Vision for 2030

BioPlat
SPANISH BIOMASS TECHNOLOGY PLATFORM

UNION EUROPEA
FONDO EUROPEO DE DESARROLLO REGIONAL
"Una manera de hacer Europa"

GOBIERNO DE ESPAÑA

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Index 

Executive Summary

Biomass is a key source of renewable energy needed to meet the energy goals that have been set both in Europe and in Spain. These objectives focus on energy diversification, reducing the external dependence on energy sources and reducing emissions of greenhouse gases.

Particularities associated with this energy source (resource dispersion and variety of use aplications) require a differentiated approach depending on the raw material and its mode of use.
In Spain, biomass it is supposed to have a significant contribution to the total renewable energy. The Spanish Renewable Energy Plan (PER) 2005-2010 projects that in 2010 biomass will involve almost 60% within the global contribution of renewable energy of 12.1 % over primary energy consumption.

Achieving the objectives set by the European Union will require strong development and a turnaround in the industry. These objectives have been defined in both the short and medium term. The short term (2010), can be highlighted by the following:

- 10% biomass contribution to the primary energy consumption, according to the Biomass Action Plan (COM (2005) 628 final), which remains to be transposed in Spain.
- 5.75% biofuels contribution in the transport sector in accordance with the Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport.

In the medium term (2020), the new Renewable Energy Directive proposes the following:

- 20% renewable energies contribution to the final energy consumption.
- 10% biofuels and other renewable fuels contribution within the transport sector.

Despite the development experienced by the biomass sector in recent years, the annual growth rates indicate that these objectives are far from being achieved.

Technological development, improvements in energy efficiency, reducing production costs and costs of biomass products, development and implementation of sustainability criteria and effective implementation of measures to promote the use of bioenergy, will be crucial in developing this energy source.

Key issues to be considered to encourage the proper implementation of biomass are:

- Assurance of supply:
    - Efficient and sustainable Implementation of energy crops.
    - Comprehensive biomass use (full resource) and the use of new biomassic raw materials.
- Development of the supply chain, logistics, separation technologies and pre-treatment of biomass so as to generate and standarize a limited number of biofuels applicable to different technologies.
- Development and implementation of technologies for biofuels production from ligno-cellulosic materials.
- Development and implementation of co-generation technologies for multi-fuel and with higher efficiency.
- Widespread the use of standardized biofuels in heating and cooling applications, both in industry and domestic fields.
- Developing the concept of biorefineries maximizing the use of biomass: biofuels production, electricity and other bio-chemicals with high added value, thereby improving the overall sustainability of the process.
- Improvement efficiencies of the valorization teams.

Introduction

Energy is a strategic sector for achieving the objectives of growth, employment and sustainability raised both in Europe and Spain.

To the benefits of renewable energies such as that they are inexhaustible, they don't produce wastes with a complicated treatment, they are indigenous, they help to decrease the external dependence on energy through diversification, they allow the development of indigenous technology, and they reduce the greenhouse gases emissions, biomass adds the following specific benefits:

· Encourages the maintenance and development of agriculture, forestry and industry, helping to the job creation, a particularly important fact in rural areas, as it promotes the establishment of population. This effect increases if the development of biomass is achieved through the cultivation of unused land and the use of forest raw materials.

· Generates extra profit in the case of the energetic valorization of wastes, such as reducing fire risk and maintenance of forests when it comes to forest residues, or minimization of discharges in the case of agro-industrial waste.

· Constitutes the most realistic alternative for replacing fossil fuels in the transport sector in the short and medium term, through the use of biofuels (especially biodiesel and bioethanol).

Studies in Europe, such as *How much biomass can Europe use without harming the environment?* of the European Environmental Agency -EEA- developed in 2006, indicate that the potential of available biomass, applying sustainability criteria, permits the compliance of the proposed objectives in Europe and in our country, although in the latter case, it is still far from achieving the goals set by the Spanish Renewable Energy Plan (PER) 2005-2010.

Current situation

European context

On December 17, 2008 Plenary of the Parliament and the European Council finally ratified the agreement on the texts that make up the so-called Climate Change-Energy Package, which includes the following regulations:

(1) Directive on the promotion of the use of energy from renewable sources.
(2) Directive amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions from the use of road transport fuels and amending Council Directive 1999/32/EC, as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC.
(3) Directive amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community.
(4) Decision on the effort to be deployed by the Member States to reduce their emissions of greenhouse gases to meet the commitments made by the Community until 2020.
(5) Directive on the geological storage of carbon dioxide and amending Directives 85/337/EEC and 96/61/EC and Directives 2000/60/EC, 2001/80/EC, 2004/35 / EC, 2006/12/EC and Regulation (EC) No 1013/2006.
(6) Regulation laying down rules of behavior on emissions from new passenger cars as part of the integrated approach to community to reduce CO2 emissions from light vehicles.

The Directive on the promotion of the use of energy from renewable sources **(1)** establishes a minimum target for the share of renewable energy in its gross energy consumption in 2020, for every Member State. These national objectives are also consistent with a binding target equivalent to a quota of at least 20% of renewable energies in the gross energy consumption of the European Union in 2020.

It also provides that the share of renewable energy in all forms of transport in each Member State in 2020, has to involve at least 10% of final energy consumption in transport.However, the trajectory of shares to be followed by Member States until 2018 that contains the directive related to the target of 20% is indicative, not including interim binding targets in any case.

Its text places emphasis on the need for all biomass and biofuels that are consumed in the European Union to be produced in a sustainable manner. This involves the use of more efficient production technologies, respect for biodiversity or reducing levels of greenhouse gases for which strict sustainability criteria are set. As a first step, these criteria are applied only to liquid biofuels for transport, but in the future they will be extended to all uses of biomass. Biofuels not achieving these criteria cannot be accounted for the fulfillment of the objective and cannot enjoy tax incentives of any kind.

The new Directive concerning the specifications of the fuels that are used in the automotive sector **(2)**,emphasizes the same criteria for sustainable production of biofuels, as in the Renewable Energy Directive **(1)**. It also proposes other measures such as introducing a higher percentage of biofuel (bioethanol) in gasoline by changing the maximum vapor pressure and oxygen content allowed. It is also proposed to require suppliers of fuels to reduce emissions by 10% of greenhouse gases for fuel in 2020 about 2010.

According to the *Solid Biomass Barometer* ellaboraed by EurObserv'ER in 2006, 2007 and 2008, in 2005, primary energy production from solid biomass reached 59.3 Mtoe, while in 2006 production increased by 10.8% reaching 65.7 Mtoe. In 2007, the growth rate decreased reaching only 66.4 Mtoe, a 1% increase on the previous year.

The countries at the forefront in the production are Finland, Sweden and Latvia, while Netherlands, United Kingdom and Cyprus are at the tail of the European Union.

According to the studies cited previously, biomass for electricity has also been increasing its production in recent years. In 2005, electricity production from biomass added up to 41.2 TWh, 13.3% fewer than in 2006, when the production reached 65.7 TWh. In 2007 there was a more discreet growth of electricity production from biomass, reaching 66.4 TWh, representing an 4.4% increase over the previous year. Throughout these years, Finland, Sweden and Germany, have remained as leaders in the production.

In the case of biofuels, *Biofuels Barometer* by EurObserv'ER in 2006, 2007 and 2008, indicating that they represented 1% of the market for motor fuels in 2005, that is half the reference value laid down in Directive 2003/30. However, it should be noted that during 2006 this value increased to 1.8%, representing an increase of 80% over the value reached in 2005. During 2007, the consumption of biofuels in the transport sector reached 2.6% (7.7 Mtoe) of total energy content of all fuels used in transport. This represents a growth of 37.4% over the 2006 figure, a more modest result of the rising price of raw materials, but enough to meet the European Union target of 5.75%. (although not at a national level in many Member States).

The major producers of bioethanol in Europe are Germany, Spain and France. During 2007 the combined production from these countries reached 74% of the European Union. Regarding biodiesel, Germany, France and Italy are the biggest consumers and producers. In 2007, these three countries produced more than 72% of the total produced in the European Union.

Biomass for thermal applications has reached different levels of development in different Member States of the European Union, due to the current lack of a comprehensive legal framework setting out specific targets for this sector.

