanisms by:

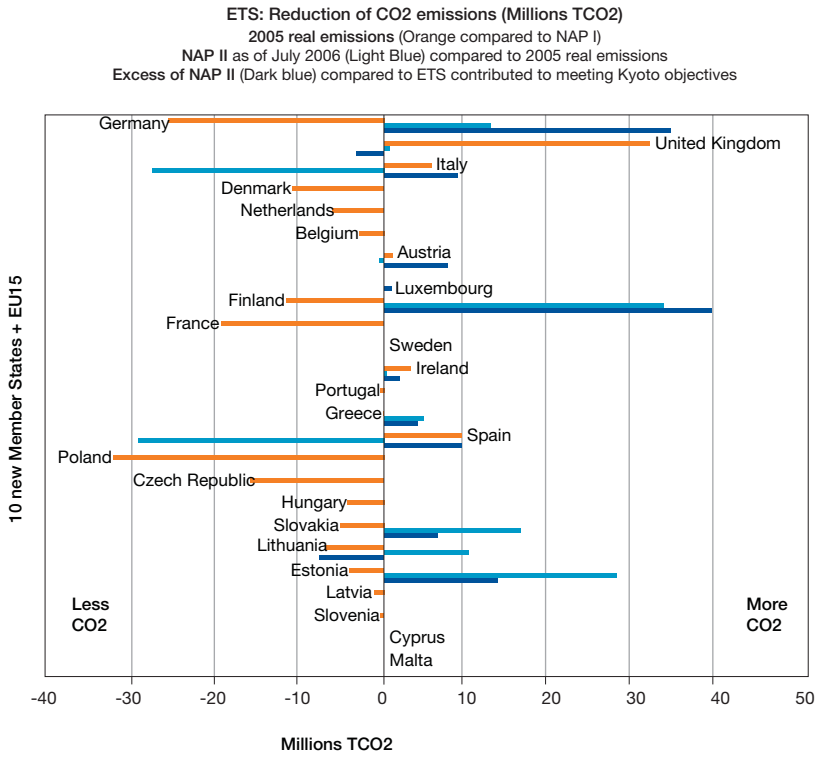
- Allowing the certificates to be carried forward from one period to another,
- Establishing clear and coherent rules for the NAP quotas allocations. Above a certain threshold these quotas could also be auctioned,
- Better qualifying the projects entering into the Clean Development Mechanism to be sure that these projects would not have been done anyway,
- Extending the Kyoto protocol obligations and mechanisms beyond 2012 to give a better visibility for Utilities investing in large and long term generation plants,

Figure 9 Coupling of the European energy markets



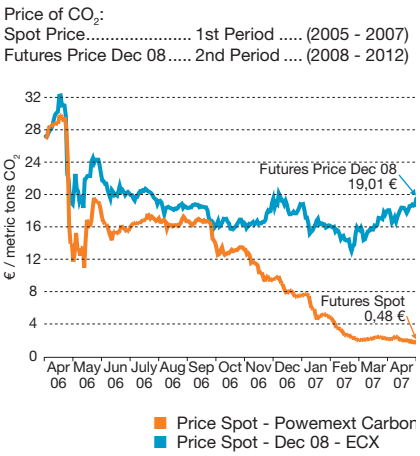
Source: E.ON: Market Coupling Status Quo; January 2007

Figure 10 Country positions regarding ETS



Source: DGTREN: Further guidance on allocation plans (December 2005), Platts, Pointcarbon, Capgemini analysis

Figure 11 Carbon spot and futures prices (April 2006 – April 2007)



Source: Powernext (2007)

- Extending the Kyoto protocol obligations to the transportation sector (13.5% of total emissions) or at least to the air carriers,
- Finally considering a tax substitution to this market mechanism. This would avoid excessive volatility or unduly high quotas prices that are disrupting the economy severely. A tax is certainly more predictable. However in order not to increase European prices compared to foreign prices and thus decrease the EU zone competitiveness, this tax should be offset by other tax reductions. The money collected should be dedicated to energy and CO_2 emission saving projects helping the EU to attain its very challenging objectives.

Organisation of the end users' CO_2 market

CO_2 emissions from the transportation sector have to be reduced. This is why the EU March summit, chaired by Angela Merkel, proposed to reduce the CO_2 emissions to 130 g/km by 2012 and raise the mandatory use of biofuels in cars from 10% to 12.5 %.[15] German car manufacturers, which have a big portion of large cars in their portfolio, reacted very negatively.

