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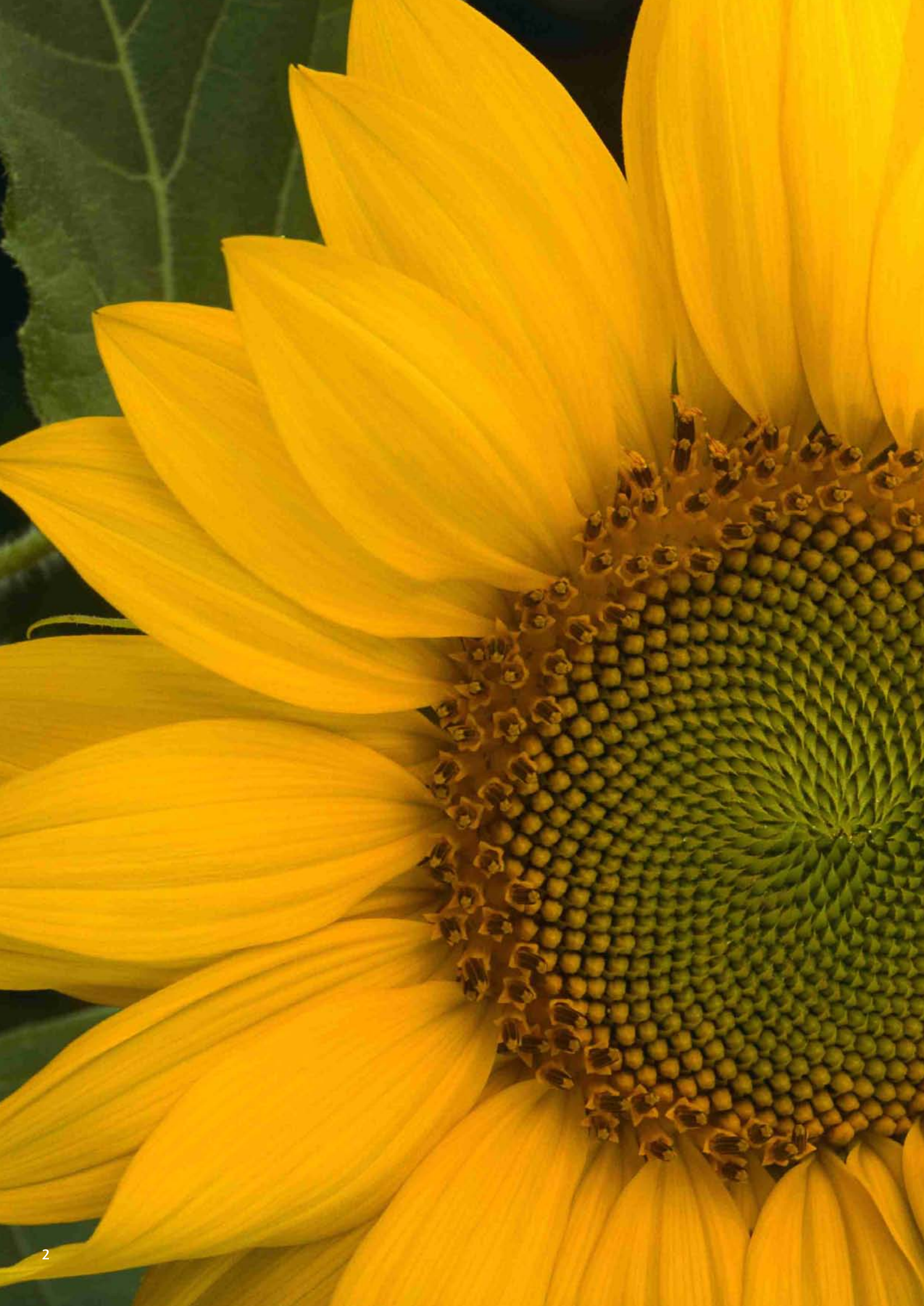
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Strategic Research Lines Document

BioPlat 
SPANISH BIOMASS TECHNOLOGY PLATFORM

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Introduction

The importance of bioenergy in Spain is irrefutable; we only need to look at the Spanish Renewable Energy Plan (PER) 2005-2010 to realize this. The goal set in this Plan aims to reach 12.1% of primary energy being produced from renewable sources by 2010. This goal is 60% based on bioenergy, which paradoxically is the least-developed renewable technology in Spain.

