-RENEWABLE ENERGIES

. **Preliminary Issues**.

The Energy Policy of the European Union, from 1994, considers that renewable energy is essential in order to decrease external energy dependence. Later, the importance of renewable energy is strengthened regarding environmental issues, by the reduction of the gases causing the greenhouse effect, of other polluting products such as NO_x and SO_2, (causing acid rain), and environmental ozone.

On this same hypothesis, the "Action Plan for Renewable Energy Sources" was included in the Declaration of Madrid in March 1994. Later on, in November 1996, the Green Paper of the European Parliament acknowledged the essential role that renewable energy may play in the preservation of the environment, in ensuring the supply of energy and the employment creation In November 1997, the necessary course of action in order to duplicate the contribution of renewable energy to the energy balance of the European Union by the year 2010 is defined in the White Book on Energy.
This will required at least:

- 40,000 MW of wind turbine generators
- 90,000 oekt of biomass
- 100 million m^2 of solar collectors
- 3,000 MWp of photovoltaic energy
- 1,000 MWe and 2,500 MWth of geothermal energy

In the Kyoto Summit held in December 1997, the European Union took on the commitment of reducing the emissions of those gases causing the greenhouse effect, and regarded the development of Renewable Energy as essential to that purpose.

In September 2001 the European Parliament and Council passed Directive 2001/77 on the Promotion of electricity from renewable energy sources in the interior market of electricity where the objectives which the Member States should meet as regards to electricity generation from

renewable energy sources and with reference to the electricity gross consumption by the year 2010, are stated.

On December 30th 1999 the Plan for the Promotion of Renewable Energies was passed, and the aim of this plan is to reach the power and energy production stated in the following table by the year 2010:

	1990	1998	2010
Minihydraulic	611.8 MW	1,509.7 MW	2,230 MW
Biomass Consumption	3,753 oekt	3,886 oekt	10,971 oekt
Wind	27.2 MW	834 MW	8,974 MW
Solar Collectors	294.918 m^2	340.892 m^2	4,840.892 m^2
Solar photovoltaic	3.2 MWp	7.9 MWp	142.9 MWp

Objectives for the year 2010 of the Plan for the Promotion of Renewable Energies

Renewable Energy in Galicia.

The Galician Government took on the Spanish and European commitments for the development of renewable energy, as it took into account the advantages associated to this kind of projects: environment preservation, increase of the degree of energy self-sufficiency and socio-economic impact.

In the following chart the current situation of renewable energy in Galicia and the distribution of the installed power can be observed.

PRODUCTION	Year 2001 Installed Power (MW)	Electric Production (oekt)	Thermal Production (oekt)
Hydraulic	2,804	776	0
Minihydraulic	165	42	0
Wind	971	181	0
Biomass	34	7	212
Solar photovolt.	0.1	0	
Solar thermal	--		0
TOTAL	**3,974**	**1,006**	**228**

Current situation of renewable energy in Galicia

A) Hydraulic power stations

Nowadays there are 34 power stations amounting to a total power of 2,804 MW, (with a pumping capacity of 420 MW) which accounts for the 17% of the hydraulic power installed in Spain and the 40% of the electric power installed in Galicia and as was stated in previous sections the 70 % of the installed power in renewable energy.

Below, the hydraulic power stations found in Galicia are listed and the distribution of installed power is listed by provinces.

	Power (MW)	No. of power stations
La Coruña	277	5
Lugo	472	6
Orense	1,979	22
Pontevedra	76	1

Province Distribution of hydraulic power listed by provinces

B) Minihydraulic power stations

Since 1980, with the entry into force of the "Law on the Preservation of Energy", the interest in small hydraulic yield reappeared, given its renewable energy nature, which together with a

policy aid and promotion of these facilities enabled the construction of new hydraulic power stations and the recovery of old disused stations.