Gross heat production from solid biomass in the European Union, as indicated in *Solid Biomass Barometer* ellaborated by EurObserv'ER in 2006, 2007 and 2008, increased from 5.5 Mtoe in 2005 to 5 7 Mtoe in 2006. In 2007, production fell to 4.9 Mtoe.

Spanish context

12.1% of primary energy consumption in 2010 will be supplied by renewable energy, according to the Spanish Renewable Energy Plan (PER) 2005-2010. Taking into account the production in 2004 and the enhancement targets set for the period 2005 - 2010 established by the Plan, the targets for 2010 are reflected in the following table, in ktoe:

	SITUATION 2004	INCREASE IN THE PERIOD 2005-2010	TARGET 2010	% OVER PRIMARY ENERGY 2010
Global renewable energies	9,152	10,481	20,220	12.6%
Biomass (Electrical and thermal applications)	4,167	5,040	9,206	
Biofuels	228	1,972	2,200	
Biogas	32	188	220	
TOTAL BIOMASS			**11,620**	**7.24%**

Source: Spanish Renewable Energy Plan (PER) 2005-2010

These objectives are aligned with those recommended in Europe. However the current situation and expected trends vary widely depending on the sector:

IN THE TRANSPORT SECTOR, BIOFUELS:

According to the report *Capacity, Production and consumption of biofuels in Spain: situation and outlook* prepared by the biofuels department of the Spanish Renewable Energies Association -APPA-, in Spain, 388.6 ktoe of biofuels were consumed by the year 2007 (129.6 ktoe of bioethanol and 259.0 ktoe of biodiesel), while total sales of automotive gasoline and diesel amounted to more than 33,336 ktoe. Therefore, the market share of biofuels in this year was 1.2%. This means that in 2007 doubled that achieved in 2006, reaching just 0.4%, with a total consumption of biofuels de168 6 ktoe. In 2005, the share was 0.3%.

The adoption of Directive 2003/30/EC of 8 May 2003 to promote the use of biofuels, led to the publication of Royal Decree 61/2006 (which amends Royal Decree 1700/2003) which is regulated by the use of biodiesel and bioethanol. Among other issues, this Royal Decree provides a series of measures to promote the use of biodiesel produced from indigenous raw materials such as sunflower, and allows the incorporation of 5% of ethanol directly mixed with gasoline. For the percentage of mixing biofuels with petroleum exceeding 5%, Royal Decree

61/2006 requires specific labeling in every outlet. However, taking into account the new Directive on the promotion of the use of energy from renewable sources, this percentage will increase once the Directive is transposed.

The installed capacity to produce biofuels in Spain at the end of 2007 was equivalent to a market share of 3%, which shows that some of the potential was not exploited because the market share for that year amounted only 1% which represented half of the reference value provided in the Directive 2003/30/EC for the year 2005, that was 2%.

Moreover, despite the growth of that share which occurred between 2006 and 2007, in 2006 it was already found to be non-compliante with the objectives set out both in the Directive 2003/30/EC, and in the Spanish Renewable Energy Plan (PER) 2005-2010 (5.83% in 2010). This culminated in the adoption of the amendment to the Law of the hydrocarbons sector (Law 12/2007) in June 2007, which introduced mandatory targets for biofuels consumption, and its related development in the Order ITC/2877/2008 was adopted on the 9th of October 2008. With regard to this legislation, it is worth noting the following issues:

The annual targets for biofuels for transport purposes are set as the following:

- 2008: 1.9%
- 2009: 3.4%
- 2010: 5.83%

The target for 2008 is indicative, while the goals for 2009 and 2010 have to be completed.

Provides that, failing at meeting these mandatory targets, will be considered a "very serious infringement", which could be fined with up to 30 M¤ and possible disqualification for one year of obligated individuals listed in the Order of development of the Law.

During 2007 the consumption of biodiesel in Spain turned out to be 292,646 tonnes, of which 142,926 tonnes were produced in the Spanish plants. The rest were imported from United States. This consumption is twice the one of bioethanol. The reason for this trend can be found mainly in the dieselization of the total number of cars and its effect on the European fuel market, generating a surplus of gasoline (it is produced more than it is demanded) and a diesel deficit (demand is higher than production and import are needed).

However, despite the positive trends in the consumption of biofuels, there are barriers that must be taken into account if the aim is to achieve the proposed levels of use:

Lack of clarity in legislation and quality standards for biofuels and their mixings. Particularly, there is a complete development of specific regulations for high mixings of biofuels (exceeding 5%) which cause uncertainty in the sector and more specifically on users.

Lack of formal support (acceptance in the automotive maintenance manuals) from some car manufacturers to use biofuels in their engines.

Lack of adaptation of the fuel distribution system to facilitate the logistics of biofuels and mixings.

Uncertainty in the sector about the stability of the tax incentives, whose regime has a review date in December 2012.

Lack of analysis of the raw material needed to meet production targets for biofuels and how these requirements could affect to agricultural markets today, so we can estimate the future availability of various raw materials, both in quantity and price.

The high costs compared with fossil fuels.

Lack of information and promotion of biofuels by the Administration to the general public.

SOLID BIOMASS FOR THERMAL AND ELECTRIC APPLICATIONS: In Spain 4206 ktoe of primary energy input in 2007 was reached, an amount exactly equal to the one obtained in 2006 (increase = 0%) and only 2% higher than its contribution in late 2004.

If we look at these results, it is paradoxical that the target of 12.1% of primary energy from renewable sources established by the Spanish Renewable Energy Plan (PER) 2005-2010 of 60% rested on bioenergy since this is the renewable technology which has installed the least capacity.

From the 20,220 ktoe to be provided by the renewable energies in 2010 to reach the objective of 12.1%, biomass for power generation should provide 27.66% of those ktoe, and 20.12 % for biomass for heating generation.

There are several reasons why the development of biomass for thermal and electric applications is not in line with the considered in the Spanish Renewable Energy Plan (PER) 2005-2010.

Regarding the applicable law to the generation of electricity from biomass, are the Royal Decrees which regulates the production of electricity in special regime responsible for such regulation.

On March 12 2004, Royal Decree 436/2004 was published. It remained in effect until May 25 2007, when the Royal Decree 661/2007 was published. Regarding biomass, there were significant changes from one Royal Decree to another, in order to improve the prospects of the sector. The classification structure of the biomass fuels was rearranged and expanded in a manner that created more subgroups that included different fuels in different ways, whose feed-in tariffs were raised for all cases respecting of Royal Decree 436/2004. For the first time the fuel hybridization was allowed, as well as the hybridization of different technologies within the scope of the biomass among themselves and with other renewable technologies. The co-digestion of different products in the same biodigestor was also allowed. In addition, a special payment for small plants of every group of biomassic fuel (usually associated with gasification technology ≤ 2MW).

Despite these improvements in the regulatory framework of technology, there are still a number of barriers that are preventing the take off of the sector:

The Royal Decree 661/2007 which regulates the electricity generation from renewable sources doesn't take into account the diversity of raw materials and valorization technologies.

The remuneration given to the established groups of raw materials is inadequate and doesn't reflect market realities. Complexity that becomes worse by the rising prices of the plants components.

Energy crops are still developing. They have to solve issues such as choice of crop for each region and for each farming system and its economic feasibility compared to traditional crops.

The reluctance to open up the existing forestry to the energy market, makes it difficult for the existing forest plantations (mainly eucalyptus) to be valorizated as biomass.

The 250 MW set in the Renewable Energy Plan (PER) 2005 -2010 as the biogas power objective in 2010 is close to be reached due to the increase of production of the landfill degassing biogas, while the biodigestion sector remains virtually static due to the non profitability of the installation of biodigestors associated to food industry or livestock facilities.

The non-recognition of the organic fraction of municipal solid waste (OFMSW) as biomass, makes the assessment of this fraction difficult, which could result in a significant percentage of primary energy from biomass.

Generally speaking, it can be said that there isn't a mature biomass market which could ensure the long-term supply of biomass plants.

In many cases, the supply chain is not clearly defined, nor as to the cost nor as to its components. This is especially important in forest wastes, taking into account the fact that its use would improve the state of conservation and maintenance of our forests. This situation is exacerbated when there is dispersion in the ownership of the biomass, since it complicates the implementation of contracts for supply security.