Companies are engaging in Corporate Social Responsibility (CSR) initiatives which usually include energy conservation and CO_2 savings. For example the French Postal office recently decided to order 500 electrical cars and to convert further its fleet if this first experience is positive.

Deciding to go "carbon neutral" in late 2004 was a pioneering step for HSBC. First the bank would cut its greenhouse gas output and then offset the rest by funding emission reductions elsewhere such as buying better cooking stoves for remote settlements in Africa. Since then, many companies have decided to go carbon neutral.

Other companies, such as Citigroup, are combining "good citizenship" behaviour with good business. This bank recently announced that it will direct $50bn over 10 years to address global climate change by supporting the commercialization and growth of alternative energy and clean technology. This shows that sustained clean growth could perhaps become a reality.

In the first nine months of 2006 up to $22bn of carbon emissions was traded, about $18bn of this was through the EU's emission trading scheme and $3bn through other Kyoto mechanisms. The third element is the voluntary market, where most offsets are bought. This unregulated market could grow by 2010 to be worth $1bn and help significantly to achieve the CO_2 emission reduction objectives. However, it has to be regulated in order to avoid:

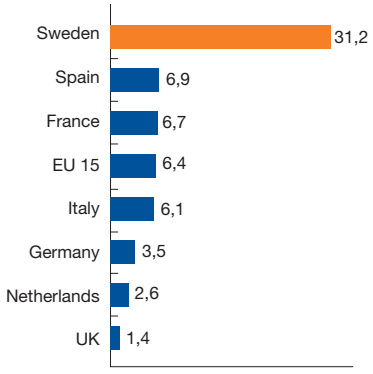
- Fraud such as sale of credits from carbon reduction mechanisms that do not exist,
- Funding carbon reductions that could have happened anyway and
- Companies selling the same credits several times.

There are effective systems in UK and France, to organise the energy savings market through the White Certificates system. This makes Utilities accountable for energy savings implemented by their own clients and forces them to "acquire" a certain amount of those energy savings certificates each year. A system similar to the White Certificates mechanism described above could be applicable to CO_2 savings. Utilities would then become the end users "trustees" regarding their CO_2 emissions offset.

[15] EU 2007 : Policy Statement by Federal Chancellor Angela Merkel in the German Bundestag Thursday, 1 March 2007; http://www.eu2007.de

Renewable Energies

Figure 12 Proportion of renewable energy in selected European countries



Source: Eurostat

Their percentage in end consumption will result partially from the previous measures however lets have a look at their potential.

Their share of the primary energy (including hydropower) varies from one country to another (Figure 12). At the EU level, in 2006 it was 6.5%[16] and their share of electricity generation was 14.5%. The previous objectives of respectively 12% and 22% in 2010 already seem difficult to achieve. This shows that having renewable energies contributing to 20% of the total energy consumption in 2020 is a very ambitious objective.

Renewable energies allow carbon free electricity generation which is a great advantage.

- **Nuclear** energy is a massive carbon free generation source and with the development of fast breed reactors (that create more fissile matter than they burn) could be considered as renewable energy. It is not today classified as such as this technology is not widely spread and also for political reasons.
- The first source of renewable energy is **hydropower**. It has a further increase potential of 30% in the EU15 countries and more in the EU27 countries. For example, to comply with the EU 2020 objectives it is necessary in France to increase the hydropower generation output from 67 TWh to 97 TWh (+30%) which is probably doable.

  Hydropower is also the only significant carbon free peak load generation option. Moreover its development will become indispensable as an energy reserve source to complement wind mill intermittent output (see below) and enable sustained grid management.

In this context, the renewable energies to consider are wind power, solar energy and biomass.

