

5 EURES

Five European RES Heat Pilots

EIE/04/086/S07.38582



WP3 – Feasibility studies for Marvão and Abrantes

Ulisses Fernandes, João Machado, Elsa Nunes and Mário Costa

February 2006

INDEX

INDEX	II
LIST OF FIGURES	IV
LIST OF TABLES	5
ABBREVIATIONS AND ACRONYMS	6
1 GENERAL OVERVIEW OF THE REGIONS	7
1.1 MARVÃO	7
1.1.1 Location, infrastructure and climate conditions in Marvão	7
1.1.2 Present energy market – industry, household, municipal, service sector in Marvão village	9
1.1.3 Future trends of energy market in Marvão	10
1.2 ABRANTES	10
1.2.1 Location, infrastructure and climate conditions in Abrantes	10
1.2.2 Present energy market – industry, household, municipal, service sector in Abrantes region	12
1.2.3 Future trends of energy market in Abrantes	13
2 IDENTIFICATION OF KEY PLAYERS	14
2.1 MARVÃO	14
2.1.1 Authorities – environmental, agriculture, forest, industry, R&D, finance	14
2.1.2 Industry – forest, energy, agriculture, transportation	16
2.1.3 Associations	16
2.1.4 Legislation, taxes, etc...	16
2.2 ABRANTES	17
2.2.1 Authorities – environmental, agriculture, forest, industry, R&D, finance	17
3 ASSESSMENT OF BIOFUEL HARVESTING POTENTIAL IN THE REGION	18
3.1 MARVÃO	18
3.1.1 Forest resources – forest area and timber production volume	18
3.1.2 Forest industry – companies and their products	19
3.1.3 Potential of forest industry residues – bark, sawdust, shavings, etc...	20
3.1.4 Potential of logging residues from final felling (tops, branches, etc...)	20
3.1.5 Potential of stumps and stem wood loss	21
3.1.6 Potential of small wood from thinnings	21
3.1.7 Potential of agrobiomasses: reed canary grass, straw, etc...	21
3.2 ABRANTES	21
3.2.1 Forest resources – forest area and timber production volume	21
3.2.2 Forest industry – companies and their products	22
4 PROBLEMS	23
4.1 THE PROBLEMS WHICH LIMIT THE USAGE OF BIOFUELS	23
5 ASSESSMENT OF THE BIOFUEL MARKET POTENTIAL IN THE REGION	24
5.1 MARVÃO	24
5.1.1 Current and future potential of biofuel consumption	24
5.1.2 Evaluation of biofuel price – forest industry residues and logging residue chips, agrobiomasses	24
5.1.3 Promising biofuel consumption sites – names and locations	24
5.2 ABRANTES	25
5.2.1 Current and future potential of biofuel consumption	25
5.2.2 Evaluation of biofuel price – forest industry residues and logging residue chips, agrobiomasses	25
5.2.3 Promising biofuel consumption sites – names and locations	25

6 DESCRIPTION OF BIOFUEL HARVESTING TECHNOLOGY AT THE MOMENT	26
6.1 HARVESTING TECHNOLOGY FOR TIMBER – CUTTING AND DELIMBING, TERRAIN HAULAGE AND ROAD TRANSPORT	26
6.2 HARVESTING TECHNOLOGY OF WOOD FUEL – FOREST INDUSTRY RESIDUES AND LOGGING RESIDUE CHIPS	27
6.3 HARVESTING TECHNOLOGY OF AGROBIOMASSES – STRAW AND REED CANARY GRASS	27
7 RECOMMENDATION FOR THE REGIONAL BIOFUEL STRATEGY	28
7.1 TARGET FOR 2010 AND 2015 FOR WOOD FUEL USE – FOREST INDUSTRY RESIDUES AND LOGGING RESIDUE CHIPS	28
8 SELECTION OF CASES STUDIES	29
8.1 MARVÃO	29
8.1.1 Case study 1 – Hotel Albergaria El Rei D. Manuel	29
8.1.2 Case study 2 – Municipal Swimming Pool	29
8.2 ABRANTES	30
8.2.1 Case study 3 – Municipal swimming Pool	30
8.2.2 Case study 4 – School with heat system installed	31
9 REFERENCES	32
10 APPENDIX - LIST OF ORGANIZATIONS AND CONTACT DETAILS	33