The development of specific regulations for biomass by the different regions could be a fact that further complicate the current situation of the sector since it could hamper the mobility of the biomass, the use of certain types of fuels, the administrative procedures that could establish more binding characteristics added to the ones set in the national regulations, etc..

According to the Spanish National Energy Commission, in November 2008 the equivalent capacity of plants in operation and with register using biomass from energy crops and agricultural, forest or industrial residues, (b.6 and b.8 groups of the Royal Decree 661/2007) amounted to 420 MW. This means that, taking into account the objective of 1,317 MW set by the Spanish Renewable Energy Plan (PER) 2005-2010 to 2010, it has been reached only 32% of this target. Regarding biogas (b.7 group of the Royal Decree 661/2007) the equivalent capacity in November 2008 reached 194 MW, representing 78% of the target, which in this case amounts to 250 MW.

Availability of Biomass

Biomass covers a wide range of organic materials that are characterized by their heterogeneity, both in its origin and its nature. In the context of energy, biomass can be considered as organic matter derived from a spontaneous or provoked biological process, to be used as an energy source. Biomass resources can be broadly grouped into agricultural and forestry products. Also considered biomass are the organic matter from wastewater and sewage sludge, as well as the organic fraction of municipal solid waste (OFMSW), and other wastes from various industries. This heterogeneity inherent in the nature of the different biomass sources makes it difficult to provide a reliable assessment of the overall availability of the resource.
According to the fifteenth European Biomass Conference and Exhibition celebrated in 2007 in Berlin (Germany), in the Europe of 27, the available land means 433.1 Mha, of which 113 Mha are arable land. The study of the proportion of the latter which may have an energy use, there are different analysis.

According to the study *How much biomass can Europe use without harming the environment?* of the European Environmental Agency - EEA - published in 2006, 19.3 Mha will be available for energy crops in 2030, from the total grown in Europe, with no regard for Cyprus, Luxembourg, Malta, Bulgaria and Romania, which amounts to 100.6 Mha.

A high ratio of hectares of arable land per capita is a good potential for bioenergy production. This is the case of Bulgaria and Romania, so that the number of hectares available for energy crops in 2030 could be slightly higher. In the case of Spain, the potential for energy crops could be 2.5 Mha.

According to the study elaborated by the European Environmenalt Agency, the European Union has a potential for sustainable biomass of about 190 Mtoe by 2010, which increase to about 293 Mtoe in 2030, for the Europe of 25. This increase is mainly due to the contribution of energy crops.

In Spain, the figures for 2010 stand at around 17 Mtoe, which amounts to 25.1 Mtoe in 2030. Although this potential covers the objectives set by the Spanish Renewable Energy Plan (PER) 2005-2010 in terms of primary energy demand, it is necessary to analyze the availability of different types of biomass for each conversion process, so determine the final available energy in real terms.

In the above context, forest residue, the use of the organic fraction of municipal solid waste (OFMSW) and the generation of biogas from livestock waste, which are currently underestimated, represents a considerable amount of biomass in our country, whose proper valorization would contribute to a high percentage of primary energy for 2010.

One factor to take into account in developing agricultural energy crops, are the recomendations consideration in the Common Agricultural Policy (CAP). Currently, the Common Agricultural Policy (CAP) is being revised. One of the proposals already agreed is to remove the aids for the energy crops. Similarly, until the 2008 campaign, this policy establishes the obligation of the withdrawal of the 10% of each cropland either in fallow or under cultivation through of a non food crop. Due to fluctuating prices, the European Union has abolished this obligation and allowed the planting of all the available land in each cropland. The entry into competition with other markets as well as the disappearance of the aids from the Common Agricultural Policy (CAP), have created uncertainty and has been a brake on energy crops, with an impact unknown so far.

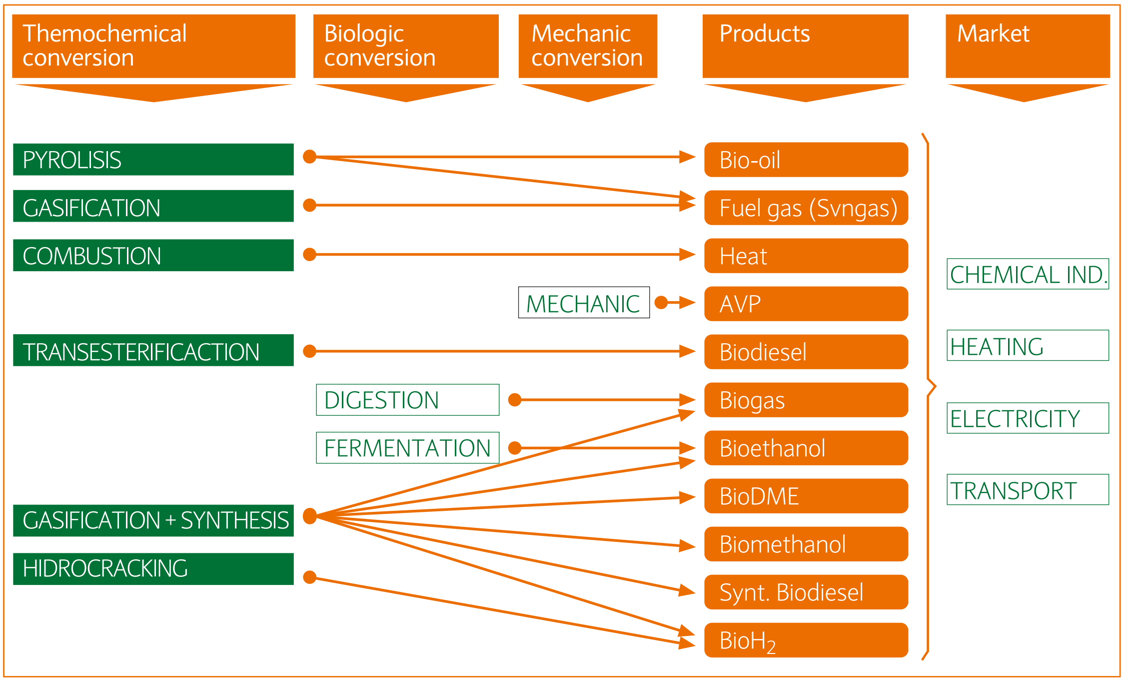
This situation increases the need for the implementation of transformation technologies of lignocellulosics and alternative raw materials to an industrial-scale, as well as more efficient processes and technologies, to increase their sustainability and competitiveness.

In addition to the national or European potential, It's necessary to consider the growing international market of raw materials for energy and biofuels, and the influence it can have on the national situation. The European Union defends in its Biomass Action Plan f, especially in the case of biofuels, a balanced approach between the consumption of domestic and imported biomass, taking into account the trade agreements with third countries and with special attention to the developing countries.

Such arrangements should be established with criteria and restrictions to ensure the sustainability of energy crops as described below. The selection and improvement of existing species for energy purposes in the short term, represents a potential increase of performance which will raise the availability of biomass.

Conversion technologies

Beyond the pretreatments that the different types of biomass can be subjected to optimize their management and logistics, the main energy conversion technologies that are used in the area of biomass are summarized in the following chart:



Source: "Biomass: Green Energy for Europe" DG for Research-EC-2005 and own elaboration.

There are four basic processes by which biomass can be transformed into heat and electricity: combustion, gasification, pyrolysis and anaerobic digestion. The first three, commonly known as thermo-chemical conversion processes, involve thermal decomposition of the components of biomass with oxidation and an associated release of energy as heat. This is true in the case of combustion, or obtaining intermediate biofuels, as in the gasification or pyrolysis processes.

The main use of biomass in Spain is in direct combustion to obtain heat and electricity. The process of complete combustion or oxidation generates carbon dioxide, ash and water as by-products. Combustion occurs at temperatures typically ranged between 600 º C and 1300 º C, with around 30% as overall performance of the process.