In 2001 the overall power of minihydraulic power stations installed in Galicia was 163 MW, which meant the 2% of the installed power in Galicia and the 7 % of the minihydraulic power installed in Spain. The province distribution of the said power can be observed in the following table:

	Power (MW)
La Coruña	33
Lugo	12
Orense	33
Pontevedra	37

Province Distribution of Galician minihydraulic power stations

In Galicia there are still plenty of locations with enough hydraulic potential in order to ensure the technical-economic feasibility of small power stations, and its potential may be estimated in 200 MW, which would produce approximately 60 oekt/year.

Nevertheless, (mainly due to environmental reasons), it is foreseen that in the period 2000-2010 100 MW will be installed, which would mean an additional electric production of 30 oekt.

	Situation in 1998	**Situation in 2001**	**Forecast for 2010**
Installed power (MW)	115	164	215
Produced power (oekt)	35	42	65

Galicia: Objectives for the year 2010

C) Wind Energy

The development of wind energy technology in the latest years has been spectacular, both regarding the power of wind turbines, as well as regarding the cost of the installed kW and regarding the availability of operation. Currently, there are commercial wind turbines round 1,500 kW and machines of 3,000 kW are undergoing the final stages of development.

The development of wind energy is especially significant in Europe, where the 73% of the world power is installed. We should emphasize the contribution of countries such as Germany, Spain and Denmark with 8,750, 3,244 and 2,417 MW respectively installed in 2001.

In July, la Xunta de Galicia (Galician Autonomic Government) passed Decree 205/95, whereby licences for wind energy use projects in Galicia were regulated and they were linked to the development of industrial plans for the region. Later, in November 2001 a new Decree 302/2001 modifying specific issues of the previous Decree was published.

The main innovation of this regulatory Decree is the implementation of the "Business Wind Energy Plans", which should be submitted by the different developers.

The essential content of Strategic Wind Energy Plans is focused in three items:

- Wind Energy Research Plan
- Investment Schedule
- Industrial Action Schedule

The Industrial Action Schedule is one of the most important issues of the Business Wind Energy Plans. Its purpose is to enable that investments associated with wind farms have repercussions on the region itself through industrial actions.
In any event these projects shall abide by autonomous legislation as regards to environment issues. Nowadays there are 18 strategic wind energy planes approved, which have 12 industrial actions associated with them.

At the end of 2001 there were 40 wind farms operating with a power of 971 MW. At the end of 2002 1,287 MW were reached.

If we make an overall analyze of the issues stated above, the effect of the Galician Wind Energy Plan in employment and total investment created is the following:

	Employment
Industrial actions	600
Purchase of auxiliary components to Galician companies	400
Building wind farms and electric lines	500
Engineering and promotion services	400
Wind farm maintenance	200
TOTAL	**2,100**

The EU considers essential to increase the installed wind energy power nowadays in order to meet the objectives set up in the White Book on Energy. To achieve this, the ambitious objective of installing 40,000 MW by 2010 has been established.

In Spain, the Plan for the Promotion of Renewable Energies also takes into account a significant increase of installed power, since it forecasts an increase of 834 MW to 8,974 MW in the period 1998 - 2010.

As to Galicia, a large yield potential of this energy is estimated since there are locations which would allow installing 7,000 MW, and therefore reserves of 1,500 oekt are estimated. During the period 2000 - 2010, it is forecast to install 3,500 MW, thus reaching a total power of 4,000 MW and a production of 900 oekt.

D) Biomass

Biomass is the main renewable energy source in absolute terms, and in 2000 it contributed to the 3% of the total energy consumption in the EU. The Commission in its "White Book on Energy", deems the increase of the biomass energy contribution essential, till it reaches the 8.5% of the overall consumption.

The main alternatives for its energy use are grouped in three areas: residual forest biomass, liquid biofuels and biogas.

Residual Forest Biomass

The use of residual forest biomass is mainly carried out for heat production in industrial processes in thermoelectric power plants and in the household sector for heating.
Nowadays, there are four thermoelectric power plants installed in Galicia using forest biomass as fuel, with a total power of 34 MW.