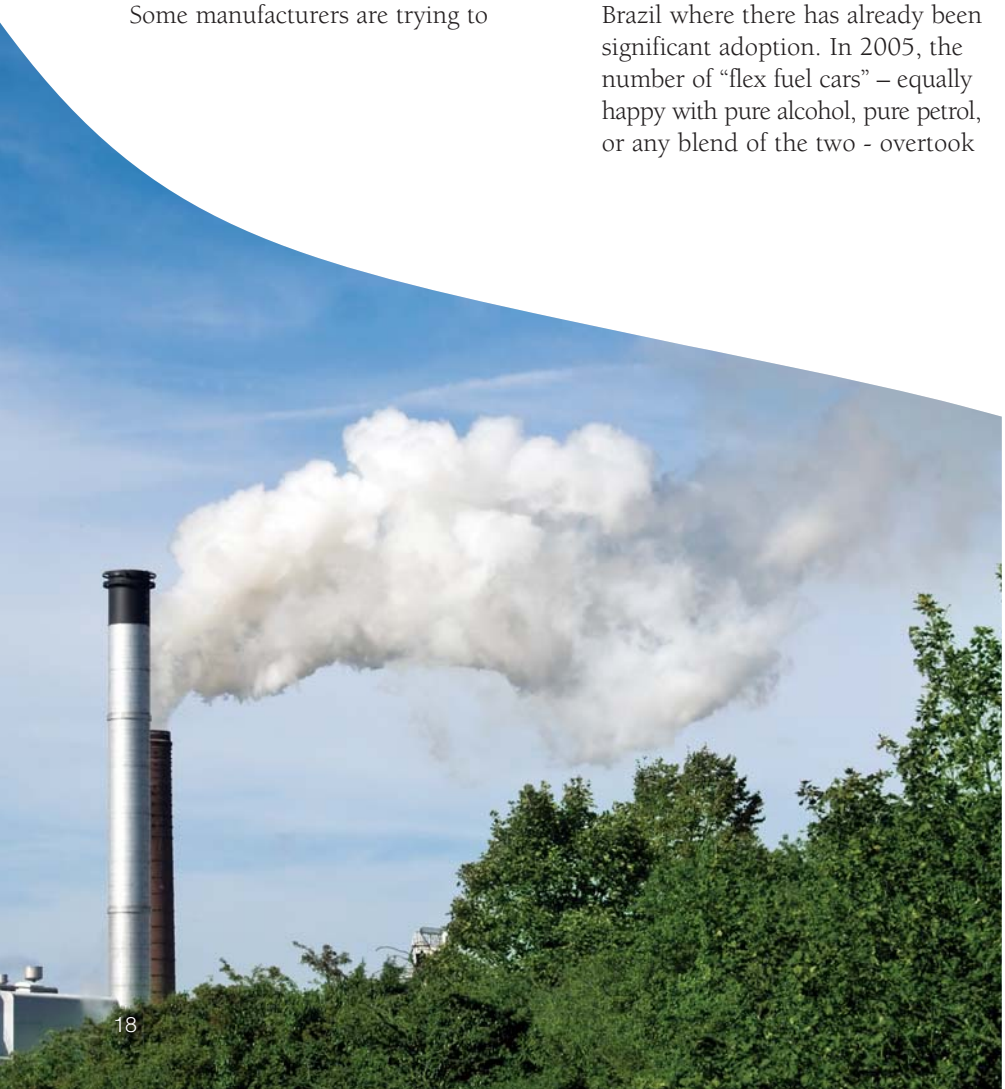
- **Wind** power is the energy that is developing fast and many Utilities have significant investments plans. In Europe, a capacity of over 40,000 MW is already installed. Wind mill manufacturing companies are in high demand and their prices are reaching heights reminiscent of the internet bubble. However, wind mills construction is encountering local opposition (which can be solved by off-shoring the wind mills at higher cost). It is also an intermittent source of energy creating difficulties for the electrical grids management in power quality and loading. To be useful it has to have backup generation. As long as their share of the total generation stays modest it can benefit from the existing reserve capacity. However when this wind power share becomes significant, a specific backup is needed, most often with diesel motors which use fuel-oil, a CO_2 emitter. With the exception of hydropower (which is already a competitive energy source), wind is the closest renewable source to become economically viable without subsidies from governments (and at the end of the day customers). But it is not there yet. Research work is being done on windmills that operate in a wider range of wind conditions and other technology improvements

[16] Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (February 2007).

are expected. Also manufacturing in low cost countries should make this energy source more attractive. However no major technology breakthrough is foreseen.

- The use of **solar** thermal panels on roofs of houses and other buildings for hot water and space heating should be strongly encouraged by adequate legislation. Of course the return on investment of this equipment is strongly dependent on the number of sunny days. Photovoltaic solar energy is particularly promising if technology breakthrough would allow a reduction in the cost of manufacturing photovoltaic cells. Some manufacturers are trying to use low cost technologies such as ink jets to make it cheaper. Again this source is intermittent and unreliable. The efficiency of photovoltaic cells is improving, as a consequence of efforts made in the spatial industry. Using Gallium Arsenide semiconductor matrix instead of Silicon allows an improvement in efficiency – up to 40% has been reported as compared to the 15% usually observed. R&D and innovation funds could accelerate the industrialization of such devices that permit the generation carbon free electricity.
- **Biomass and biofuels** are certainly well-adapted for countries such as Brazil where there has already been significant adoption. In 2005, the number of "flex fuel cars" – equally happy with pure alcohol, pure petrol, or any blend of the two - overtook petrol-driven models taking 53.6% of the market for new cars. In Europe it is more questionable to use fields that are producing food for biomass production. There is much less water than in countries as Brazil and a much higher man-hour cost. The downside in Brazil has been the clearing of the rainforest for ethanol production.