In addition, in the Spanish Renewable Energy Plan (PER) 2005-2010, targets by technology and type of biomass feedstock have been set. For biomass from energy crops and agricultural, industrial or forestry wastes, (b.8 and b.6 groups of the Royal Decree 661/2007) a goal of 1,317 MW to be installed in 2010 was set. However, this goal has only slightly exceeded 30% of the power target in Spain. For biogas (b.7 group of the Royal Decree 661/2007) a power target of 194 MW was set and currently, around 80% of target has been satisfied, mainly due to the biogas from the landfill degasification.

It is necessary to facilitate the achievement of the objectives. Moreover, the situation has become more urgent with the approval of the mandatory target set out in the European Directive on the promotion and use of energy from renewable sources, which states that 20% of the final energy consumption has to come from renewable sources by 2020.

In the case of biofuels, according to the report *Capacity, Production and Consumption of Biofuels in Spain: situation and prospects* developed by the Biofuels Department of the Spanish Renewable Energy Association -APPA-, 388.6 ktoe of biofuels were consumed in 2007 in Spain (129.6 ktoe of bioethanol and 259.0 ktoe of biodiesel), while total sales of automotive gasoline and diesel amounted more than 33,336 ktoe. Comparatively the market share of biofuels in that year was only 1.2%.

The prices of certain raw materials and the compliance of the strict mandatory sustainability criteria set by Brussels, call for the development of new biomass materials such as algae, lignocellulosic materials or waste; to improve of the existing production processes; to develop alternative production technologies. These developments and their implementation will not only help the performance of the target of 5.83% use of biofuels set in the Spanish Renewable Energy Plan (PER) 2005-2010 by 2010 (which has subsequently led to the introduction of mandatory targets for biofuel consumption for 2009 and 2010) but also in order to comply with the mandatory target picked up by the recent Directive on the promotion and use of energy from renewable sources, which states that by 2020, 10% of the energy consumed in the transport sector has to come from renewable sources, in which biofuels will play a major role.

The biomass sector is hugely diverse, covering three very different fields: raw materials, its processing into biofuels, and their applications. Each of these fields can be subdivided into more, making a hugely diverse factorial collection. The basis of biomass is the availability of the resource, which is rarely taken into account. Therefore, there are projects based on application and processing technologies that fail to achieve the expected success due to the lack of raw materials availability.

It is obvious that a clear policy on R&D on biomass is needed, with an adequate budget commensurate with the expected importance of this type of renewable technology, and taking into account all the links involved in the sector (raw materials production, collection, processing and logistics machinery, valorization processes, etc.), in order to promote the development of national equipments and generate the conditions to enable the improvement and maturation of the biomass markets.

In Spain, the current research activity in the bioenergy field is still at a base level, with small investments away from commercial deployment. There is a gap between research and implementation of the developed technologies, that has to be filled with research activities at a demonstration and industrial scale, which requires larger investments, that are very scarce at present.

The parties involved in the investigation are mainly universities, research centers and small technology-based companies, this is the reason of the very specific developments on their applications, a lack of vision of the integrated chain, and finally, the missing extrapolation to the industrial scale. Similarly, programs for financing R&D in renewable energy, are scattered and many overlap those from different organisms, with a lack of coordination among the various funding entities. There is no national uniform proper planning for technology development in the field of renewable energies (lines, objectives, etc.).

The Spanish Biomass Technology Platform -BIOPLAT- in compliance with some of the objectives that are its reason of existing, as the identification of high relevance areas for biomass, and approach strategies and sustainable alternatives that enable the final take off of the sector, has produced this document named the *Strategic Research Lines*, which will serve as the basis of the Strategic Research Agenda of BIOPLAT.

This document contains a number of high priority research lines, whose purpose is to indicate those areas or segments of the biomass sector in which it is considered that R&D investment, would be a breakthrough in eliminating the barriers that are impeding the progress of the sector.