By subjecting the biomass to temperatures that can range between 800 º C and 1500 º C in the absence of oxygen, gaseous products are created with a calorific value of 1,000 kcal/m3 to 1,200 kcal/m3. These products constitute a gaseous mixture called synthesis gas, syngas or poor gas, and is mainly comprised of nitrogen, carbon monoxide, carbon dioxide, methane which hydrogen in varying proportions. This process is known as gasification and it occurs in the gasifiers. The gas can then be used for thermal or electrical means using engines. The gasification process primarily used for electric generation use fluidized bed systems, getting a high efficiency by combining gas turbine cycle and steam cycle, for which the production of clean gas is very important.

Pyrolysis is the decomposition of biomass by the presence of heat in the absence of oxygen, a process in which the nature and composition of the final products depend on the properties of the treated biomass, temperature and pressure of operation and the time the material stays in the pyrolysis unit. Thus, the products can be classified into three groups: gases consisting of hydrogen, carbon oxides and hydrocarbons in the case of fast pyrolysis (residence time less than 1s) at high temperatures (between 450 ° C and 900 ° C). Liquid hydrocarbon is prouced in the case of slow pyrolysis (residence times between 5 m and 30 m) at temperatures between 400 ° C and 600 ° C, as well as solid carbonaceous waste, such as charcoal for the carbonization process, with residence times that may be days with temperatures between 300 ° C and 500 ° C.

Anaerobic digestion is a microbiological process that takes also place in the absence of oxygen. By digesting biomass, biogas is obtained, at a rate of 300 l/kg of dry matter. Its composition is variable, but the main components include methane (55-65%) and carbon dioxide (35-45%). Nitrogen appears in a smaller proportion (0-3%), as do hydrogen (0-1%), oxygen (0-1%) and hydrogen sulfide (traces). Biogas has a calorific value of about 5,500 kcal/m3. This is determined by the concentration of methane which can be increased by removing part or all of the carbon dioxide that is produced during digestion.

Biogas is produced in landfills for municipal solid waste, given the high concentration of organic matter in anaerobic conditions. This biogas can be extracted by drilling during the degassing of the landfill, avoiding its emission as a greenhouse gas and thus reducing its negative impact. Anaerobic digestion is also a typical treatment process, which is also used to treat organic wastewater and effluents from industries and agricultural farms. The biogas obtained in each of the processes is normally used for power generation.

The processing of biomass into biofuels can be classified broadly into biochemical technologies and thermochemical technologies.

In the biochemical processes, microorganisms and enzymes are the mechanisms which carry out the transformation of biomass fractions in products. The thermochemical process are carried out at high temperatures, in the absence of microorganisms and in the presence or absence of catalysts that can make the chemical processing to be more efficient.

In biochemical processes the most important biofuel produced is bioethanol. This is derived when the sugars contained in biomass (mainly glucose) are hydrolyzed using enzymes and then subjected to a fermentation process, carried out by yeasts or bacteria. In the current market processes, sugar (cane or beet) or starch (corn or cereal), is directly converted to ethanol after an initial hydrolysis. The technology to convert cellulose and hemicellulose from lignocellulosic biomass (agricultural waste, straw, woody biomass) into bioethanol, which due to its complex structure, requires the inclusion of additional stages in the production process, is under development. To transform the different molecules in simple fermentable sugars, a wide range of processes of pretreatment, fractionation, hydrolysis of chemical, thermal, enzymatic, etc., are used.

Thermochemical processes in general involve eather the initial gasification or conversion of biomass into synthesis gas (syngas). The syngas can be converted into methanol, synthetic diesel, dimethylether, hydrogen, ethanol and alcohols by catalytic conversion processes. These compounds are suitable for automotive fuels. In an integrated manner the chemical conversion can generate electricity by burning gas in the gas or steam turbine cycle.

Currently, the chemical process used to produce biodiesel (methyl esters of fatty acids) is the transesterification. This process combines the oil, usually vegetable oil, with a slight alcohol, usually methanol, giving glycerine as the main byproduct, which can be used in various applications.

The concept of advanced biorefineries, has emerged as a combination of thermochemical and biological processes and new chemical processes, to form a scheme that enables a wide range of raw materials and produces an equally wide range of products, not just biofuels, but electricity, heat and chemicals with high added value.

Finally, hydrogen should be noted as an energy vector with great potential since its combustion produces large amounts of energy, about 27 kcal/g, and water as waste. Obtained from hydrogenated organic compounds such as alcohols and hydrocarbons, hydrogen is subjected to the reform process, which involves the breakdown of organic molecules into their elemental components, which are carbon, hydrogen and oxygen at times. An important source of hydrogen can be bioethanol.

Development of biomass in Spain

The level of development is very different depending on the application of biomass to which reference is made. With regard to biomass for thermal and electric applications the development of the sector between 1999 and 2005 was much lower than envisioned in the Spanish Plan for Renewable Energy Development published in 1999. The current trend requires a major change to achieve the objectives set in the Spanish Renewable Energies Plan (PER) 2005-2010. If we distinguish between the two applications considered, electrical applications have fared even worse than the heat.

Ktoe	1999	2000	2001	2002	2003	2004	2005	2006	2007*	Objetive 2010
Electrical application	285	291	348	561	673	709	732	761	744	5,311
Thermal application	3,317	3,340	3,356	3,361	3,388	3,428	3,445	4,457	3,499	4,318
TOTAL	**3,602**	**3,631**	**3,704**	**3,922**	**4,061**	**4,137**	**4,177**	**5,218**	**4,243**	**9,629**

Source: Bulletin IDAE 2007: Energy balance *2007 Provisional data

The use of biomass in the domestic sector is the most competitive implementation of this resource, but its development is hindered by the lack of incentives to help cover the risks of initial commercial deployment. In some countries like Austria, which have supported this use of biomass with appropriate measures, solid biofuels are currently a major source of energy in this sector.

The thermal utilization of biomass in the industrial sector is hindered by its lack of competitiveness with fossil fuels, so that in the current circumstances, is practically reduced to the self consumption of wastes from specific industries.

The reason for the delay with the forecasts in the thermal applications of biomass is due to the lack of national support. In the domestic sector, this support would be needed to overcome the risks associated with high investment costs of thermal equipments, the uncertainty in the supply of biomass and the maintenance of installations, resulting largely from the lack of a developed market. It is expected that the changes proposed in the Regulation of Thermal Installations in Buildings (RITE) for biomass installations, provide an important boost to the domestic thermal biomass projects.

In the industry today, aids should serve to promote the self consumption of the generated biomassic wastes. The development of electrical application has been hampered by a lack of government support in the form of unattractive retributions to the electricity generation under the special regime because the current profitability of these plants is clearly insufficient to compensate the risk of technology and provision of these facilities.

The review of Royal Decree 436/2004 that became the Royal Decree 661/2007, was expected to improve the payment for different fuels and that to reflect the diversity of raw materials and installed capacity, so as to promote implementing a number of initiatives to facilitate the take off in the sector. However this has not happened, and the sector remains stagnant, with widespread shortages of any development of new projects.

The final take off and establishment of the sector would require a clear bet by the administration. Some measures to be undertaken to attempt to revitalize a sector about which there is great interest from many players but its evolution is still hard in Spain are the following: it would be necessary to develop a framework considering each particular biomassic fuel, providing the support required by each scale of power in the subgroup of biodigestors, a specific retribution associated with each step of power, that allows installation and operation to be profitable at all levels; additionally, a definition for forest biomass will allow the sustainable use of forests maximizing their potential in different markets; also, a real support to the small biomass plants (≤ 2MW) that compensates for its risk and consider the added profits they generate; finally, systems for the field processing of the biomass are necessary to facilitate those treatments and the biomass supply of the plants.

Resources used in these applications to date have been largely agricultural and forestry industries wastes, and to a lesser extent the agro-industrial, forest and agricultural wastes. The development of energy crops, both agricultural and forestry, biogas from biodigestion of the organic fraction of municipal solid waste (OFMSW) and an increased mobilization of the existing agricultural and forest biomass are key factors for achieving the objectives of the Spanish Renewable Energies Plan (PER) 2005-2010.

The following table outlines the goals of increasing energy for the period 2005-2010, both in the area of biomass, thermal and electrical applications, such as in biogas for electrical applications, by type of resource.