	Power (MW)	No. of plants
La Coruña	2.4	2
Lugo	-	
Orense	2.4	1
Pontevedra	30	1

Province distribution of installed power in biomass

These plants produced 5 oekt of electricity in 2001.

In 1999, la Xunta de Galicia (the Galician Autonomous Government), with the purpose of assessing the supply possibilities in sustainable conditions of biomass quantities and price to supply several thermoelectric power plants, draw up a stock inventory of residual biomass from forest systems, (pruning, thinning, clearings, remains of final felling, etc.) and it estimated a resource of 995,000 Tm/year. This quantity may allow to install 100 MW from fuel produced in forest clearing. The energy produced from this power would be 70 oekt. In the period 2000-2010, it is forecast to install around 50 MW.
Currently, the technical-economic feasibility of a 10MW-power project in the North area of A Coruña and Lugo provinces is being analyzed.

Liquid Biofuels.

Biomass enables to obtain liquid fuels which are replacing fossil fuels for transports in a modest way for the time being.

The European Union intends that the consumption of liquid biofuels obtained from agricultural raw materials of their own production, may reach a 5.75 % share in the fuel for transports market by the year 2010.

Though the Galician climate is not favourable for obtaining biofuels from energy crops, the Bioethanol Galicia facility (Curtis), where ethanol is produced from cereals, was put into operation and it produces annually 65 oekt of fuel, which is used as fuel for transports.

Biogas

Among those fuels that can be obtained from biomass, we can find biogas from animal production, food and agriculture effluents, sewage treatment and waste disposal areas.

At present the feasibility of different projects for the use of biogas are under study in Galicia.

With reference to biogas from municipal solid waste treatment, a biogas power station of 6.27 MW has been built in A Coruña and it reaches an energy production of 4 oekt electricity.

The White Book on Energy of the EU sets up the objective of increasing the biomass contribution to energy consumption from 3 to 8.5% reaching a production of 90,000 oekt with the following contributions: 15,000 oekt from biogas (animal production, sewage treatment, waste disposal, …), 30,000 oekt from agriculture and forest waste and 45,000 oekt from energy crops.
In Galicia the installation of 50 MW in forest biomass thermoelectric power plants and the development of biofuel plants are envisaged.

E) Solar Energy

Though the current presence of solar energy in our Community is not significant, we may say that it is making progress continuously, both regarding low-temperature collectors for hot water supply and regarding photovoltaic panels. That is the reason why a plan for the promotion of solar energy is being implemented with the purpose of increasing the use of this energy source.

The forecasts for the development of solar energy in Galicia are made conditional on future technological development. It is expected that by the end of the year 2010 about 5 MWp solar panels and about 40,000 m^2 thermal panels are installed.

F) Geothermal energy

Till the present moment, small experiences of geothermal energy use for house heating and water heating have been carried out only for thermal use in the city of Ourense.

The geothermal energy potential in Galicia ranges from 120 and 30 oekt/year. However, since its temperature does not reach 100 ºC, it is not feasible to use it for electric production.

G) Tidal energy

The prospects for the short-term development of tidal energy are scarce, due to the low profitability and the high environment aggression they involve.
In Galicia there are isolated uses of low power, with Nasuda-type buoys, in different locations along the coastline, used for sea signalling.

Objectives for 2010.

Renewable Energy:

Out of the conclusions of previous sections, the energy production situation envisaged in the White Book on Energy of Galicia for the year 2010 will be the following:

	Year 2010	
GENERATION	**Installed Power (MW)**	**Average final energy Production (oekt)**
Hydraulic	2,759	525
Minihydraulic	215	65
Wind	3,000	700
Biomass	93	280
Other renewables	5	4
TOTAL	**6,073**	**1,574**

Situation envisaged in Galicia by 2010 regarding the EU objectives