Each line consists of an action, which generally defines the ultimate objective of the research. Each action has been defined with a number of objectives. The latter are associated with some goals in the short (5 years), medium (10 years) and long term (15 to 20 years) who are the targets to be achieved within the set time intervals to allow the desired progress in the sector.

There are a total of 16 strategic lines, classified into two categories depending on their purpose:

14 strategic research lines aimed at the promotion of R&D in the biomass sector. These lines indicate those strategic issues that may boost the evolution of the sector through the development of R&D in all its areas:

- Raw materials.
- Technologies.
- Logistics.
- Regulatory Framework.
- Sustainability.

2 support to development lines that, not being research per se, they are horizontal actions for all of the biomass sector areas, which both significantly would favor the promotion of R&D as well as the boost of the biomass.

The definition of these lines has been the result of a long process of analyzing the current state of the sector and the R&D in the bioenergy field in Spain; at a later stage, defining the goals that, once achieved, would allow the development of the potential that biomass could provide as a renewable source of energy, according to the document *Vision to 2030* of BIOPLAT. In the first phase, a study was carried out on the current state of the biomass sector through a SWOT analysis of all the subsectors. As the result of the analysis, the strengths, weaknesses, opportunities, and threats for each subsector were indentified. This method was used at first within each subgroup, of the following BIOPLAT working groups:

- **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 Microalgae.
- **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 a resource for electricity production, from both to 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 which have not been a priority in the elaboration of the SWOT analysis and the subsequent 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 (whose goal is to encourage the participation of Spanish entities, both public and private, within the European research programs and with respect to biomass); Education and Diffusion Working Group (its main objective is the incorporation into the curricula of the various degrees, the specific skills required for the sector, and on the other hand, the disclosure of all information in the sector that may be of interest to members of the Platform); and the Consultative Working Group (its goal is to increase coordination between different administrations and other related institutions for the promotion and development of technologies related to biomass, optimizing public resources devoted to R&D).

With the analysis done by each individual sub-working group, one was established for each group, making a compilation of all the critical points for the development of R&D (preliminary research lines) that was identified by the various subgroups in each working group, and selecting the real priorities.

Once this analysis and subsequent compilation of the critical points in R&D was done, the definition of the strategic research lines begun, based on the development of these points that had been identified as critical for the whole industry. Given the heterogeneity of the sector and the cited current barriers to its development, a large number of lines on each subgroup were identified. Prioritization and treatment of these research lines was conducted within the Coordinator Group of BIOPLAT. In which all the coordinators of the working groups are present, and therefore, all areas of the sector are represented in a balanced and an objective way.

After a large number of meetings, where sometimes it was difficult to reach consensus, and working hours after, 16 priority research and support to development lines were defined, as it is reflected in the following tables.

Priority Research Lines

A close-up photograph of a hand holding a glass pipette, dispensing liquid into a grid of small, circular pots. Each pot contains a young, green, grass-like plant. The background is a blurred field of similar plants, suggesting a large-scale agricultural or research setting. The text "Priority Research Lines" is overlaid in white, serif font.



- 1 • Studies of production and market potential with sustainability criteria
- 2 • Development of agricultural practices and forest practices of biomass produced from crops and other additional biomass sources
- 3 • Study / analysis of a certification system for raw materials, products and co-products
- 4 • Biofuel production from alternative raw materials and by conventional technologies
- 5 • Technologies used for biofuels production from lignocellulosic biomass
- 6 • Develop concepts for biorefineries
- 7 • Improve logistics (machinery and field pretreatment, methods of collection, transport and storage) and their associated processes to supply biomass plants
- 8 • Development of commercial solid biofuels from non-conventional raw materials and processes and development of technology for its use
- 9 • Life cycle assessment (LCA):
 - Raw Materials
 - Processes
- 10 • Development and demonstration of valorization systems for the ashes and slag produced during combustion
- 11 • Optimization of pretreatment facilities, power systems and burners for combustion and co-combustion of biomass in order to reduce costs
- 12 • Improvement of gasification systems for the flexible use of different biomass, either independently or combined
- 13 • Recycling and utilization of digestate
- 14 • Feasibility of the use of biogas in vehicles and small engines for electric power generation, including gas cleaning