BIOMASS FORM THERMAL AND ELECTRIC APPLICATIONS		
	Toe	Percentage
Enegy crops	1,908,300	37.9 %
Forest wastes	462,000	9.2 %
Woody agricultural wastes	670,000	13.3 %
Herbaceous agricultural wastes	660,000	13.1 %
Ind. forestry wastes	670,000	13.3 %
Ind. Agricultural wastes	670,000	13.3 %
TOTAL:	5,040,300	100.0 %

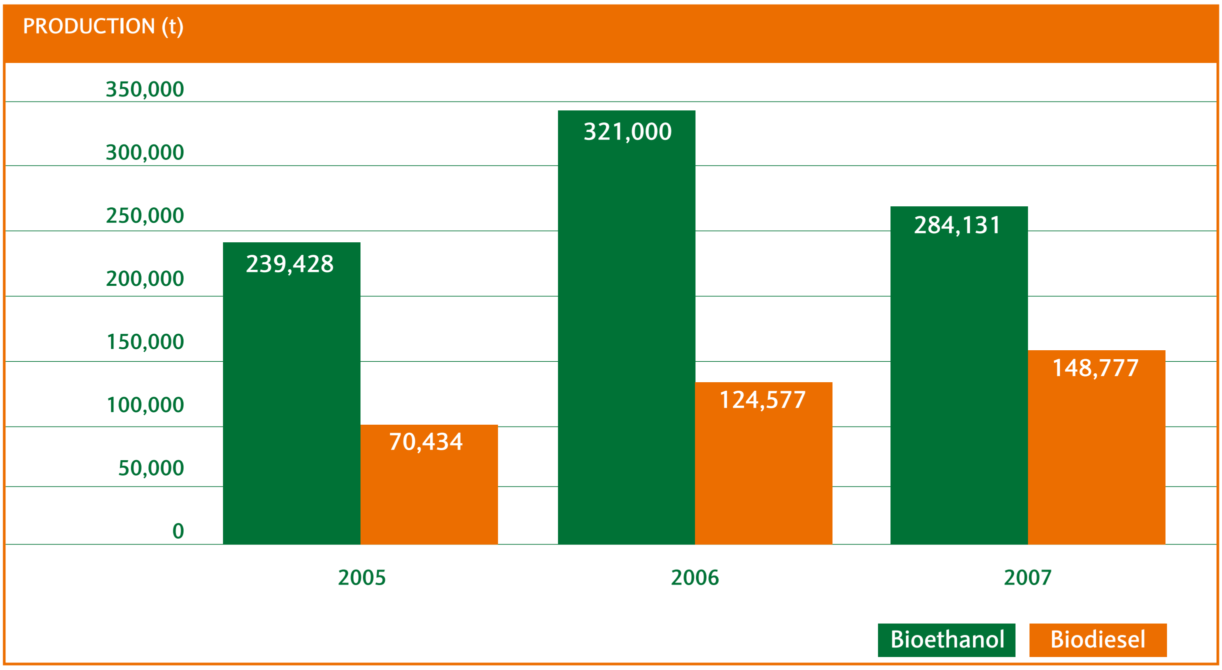
Source: Spanish Renewable Energies Plan (PER) 2005 - 2010.

BIOGAS		
	Toe	Percentage
Stockbreeder wastes	8,000	4.3 %
OFMSW	110,000	58.5 %
Biodegradable ind. wastes	40,000	21.3 %
Sewage sludge from municipal	30,000	16.0 %
TOTAL:	188,000	100.0 %

Source: Spanish Renewable Energies Plan (PER) 2005 - 2010.

With regard to applications in the transport sector at present, Spain is between the second and third place as a producer of bioethanol in Europe. During 2007 the production was reduced as a result of the increase in prices of raw materials used in the process. The installed production capacity of biofuel that has been maintained since 2006 reached 456,000 tonnes and was the largest consumer until 2005. Now consumption is being overtaken by Germany, Sweden and France. With regard to biodiesel it should be noted that in the last three years an aggressive implantation of production plants has begun which in the short term, will allow for the generation of a large capacity.

There is a huge gap between the installed capacity of each year and the quantity produced in that period. In the case of bioethanol production in 2007 the system produced only 62.3% of total capacity. In the case of biodiesel, 2007 was only 18% of capacity. This data is a clear indicationof the difficulties the sector is facing.



Source: Spanish Renewable Energy Association -APPA-, 2008

CRITICAL ASPECTS TO CONSIDER

In individual cases (for biomass for thermal, electric and transport applications) the supply of raw material is a key aspect. The increased consumption resulting from increased production capacity raises the need for imports from outside the European Union (in the case of raw materials for biofuels) or interactions with the market. This requires the implementation of sustainability criteria in choosing the most suitable alternative for developing biomass in Spain, as it did later.

Technological aspects:

Problems related to the resource management:

- Resource collection: an increase in the level of mechanization and the development of collection systems is needed.

- Resource appropriateness for each energy application: physical and chemical characteristics and shape and arrangement (grain size, etc.).

- Logistics and supply: problems differentiated by level of consumption, from domestic consumption to big capacity plants.

- Necessity of the creation and the development of markets focused on the collection, preparation and supply of different kinds of biomass.

Transformation in energy phase: thermal and electric applications:

Technologies for the combustion of biomass for thermal and electric applications have achieved a high level of development, and in general, solid biofuels are competitive in both emissions and efficiency. Moreover, these applications represent the greatest savings in greenhouse gas emissions when compared to similar existing technologies based on fossil fuels.

However, the current technologies for biomass combustion have some disadvantages compared to those applied to fossil fuels. This directly affects the competitiveness of biomass certein applications:

- Higher technical and operational complexity in the management of multi-fuel biomass plants. The sector continues to develop.

- Higher initial investment cost of equipment compared to that of liquid or gaseous fossil fuels.

- Higher maintenance costs of biomass plants. Major difficulties of storage and handling of biomass.

- Seasonality and dependence on agro-climatic conditions for obtaining the necessary raw material.

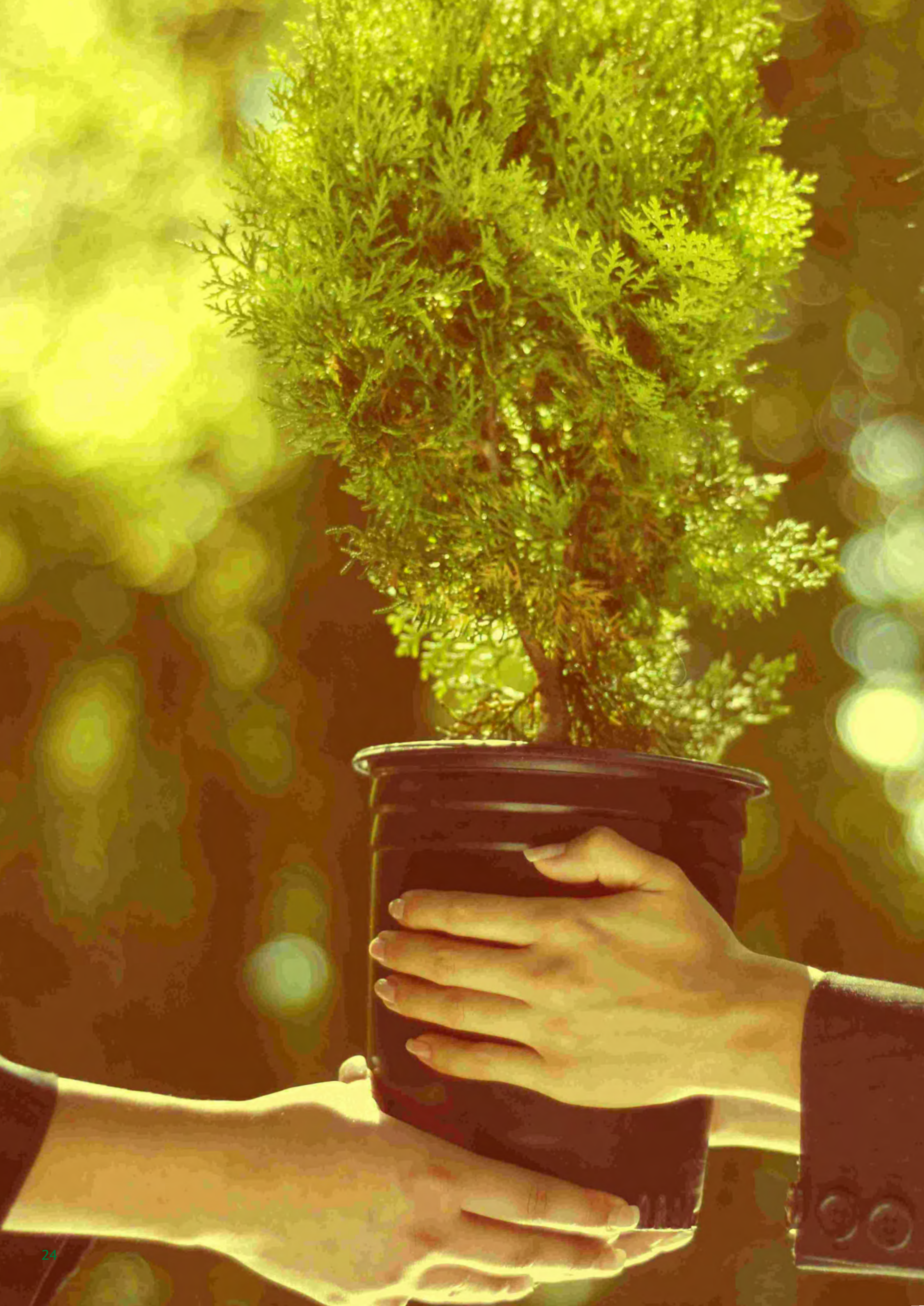
Despite the drawbacks mentioned, a solution that was suggested to counter the current problems in thermal applications is the implementation of measures to encourage the market development.