Reaching this 20% share of renewable energies is a big industrial and financial challenge. The required investments amount to 18 billion euros per year but this would also boost Research and Development and new "clean" technologies.



Conclusion

The EU recommendations are aimed at building a road map to avoid the disastrous consequences of Climate Change. The situation in each European country is different however the detailed objectives seem very ambitious:

- Energy conservation aimed at a reduction of 20% refers to scenarios where voluntary savings measures were already included.
- As for CO_2 Emission reduction, the Kyoto objectives (10% reduction in 2012) are already difficult to meet so a 20% in 2020 is really a very ambitious target.
- The renewable energies target of 20% is also tough. These energies today represent only 6.6% of the EU energy consumption, hydropower opportunities are saturated in Europe and new nuclear plants are not included is this objective.

We estimate that the energy conservation is really THE key objective since it will automatically drive CO_2 reductions and the implementation of decentralized renewable energies. In this respect, thanks to automation, remote control and electronic industry progress, electricity should be the best vector to achieve these savings.

A strong political will is needed to reach these goals. Practical plans should be articulated around:

- Information campaigns to increase the citizen's awareness on these challenges, coupled with the right incentives,
- New regulations to boost existing energy saving and CO_2 saving equipments or industrial processes,
- R&D programs, especially around photovoltaic energy and CO_2 sequestration,
- All carbon free generation sources, including nuclear, should be considered at equal foot.

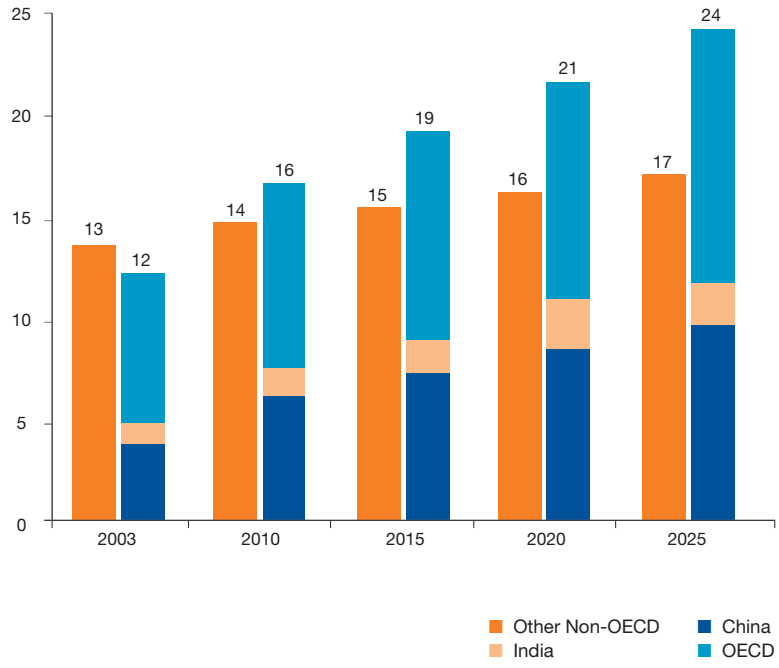
The cost of these policies should be evaluated in order to prevent an impact on Europe's competitiveness.

Finally, these types of measures should also be applied in other regions of the world, especially in high energy consuming areas such as North America, China and India. A recent EIA report shows that by 2030, worldwide energy consumption should increase by 57% and CO_2 emissions by 59%!

Figure 13 shows that by 2020, the majority of the CO_2 emissions will come from outside OECD countries with a strong contribution from China. Moreover OECD countries, that include USA and Canada, also show a growth in their CO_2 emissions. Discussions are underway to convince other countries – notably the United States, Canada and China – to take strong CO_2 reduction measures.

If they were not successful, the European efforts would represent a drop of water in the ocean while jeopardizing Europe's development. In this case, the whole European scheme would have to be thought of again.

Figure 13 CO_2 emissions forecast for different regions in the world (2003-2025); in Billion metric tons



Source: AIE – International Energy Outlook 2006

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