Studies of production and market potential with sustainability criteria

Objectives:

IDENTIFY a working methodology that enables the establishment of real targets

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Preparation of documents setting out the methodology and objectives		

IDENTIFY the potential and parameters characterizing the availability of each biomass

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
<p>Elaboration of a database associated with the availability of biomass in a small scale</p> <ul style="list-style-type: none"> • Physiography and sustainability • Farm land and competition with other uses • Collection and treatment technologies • Policies on management and use • Industries producing waste biomass • Returns of large-scale energy crops • Distribution of land, crop area, fallows, etc. <p>Carrying out inventories of the current potential of different types of biomass</p> <p>Estimating the potential for sustainable energy crops in Spain</p>	<p>Integration of results and statistical data, reports and sectorial inventories</p> <p>Proposing strategies to improve the availability criteria of biomass</p>	<p>Setting standards for management and administration in the areas involved in generating effective and sustainable biomass for energy uses</p>

ENCOURAGE cultivation on degraded, abandoned or contaminated lands

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Developing an inventory and characterization of lands Identification of the suitable types of commercial varieties of plants for these lands	Putting into agricultural production of selected demonstration areas with energy crops	Launching a program to start the agricultural production of these lands

MEETING the energy demand with the available biomass

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Market analysis of the current supply and demand for biomass and projection future scenarios in the context of renewable energy		

Development of agricultural practices and forest practices of biomass produced from crops and other additional biomass sources

Objectives:

DEVELOP breeding programs and selection of species designed to produce energy and adapted to each territory characteristics

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Definition of criteria and indicators of sustainability as an integrated goal in improvement programs Assessment and selection of parental specimens with potential interests	Obtention of efficient varieties according to energy sustainable criteria Evaluation in field of these varieties	Market integration and implementation of improved materials specifically for energy production

OPTIMIZE cultural practices apply to the biomass production and to the territorial needs and requirements

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Definition of the best practices according to sustainability criteria apply to energy crops	Methodological design and implementation of sustainable management practices in the production of biomass for energy at a local level	Extension of sustainable management practices

CHARACTERIZE the main biomass energy sources under normalized standards

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Definition and standardization of biomass quality and valorization parameters Creation of a public database containing the characterization parameters of different biomass kinds		

Study / analysis of a certification system for raw materials, products and co-products

Objectives:

ANALYZE all potential biomass fuel

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Identify, qualify and quantify them	Facilitate its uses	Identify and valorize the waste produced

DEVELOP measuring systems to determine the traceability of the biomass in the industrial plant

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Installation in plant of control and measuring systems for the valorized biomass which will be economically viable to install and user-friendly		

ASSESS the sustainability of crops by indicators of biomass sustainability

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Characterization of the indicators that make up a program to monitor sustainability in the use of biomass	Development of a standard procedure for certifying the sustainability of biomass Study / planning for the establishment of a traceability monitoring body to ensure the sustainability of both national and imported biomass	Implementation of a certification system of biomass produced under sustainability criterias

APPLY the use of chemical tracers to biofuels in Spain

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Development of tracer identification procedures		

Biofuel production from alternative raw materials and by conventional technologies convencionales

Objectives:

SEARCH for new raw materials

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Develop a database of materials and their characteristics	Medium-scale production of biofuels from these raw materials	Implementation of a large-scale production project with the introduction of the appropriate technologies

ADAPTING technologies to new materials

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Identifying the adaptation needs of the technologies	Adaptation of the technologies	Implementation of a large-scale production project with the introduction of the appropriate technologies

Technologies used for biofuels production from lignocellulosic biomass

Objectives:

DEVELOPMENT of technologies for biofuels production through **biochemical** conversion of lignocellulosic biomass

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Generate knowledge and research infrastructures, new processes of critical points of the technology: <ul style="list-style-type: none"> • Thermochemical and biological pretreatment • Production and mixes of enzymes for hydrolysis • Innovative fermentations 	Integration of the processes in pilot and demonstration plants	Implementation on an industrial scale