Formatada: Índice 1

LIST OF FIGURES

Figure 1-1: Location of Marvão region (source: http://www.cm-marvao.pt/)	7
Figure 1-2: Location of Abrantes region.....	11
Figure 3-1: Pine stems wood with and without bark.....	19
Figure 3-2: Pine Barks and shaving produced in Pires Barbacena sawmill.....	20
Figure 6-1: Forwarder working in the forest (source: www.logistica-florestal.pt).....	26
Figure 6-2: Forwarder and wood truck for industrial roundwood.....	26
Figure 6-3: Harvester and wood chipper machines (source: Forestech).....	27
Figure 8-1: Hotel Albergaria El Rei D. Manuel.....	29
Figure 8-2: Boiler of the Municipal Swimmingpool in Marvão.....	30

LIST OF TABLES

Table 1.1: Population and surface area of Marvão (2003).....	9
Table 1.2: Electricity market data in Marvão (2003).....	9
Table 1.3: Population and surface area of Abrantes (2001).....	12
Table 1.4: Electricity market data in Abrantes (2003).....	13
Table 3.1: Forest area, species distribution, and existing main trees volume of Marvão and Portugal (Source: DGRF 1995).....	18
Table 3.2: Estimative of annual timber production volume in Marvão.....	19
Table 3.3: Production of the enterprise operating in forest industry in Marvão.....	19
Table 3.4: Annual production volumes available in industrial wood residues.....	20
Table 3.5: Estimative of biomass residues production by main species in Marvão.....	20
Table 3.6: Forest area, species distribution and existing tree volume of Abrantes (Source: Municipio Abrantes, 2004).....	21
Table 3.7: Estimative of annual timber production volume in Abrantes.....	22
Table 3.8: Production from the enterprise operating in forest industry in Abrantes.....	22
Table 5.1: Mean price of wood for energy use in Portugal in 2004.....	24
Table 5.2: Price of pine wood residues in Marvão.....	24

ABBREVIATIONS AND ACRONYMS

APFDP	Portalegre District Forest Producers Association
APROFNA	North Alentejo Forest and Farming Producers Association
CCDRA	Commission of the Coordination and Regional Development of Alentejo
CHP	Combined Heat and Power
DGGE	Directorate General of Geology and Energy
DGRF	Directorate General of Forestry Resources
EDP	Portuguese's Electricity Company
EFI	European Forestry Institute
EFN	National Forest Station
EI	Environment Institute
EU	European Union
INE	National Statistical Institute
IST	Instituto Superior Técnico
MADRP	Ministry of Agriculture, Rural Development and Fisheries
MAOTDR	Ministry of Environment Territory Order and Regional Development
MEI	Ministry of Economy and Innovation
MOPTC	Ministry of Public Works Transports and Communications
REN	National Electricity Network
RES	Renewable Energy Source

Formatada: Francês (França)

1 GENERAL OVERVIEW OF THE REGIONS

1.1 MARVÃO

1.1.1 Location, infrastructure and climate conditions in Marvão

Marvão lies in the area of the Serra of São Mamede Natural Park (Portalegre County, Alto Alentejo Province), on an escarpment only a few miles from Spain, with a wide range of flora and fauna due to its geological diversity and varying climate. It includes four districts, with villages set in the wide valleys among the mountains and it is mainly rural, with a predominant agricultural sector. Covering an area of 31750 hectares, the Serra of São Mamede Natural Park includes a large part of the Serra and extends into the municipalities of Arronches, Castelo de Vide, Marvão and Portalegre, bordering on Spain to the east. It reaches an altitude of 1025 metres at its highest point, is the most important range of hills in the Alentejo.