Biofuels:

The conventional transformation technologies have achieved a high level of development, both for bioethanol production from grain and biodiesel from oils. However, there are some aspects to consider:

- Availability of raw materials competing with other markets.
- Low conversion efficiency considering the whole cycle of biofuels.
- High production costs, mainly influenced for the raw material cost.
- Need of guaranteeing the sustainability of the complete production chain.

The development and implementation of production processes associated with biofuels produced from ligno-cellulosic raw materials, would improve the situation in the afare mentioned areas. The development of these technologies for biofuels is being driven by various R&D and demonstration projects. In Spain it is worth noting the construction of the demonstration plant of bioethanol from cereal straw Babilafuente (Salamanca) and the PERSEO project includes building a pilot plant producing ethanol from domestic solid organic waste. The ATENEA project includes building a pilot plant to produce bioethanol from citrus waste.



Opportunities and challenges for the future

The main challenges and opportunities identified are:

Increase the amount of usable biomass

In this context, there are two main aspects:

Increase the area dedicated to biomass production and utilization of waste biomass with sustainability criteria.

Possibility to use new raw materials for energy production.

In the short term it is expected to use disused land, boosting the incentives its use as energy, and considering the use of alternative agricultural and forestry raw materials with access to a specific energy use and increase the use of biomass waste. In the long term, alternatives to the current energy sources, such as aquaculture in general and new more productive and competitive energy crops, could provide significant amounts of the required biomass.

Microalgae have been cultivated for many years, having developed extensive industrial applications in the fields of food and manufacture of high added value products. The theoretical high yields per hectare compared to the yields obtained from traditional crops, make microalgae a very interesting option for biofuel production. This biomass, depending on growing conditions, can have high levels of carbohydrates, lipids or proteins capable of being converted into ethanol, biodiesel, biogas or bio-hydrogen, including the possibility of obtaining other products with high value.

It is noteworthy that this field of biofuels production most of the studies, very promising in terms of yields, have been made at laboratory level. When it has been tried to make a wide pilot or industrial scale plant, performance has not been so successful.

There is a real problem of escalation, so the work in this area currently focuses both on the selection of species that generate high volumes of biomass, and on the optimization of industrial processes to achieve economic viability of such industries to biofuels production.

It is imperative the development of programs of breeding and selection of species, targeted to their energy use and adapted to different local characteristics. It is also necessary to optimize cultural practices applied to biomass production and the needs of each field. Another factor that could significantly affect in the long term, is the application of genetically modified varieties.

It is also necessary the development of more flexible conversion technologies than the current ones referring to the range of biomass to be used, which could enable the more easily achievement of the objectives raised: greater security of supply of raw materials, availability of lower cost biomass or less interference with other markets.

Helping to ensure the renewable energies supply

The contribution of biomass to the overall renewable energy is critical within the scheme raised in both the European Union and in Spain, with contributions exceeding 50% of the total renewable in both cases. The development and deployment of energy crops and the optimization of utilization of waste, in both agriculture and forestry or organic fraction of municipal solid waste (OFMSW), will increase the production potential of biomass needed to meet the objectives proposed.

Reduce greenhouse gases emissions

The positive effects are clear in this regard. In the case of thermal and electrical applications of solid biomass, savings in greenhouse gases emissions are more than 80% in all cases compared to conventional fossil fuels technologies, and can be higher than 90% when compared to coal. Moreover, in the case of the energy use of some wastes as the livestock and agro-industrial wastes, it has to be considered not only the positive effect of reusing, but also the reduction or, in some cases, the elimination of the emission of very aggressive greenhouse gases (primarily methane) that its anaerobic digestion produces.

In the case of biofuels, in different Life Cycle Assessment studies carried out in Europe, reductions of between 30% and 50% in emissions of greenhouse gases have been proved for the biofuels (bioethanol and biodiesel) produced in the European Union, with conventional technologies from cereal and vegetable oils respectively, compared to their corresponding fossil fuel.

However, it was raised that in the case of biofuels produced from lignocellulosic biomass, reductions of 80-90% will be achieved as a result of optimizing the energy balance and minimize the use of fossil fuels in their processes.

By-products and co-products

The by-products are a key to the energy balances of the greenhouse gases emission, but so are for the economic balance of biomass production.

Today, the quantitatively most important by-products of the biofuels manufacture are the flours for animal feeding obtained in the oil extraction, although this depends on the raw material. Glycerine is the main co-product of processing oil into biodiesel. It has multiple applications in the production of various products such as cosmetics, detergents, tobacco, etc. However, a high production of biodiesel can have the effect of supersaturation of the market of glycerin so that the prices of this product may be so reduced that instead of a co-product can become a waste. It is therefore desirable to investigate new applications for glycerine, for its sale to remain economically viable. Currently there are various initiatives and/or lines of investigation:

Production of Biopolymers from glycerol water obtained after the transesterifiación.

Conversion of glycerol into a biofuel called S-50, which could be used mixed with biodiesel produced in the same plant, increasing the efficiency of the biofuel production system.

Use of glycerin as an animal food supplement on the one hand, and production of high added value molecules for various uses on the other.

These examples represent a first stage of the underlying idea in the concept of biorefineries, that is to say, to involve the energy and chemical products, and all co-products from biofuel production.

Environmental sustainability

It is necessary to ensure the achievement of positive energy and CO_2 balances for power generation from biomass, considering the full life cycle.

Here, the influence of the factor of biomass production, transportation and use, are key factors to securing the sustainability of this production.

In general, in the field of biofuels, new processing techniques in developing and implementing the concept of biorefineries, is expected to enable greater efficiency and productivity of the systems, and therefore, more favourable and environmental friendly energy balances than the current ones.

Increasing
the energy sector contribution to local/rural development

Biomass is one of the renewable energy that generates more jobs, which promotes local development, both in the production and harvesting stages of the biomass production, as in its transformation. An important part of this effect is noticeable in the rural area, much needed to stimulate the establishment and development of its population.

The Biomass Action Plan notes that although there are studies with different results, meeting the objectives of biomass in the European Union set for 2010 could generate between 250,000 and 300,000 new jobs, most of whom would belong to rural areas.

In the case of biofuels, this plan indicates that they generate between 50 and 100 times more employment in the European Union that the alternative fossil fuels, and that meeting the targets set for biofuels for 2010 could generate up to 100,000 new jobs.


2030

Vision for 2030

Previous sustainability criteria

The vision scenarios that follows, have to be considered in the light of the following sustainability criteria which must be respected at a global scale:

The alteration of natural forests and other unique ecosystems such as meadows, can't be considered for biomass production.