DEVELOPMENT of technologies for biofuels production through **thermochemical** conversion of lignocellulosic biomass

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Technical, economical and environmental feasibility studies of different technologies (products, processes of conversion, etc.) Generate knowledge and research infrastructures, new processes of critical points of the technology: <ul style="list-style-type: none"> • Thermochemical pretreatment • New gasification concepts • Cleaning and conditioning of gas • Synthesis processes: ethanol, alcohols, DME, diesel 	Integration of the processes in pilot and demonstration plants	Implementation on an industrial scale

Develop concepts for biorefineries

Objective:

DEVELOP advanced biomass conversion concepts, identify synergies between the fuels generation and industries fully established

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Identification and techno-economic evaluation of products, processes and integrate them within the concept of biorefinery	Trials and testing on a laboratory scale	Demonstration of integrated concepts

Improve logistics* and their associated processes to supply bioenergy plants

Objectives:

IMPROVE the technical and economical feasibility in the handling and management of the biomass in order to increase its availability and ensure the supply

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Assessment of the parameters that determine the costs of handling and management of technical and human resources in the biomass generation	Demonstration projects of optimized mechanization in the collection of the main biomass	Harvesting and handling of biomass for differential valorization of biomass products in the commercial level
Identification and assessment of critical points of the existing logistics chains and identifying improvements and new options	Demonstration projects of optimized machinery for cultivation, handling and processing of various biomass	Market introduction of specific and adapted machinery for the biomass use

DEVELOP specific machinery for the biomass optimization and management

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Development of machinery designed for the cultivation, collection and in a pre-commercial level	Demonstration projects of optimized mechanization in the collection of the main biomass	Harvesting and handling of biomass for differential valorization of biomass products in the commercial level
Implementation of optimized storage systems for each biomass	Demonstration projects of optimized machinery for cultivation, handling and processing of various biomass	Market introduction of specific and adapted machinery for the biomass use

* (machinery and field pretreatment, methods of collection, transport and storage)

OPTIMIZE the biomass transport to processing plants

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
<p>Development of biomass densification systems through thermochemical and physical processes</p> <p>Development of computerized management tools for calculating optimal and critical logistics routes</p> <p>Determination of the optimum measurements for the logistics in biomass specific transport</p> <ul style="list-style-type: none"> • Assessment of the most effective means of transport and proposing technical measures needed for its achievement • Assessment of transport routes and proposing improvement and management measures 	<p>Availability of optimized means for efficient transport of biomass</p>	

Development of commercial solid biofuels from non-conventional raw materials and processes and development of technology for its use

Objective:

DETERMINE the process conditions, energy and economic costs of the production of pellets and other commercial solid biofuels from non-conventional biomass and processes. Development and validation of technologies for its use

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Production of pellets and other solid biofuels. Defining quality standards	Production of pellets and other solid biofuels with quality standards	

Life cycle assessment (LCA):

- Raw Materials
- Processes

Objectives:

DEVELOP a harmonized methodology for calculating LCA (according to the needs of the sector at an international level)

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Creating a database containing data from processes and emerging technologies Introduction of parameters to be considered in the LCA based on sustainability criteria	Implementation of certification with the prefixed limits	

IMPROVE energy efficiency and reduce emissions in different production lines

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Determination of the current limits and setting targets	Achieving the new set targets	

INCLUDE estimations for each phase of the economic analysis

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Define the tools that allow quantification of the various costs involved in the analysis at each stage of the LCA		

INCLUDE the sustainability certifications for the biofuels

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Define the model of certificate, which includes information about the results of the LCA, joining them with the corresponding raw materials packs or finished product (biofuel)		

Development and demonstration of valorization systems for the ashes and slag produced during combustion

Objective:

VALORIZATION of Ashes and slag

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Characterization of ashes and slag, identification of viable options for its use	Specific plant construction (between 2 and 4 units) for the mixing and treatment of the ashes from various sources, to generate high added value products	Identify different mixtures from different fuels to produce particular ashes for certain uses, as well as mixtures of ashes from different boilers as a higher added value product Identify ash treatments to increase their added value