Specific plans for compatible energy uses with other sectors will be developed.

A favorable net balance of energy efficiency and emission of greenhouse gases for a given application of energy, considering the chain complete will be obtained.

Alternatives for more environmental sustainable biomass obtaining and processing will be adopted, through the implementation of good agricultural practices adapted to the capabilities of each environment, taking into account the efficient use of water by the new energy crops.

Indicators to assess the achievement of the objectives of sustainability within the framework of certification schemes agreed in Europ, will be developed.

Vision scenarios

With the best available knowledge of the current situation of the biomass sector, the following scenarios for 2020 and 2030 are raised in terms of participation rates on the total energy consumption.

According to data collected by the studio *Well-to-Wheels Analysis of future automotive fuels and powertrains in the European context* developed by JRC-CONCAWE-EUCAR in 2006, in 2020, Spain will have to respond 20% of primary energy demand estimated in 200 Mtoe, with renewable energy, approximately 40 Mtoe, of which 22 Mtoe roughly correspond to biomass.

Electrical Applications: from an objective of 37% of total participation renewable electricity by 2020, in line with the proposal of the Spanish Strategy for Climate Change and Clean Energy (Proposal for the Spanish National Council for Climate and and the Coordination Committee for Climate Change Policy in February 2007, adopted in July of that year by the Government), of the Ministry of Environment, Rural and Marine Environment, a 5% correspond to biomass (Approximately 8 Mtoe).

Thermal Applications: from a total renewable energies participation of 25% for thermal use in 2020, as proposed by the European renewable energies associations of in its position documents about the Green Paper of the European Commission “European Strategy for Sustainable, Competitive and Safer energy”, 20% correspond to biomass (about 10 Mtoe).

Transport: the binding target adopted by the European Council in March 2007, a 10% share of biofuels in the transport sector in 2020 (from a total consumption estimated by the study of Energy Scenarios for Spain, of 40-50 Mtoe in 2020 of fuels in the transport sector) would be equivalent to a consumption of 4-5 Mtoe)

In 2030, an scenario of savings and energy efficiency improvement is suposed, which would moderate the increase in overall energy consumption, in line with the forecasts of the European Union in the document European Energy and Transport Outlook to 2030 (2030 energy and transport prospects in Europe) published in 2006, and technological development and implementation of policies to promote renewable energy. Moreover, according to the research *How much biomass can Europe use without harming the environment?* of the European Environmental Agency - EEA - developed in 2006, substantial quantities of biomass can technically be available to meet ambitious targets for renewable energy, even if stringent environmental restrictions are applied. The potential of bioenergy in 2030 (EU 25) represents approximately 15-16% of the projected primary energy requirements of Europe in 2030. Given this situation could propose the following objectives:

Electrical Applications: The contribution of biomass will increase to 10 Mtoe, considering about 5% of total energy consumption expected in 2030.

Thermal Applications: The contribution of biomass will increase to 12 Mtoe, considering approximately 6% on the expected total energy consumption in 2030.

If we refer specifically to the thermal and electric biomass potential for 2030, this will be provided primarily by three groups of materials:

Organic wastes, which will contribute to 100 Mtoe in 2030, considering as raw materials involved, the livestock droppings, wastes from the forestry industry and black liquor.

Energy crops, which will help with the increas in crop productivity, the opening of agricultural markets and the introduction of new crops with high yields.

Forest biomass, whose potential is estimated at 40 Mtoe that are constant throughout the study period (2010-2030). Without increasing the prices paid for biomass, the potential of forest biomass is determined by demand for timber, considering that with increasing demand for wood along time, forest residues will also increase.

This study also shows that while the environmental considerations restrict the amount of technically exploitable biomass from wastes, crops and forests, their use may generate additional benefits related to biomass production and nature conservation. For example, forest management and the wastes removal reduce the risk of forest fires in forests and many other benefits. Furthermore, new systems of energy crops and perennial energy crops could also provide diversity and to have lower requirements of pesticides and fertilizers that the current systems of intensive agriculture.

Transport: the panel of Biofuels Advisory Council - BIOFRAC - established by the European Commission and composed by experts from different areas (industrial, academic, research) related to the biofuels sector, in its document Vision Biofuels in the European Union: A Vision for 2030 and beyond presents a 25% participation of biofuels in 2030. This report was also adopted as an introductory and a decision maker document by the European Biofuels Technology Platform - EBTP -) in their strategic research agenda.

To achieve these goals the industrial establishment of biofuels produced from ligno-cellulosic raw materials is required, during a long period, they will coexist with those produced from conventional raw materials (conventional bioethanol and biodiesel).

Furthermore, the International Energy Agency - IEA - raises in its World Energy Outlook - 2006 in a scenario of technological development, a share of 12% of biofuels on the transport sector in 2030 in the European Union. Nationally, 25% participation of biofuels of total transport fuel sector in 2030, would consume approximately 10 to 12.5 Mtoe, and a contribution to the total primary energy needs of approximately 5%.

Taking into account the previous references, it could be posed an intermediate stage in 2030, which reached a 15% replacement of fossil fuels by biofuels. Achieving this goal would require an injection of raw materials both domestic and imported. If data from the Biofuels Cometee, from the old Ministry of Agriculture, Fisheries and Food, now Ministry of Environment, Rural and Marine areas are extrapolated, to meet the objectives of the Spanish Renewable Energy Plan (PER) 2005-2010, the achievement of 15% biofuels replacement (6.6 Mtoe) in 2030 could be achieved with a dedication of a national area of:

825,000 ha for biodiesel: assuming up t0 15% national raw material depending on the crop (rapeseed - high oleic sunflower) and the yields obtained.
1,700,000 hectares for bioethanol: assuming 100% domestic raw materials, with an orientative distribution as follows:
Wheat: 1,100,000 ha
Barley: 500,000 ha
Maize: 100,000 ha
Beetroot: 100,000 ha

Analyzing these numbers with the national agricultural area, and maximizing its use, it is reasonable to set the 2020 target of 25% of national raw material for biodiesel and 70% to the goal of national raw material for bioethanol.
By an effective incorporation of an industrial level of biofuels produced from ligno-cellulosic material in the period 2020-2030, would allow a diversification of raw materials, including the use of residual agriculture and forestry lignocellulosic materials, and full use of energy crops.

Considering the used resources:

Energy crops must have contributed in terms of primary energy, an amount not lower than 7 Mtoe/year to the biomass mix. t should considerably have increased the energy use of wastes, mainly agricultural. These should provide not less than 2 Mtoe/year of primary energy.

It should have reached a level of technical development and management in the biomass collection and supply chain able to provide different scales of biomassic material in a safe way to the facilities, in a competitive cost and with quality.

These figures have been calculated taking into account the use of about 2 Mha of agricultural land, and approximately 10% use of agricultural wastes produced at present. The contributions of biomass to produce heat and electricity should have reached a level of competitive efficiency and cost compared with fossil sources:

Maximum level of fossil fuel substitution in co-combustion with coal. Biomass should contribute with around 10% of the energy fuel of the coal-fired power plants through the incorporation of multi fuel cogeneration technologies with high efficiency.

Development of multi-fuel plants in electricity production, thereby increased efficiency and reduced costs of generation with biomass.

Development of applications for heating and cooling of high performance and efficiency in the domestic and industrial sectors.

In the transport sector:

Beyond the diversification of the fleet of cars towards advanced propulsion systems, such as fuel cell, it is estimated that the majority of the fleet will keep the current technology, so that biofuels should be used in internal combustion engines, gasoline or diesel.

Plants with current technology will keep its business with the criteria for the corresponding optimization considering its evolution, which is expected to mark a considerable increase in its efficiency, including possible integration into biorefineries. A parallel development in terms of saving energy costs will follow the consideration of raw materials for their production.

While the car manufacturers have a strong vision in favour of biofuels produced from ligno-cellulosic materials and, more specifically, towards the fuels generated from biomass, they will coexist with the current ones (biodiesel and bioethanol).

The biorefineries integrated with co-production of biofuels, chemical products and other forms of energy will be in full operation. The biorefineries will be characterized by the efficient industrial-scale integration of the various stages, from the handling and processing of biomass, fermentation in bioreactors, chemical conversion and obtaining and purification of final product/s.