Optimization of pretreatment facilities, power systems and burners for combustion and co-combustion of biomass in order to reduce costs

Objective:

MINIMIZE the sintering

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Identify mechanisms that produce the formation of sintered in combustion plants and develop alternatives to reduce or avoid these phenomena	Implementate of these mechanisms in the boilers	

Improvement of gasification systems for the flexible use of different biomass types, either independently or combined

Objective:

IMPROVING the efficiency and versatility of gasification systems for different biomass fuels

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Characterization of gasifiers according to the presentation or pretreatment of the raw material Determine the optimal conditions of the process according to the installation and presentation of the raw material	Demonstration plant construction at a pilot scale of gasification systems for generating electricity	

Recycling and utilization of digestate

Objective:

STANDARDIZED use as fertilizer in different crops (energy or traditional crops), contributing to the sustainability of the respective systems

HITOS		
Corto Plazo (5 años)	Medio Plazo (10 años)	Largo Plazo (15 a 20 años)
Treatment characterization and agronomic enhancement trials of digestate Field analysis of the previously established control parameters	Obtaining information and conclusions about the behavior of the crops and the digestate used	

Feasibility of the use of biogas in vehicles and engines for electric power generation, including gas cleaning

Objective:

INCREASE the viability of the use of biogas from landfills and biogas plants for generating electricity and transport

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Develop cleaning systems for biogas for transport and energy production	Obtaining data of the engines test program	Validation and certification of the techniques and technologies employed
Plants construction and testing of methodologies for monitoring and controlling, as well as improving the quality of the supplied biogas	Obtaining data on prototype testing	
Analysis of the established control parameters		

Support to Development Lines



Analysis of the existing regulatory framework

Objectives:

REGULATE all fuels including the any potential fuels

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Studies of the different regulatory frameworks affecting the sector (waste, environmental, Common Agricultural Policy (CAP), forestry, transport)	Unify the different regional regulatory frameworks to European guidelines	

INCLUDE all the existing valorization technologies, levels of capacity that could be installed (if necessary) and all the possible hybridizations that may arise

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Integrating these technologies, levels of capacity and potential hybridizations in the regulatory frameworks		

REMOVE barriers (streamlining of bureaucratic procedures)

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Creation of a unique window		

Social perception of the sector in society

Objectives:

STUDY the social opinion about bioenergy

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Sociological studies		

IMPROVING the society understanding and knowledge on bioenergy (benefits, opportunities, etc.)

GOALS		
Short term (5 years)	Medium term (10 years)	Long term (15 to 20 years)
Campaigns at all levels		

Thank you

to all the BIOPLAT members and the coordinators of the working groups and subgroups who, in successive and sometimes never ending meetings, have made possible to have the first Strategic Research Lines document in the bioenergy field in Spain.

Additional thank you to the BIOPLAT Coordinator Group members who have been the left and right hands that have managed to bring this document to the light: entities like CDTI (Centro para el Desarrollo Tecnológico Industrial ~ the Spanish Centre for Industrial Technology Development); CENER (Centro Nacional de Energías Renovables ~ the Spanish National Renewable Energy Centre); CIDAUT (Fundación para la Investigación y Desarrollo en Transporte y Energía ~ Research and Development Center in Transport & Energy); CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas ~ Public Research Agency for Excellence in Energy and Environment); INIA (Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria ~ the Spanish National Institute of Agricultural, Technology and Food Research); and MICIIN (Ministerio de Ciencia e Innovación ~ the Spanish Science and Innovation Ministry); companies such as ACCIONA, ABENGOA and REPSOL, and the Agroenergy Unit belongs to the Technical High School of Agronomic Engineers of the Technical University of Madrid, and the Spanish Renewable Energy Association, APPA.

We all have invested a lot of effort and determination on this strategic report, but in the end we have succeeded thanks to the consistent and coordinated work of all BIOPLAT members. All of us can feel proud of it.

Margarita de Gregorio
Manager - BIOPLAT Secretariat