Strategic objectives

Assurance of supply:

Efficient and sustainable Implementation of energy crops.

Comprehensive biomass use (full resource) and the use of new biomassic raw materials.

Development and implementation of technologies for biofuels production from ligno-cellulosic materials.

Development and implementation of co-generation technologies for multi-fuel and with higher efficiency.

Widespread the use of standardized biofuels in heating and cooling applications, both in industry and domestic fields.

Developing the concept of biorefineries maximizing the use of biomass: biofuels production, electricity and other bio-chemicals with high added value, thereby improving the overall sustainability of the process.

Improvement efficiencies of the valorization teams.

Technical potential that holds the objectives

The European research program on biomass resulted in the Seventh Framework Program for R&D of the European Union, which includes most the set strategic objectives and is the biggest opportunity to incorporate the international collaboration to the achievement of national objectives

National R&D programs like PROFIT or CENIT among others.

In the context of these programs, many projects are developed, like:

The development of national strategic projects about biogas (ProBioGas), energy crops (On-Cultivos) and about collection and use of forest biomass (Eco-Combos), covering aspects of resources production and the development of applications and energy conversion technologies.

The development of integrated industrial research projects with a strategic character like the ones under the CENIT call, like the "Research for the Promotion of Biodiesel in Spain" or "Research and Development of ethanol for Automotive"

Considera-tions for reaching the targets

Availability of biomass: the dedication of arable land to produce biomass for energy generation competes with other markets which often increases the price. It should be taken into account the influence of the international market on the supply of raw materials, the Common Agricultural Policy (CAP) and agreements of the Organization for Economic Cooperation and Development - OECD - for the release of the agricultural product market worldwide.

Need of stability in the adequate frameworks to encourage private sector investment.

Inclusion its externalities in the calculation of the cost of bioenergy balance in economic terms: the environmental and socioeconomic benefits.

Implications in local markets of third countries of the subsidy policies implemented in occidental countries.

Benefits

Diversification of energy sources to ensure its long-term supply.

Establishment of an industrial sector linked to bioenergy nationally consolidated, both directly in energy production, as in the manufacture of the equipments required throughout the hole valorization biomass chain.

Promotion of sustainable agriculture and forestry, including reducing the risk of forest fires.

Reducing emissions of greenhouse gases collaborating in meeting the goals set by the Kyoto Protocol through the replacement of fossil energy sources and the efficient energy use, freeing up the economic growth in its consumption.

Increase the percentage of energetic valorized wastes instead of their dumping.

Strategic research agenda

The definition of a Strategic Research Agenda is one of the main objectives of the technology platforms, because through this instrument makes possible the implementation of the vision they agents on the platform have respecting to the area where they work. These agendas identify the actions to be carried out in the R&D field to meet the objectives proposed in the framework of these forums and permit the industry development.

The Spanish Biomass Technology Platform - BIOPLAT- mainly aims at determining the conditions and at identifying and developing viable strategies for the promotion and sustainable commercial development of biomass in Spain. In addition BIOPLAT has the following specific objectives:

1. BIOPLAT aims to provide a framework within which all sectors involved in the development of biomass work together in a coordinated way to ensure that the commercial settlement of biomass in Spain enjoys a continuous growth, in a competitive and sustainable way.

2. To analyze the current situation of biomass in Spain in all its aspects and to identify needs in R&D.

3. To recommend research funding in areas with high relevance to biomass, covering the whole economic value chain, raising awareness and mobilizing public authorities, both at nationally, regionally and locally level.

4.To propose strategies and sustainable alternatives, in particular type of technology, to boost biomass development and the elimination of existing barriers to enable its implementation.

5.To promote coordination between different involved sectors (entities, Technology Centres, universities, etc.).

6. To spread biomass possibilities and in particular the results and recommendations of the Platform.

In BIOPLAT, the identification of the strategic actions that would favor the implementation of the primary objective of this platform was implemented in three stages. In the first step, it was considered appropriate to conduct an analysis of the current situation of the biomass sector. To this end, the method used was the SWOT matrix, which classifies the weaknesses, threats, strengths and opportunities of each segment of the industry. Given the heterogeneity of the biomass and diversity of the technologies involved, and the objective to conduct an analysis as complete as possible, matrices were developed within each level (working groups, and included in these, working subgroups) within the groups directly involved in the biomass sector. These groups and subgroups are:

Biofuels for Transport Working Group:
Its main objective is to identify necessary measures for the development of biofuels production in Spain from biomass following criteria of economic and environmental sustainability. Within this, there are subgroups of Bioethanol, Biodiesel, Biogas and Synthetic Biofuels and Biorefineries.

Raw Materials Working Group:
Its aim is to establish key factors in the logistics of raw materials supply for the different technologies of biomass use, and to raise necessary actions for its optimal development. Within this, there are subgroups of Raw Materials, Machining & Logistics, Organic Wastes and Algae.

Biomass for Thermal Generation Working Group:
Its aim is to develop activities that contribute to increase the feasibility of biomass use in thermal sector, both industrial and domestic field, considering aspects of economic, energetic and environmental sustainability.

Biomass for Electricity Generation Working Group:
Its aim is to promote the use of biomass as an energy resource for electricity production, from both the supply and demand, taking into account sustainability criteria. Within this group, the subgroups are Gasification, Biogas, Combustion, Co-combustion and organic fraction of municipal solid wastes (OFMSW).

Sustainability and Regulatory Framework Working Group:
Its aim is to promote the economic developments of the biomass industry within the framework of sustainable development. Promoting the adaptation of legal and economic regimes which shapes the regulatory framework for biomass energy and its uses. Within this, there are subgroups of Sustainability, Regulatory Framework and Biomass Traceability.

There are other working groups that are not prioritized the development of the SWOT analysis and identification of priority actions, since they are horizontal groups critical to the articulation of the work done by the Platform. These groups are:

International Relations Working Group (its primary purpose is to encourage the participation of Spanish entities (public and private) within the European research programs and with respect to biomass),Education and Diffusion Working Group (its main objective is the incorporation in the curricula of different degrees, the specific skills required by the sector and, on the other hand, it disclosures all information of the sector that may be of interest to the members of the Platform, and it increases their understanding) and the Consultative Working Group (its objective is to increase the coordination between different administrations and other related institutions for the promotion and development of technologies related to biomass. It also aims to maximize the public resources devoted to R&D)

Once the starting point and the desirable future scenarios gathered in this document were clear, those strategic actions that would bring the biomass to an optimum position for allowing the fulfilment of the objectives set in the Spanish Renewable Energy Plan (PER) 2005-2010, as in Europe with the new renewable energies directive, were identified.

Each group and subgroup previously mentioned, identified those strategic actions which through the R&D could allow bioenergy to get from its current position to a desirable future situation.

Given the large number of actions identified, they have been ranked according to priority within the Coordinator Group of BIOPLAT, formed by the coordinators of all working groups, in which all the agents involved in the biomass sector are represented.

Strategic actions have been collected and captured in a document known as Strategic Research Lines. This document contains 14 prioritary research lines, and two lines known as support to development lines. Each of these lines includes a strategic action for which a set of objectives and goals in the short (5 years), medium (10 years) and long term (15 - 20 years) are defined.

These priorities, with a development document, will make up the Strategic Research Agenda of the Spanish Biomass Technology Platform - BIOPLAT - .

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Thank You

The preparation of this document has been possible through the efforts and enthusiasm of the Coordinator Group of BIOPLAT, which started work on it shortly after the constitution of BIOPLAT. Once the first version of this document was ready, it was kept on stand-by while all members of BIOPLAT produced the document of the Strategic Research Lines, to take it up later and update its content. The result is this document that we are now presenting.

Entities like the Spanish National Renewable Energy Centre, CENER; the Foundation for Research and Development in Transport and Energy, CIDAUT; the Center for Environmental and Energy Technology Research of Spain CIEMAT; the Spanish National Institute of Agriculture, Technology and Food Research, INIA; and companies such as ABENGOA, ACCIONA, and the Spanish Renewable Energy Association, APPA, deserve a special mention.

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