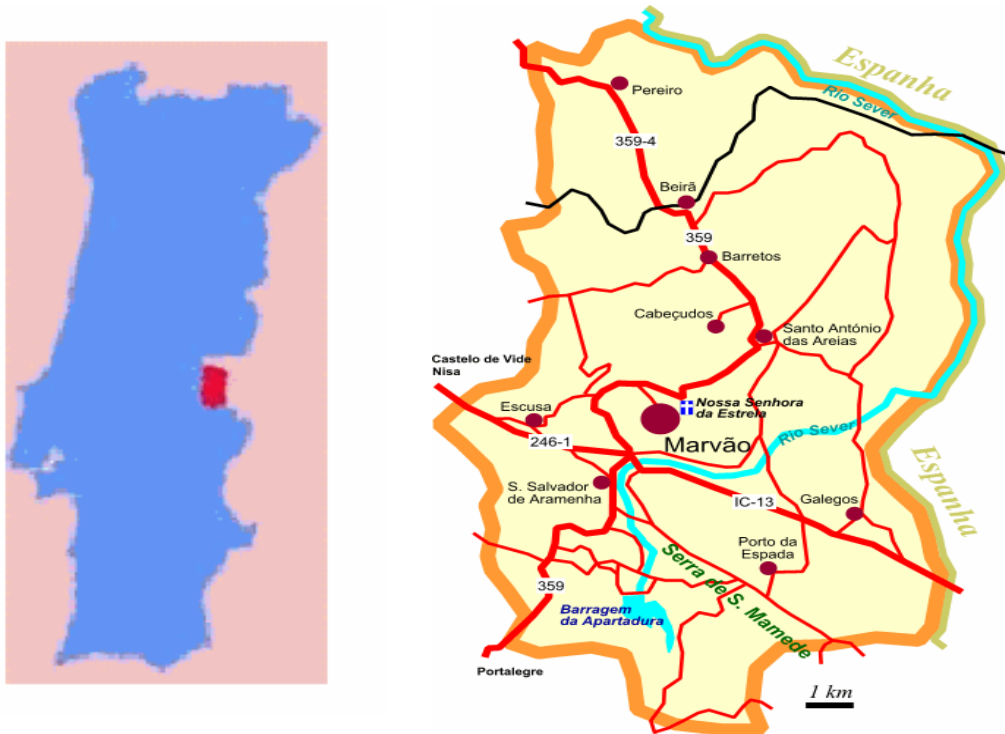


Figure 1-1: Location of Marvão region (source: <http://www.cm-marvao.pt/>).

The park covers an unusual part of the Alentejo, consisting of uplands instead of flat plains, and a lush green area instead of the normal dry-looking fields. In addition to its impressive natural features, it will also be able to find here many different traces of the human presence at different stages throughout history. The climate joins forces with the diversity of soils to create completely different types of scenery, with the vegetation being determined by the Atlantic's region and Mediterranean characteristics.

The region's human ancestors brought profound alterations to the natural environment, transforming the natural plant cover into a diversified mosaic through agriculture, cattle

farming, urban development and the planting of forests with the introduction of outside species. However, despite the negative impact of some human activities, the ecological community allows for the presence of numerous animal communities.

There are two exceptional viewpoints: the chapel of Senhora da Penha, on the road from Castelo de Vide to Portalegre and the Pico de São Mamede, the highest point in the serra, from where, on a clear day, it's possible to see as far as the sea more than 200 kilometres away.

The town of Marvão is completely surrounded by walls dating from the 13th to the 17th century. From the narrow streets filled with neat white houses a spectacular view can be obtained, as Marvão stands at more than 862 metres (2900 feet) high.

An important tourism infrastructure is developing regarding lodging and leisure center (as for instance the Golf Club and the practice of nautical sports in the Apartadura dam).

There are many historically interesting places, with various megalithic to roman and medieval constructions. The Village of Marvão is in an advanced stage of a nomination for inscription on the world heritage list.

Inside the walls are narrow streets lined with the beautiful popular houses that are typical in Alentejo. Amidst them, it is easy to find Gothic arches, Manueline windows, wrought-iron balconies and other embellishments in the nooks and crannies of the buildings made from the local granite.

Besides the castle and the walls that no visitors to the town will ever forget, Marvão's architectural heritage includes the Santa Maria church, a church that has been transformed into the Municipal Museum, Santiago church, the Renaissance Espírito Santo chapel and the Nossa Senhora da Estrela convent, lying outside the walls.

Geographically, Marvão is a point of natural strategic defense, marked by steep slopes to the north, south and west. Access on foot is only possible from the east, which was the direction in which the town gradually spread.

The climate in Marvão region is characterized by long and hot summers, average temperatures ranging from 16.5 °C in May to 28 °C in August. Even by mid-November, temperatures are still around 13.5 °C.

The Flora is diversified, where can be found the Holm oak (*quercus rotundifolia*), the cork oak (*quercus subers*) and the pines that, in set with the mirrors of water and the rivers, form charming landsc

Eliminado: apes.¶

Table 1.1: Population and surface area of Marvão (2003).

Marvão	
Total surface area (km ²)	154.80
Forestry area (km ²)	35.66
Total Population	3 859
Population density (inhab/km ²)	24.90

1.1.2 Present energy market – industry, household, municipal, service sector in Marvão village

In Portugal, the total primary energy consumption is about 26.5 Mtoe (DGE, 2004) and approximately 10.6% is derived from biomass. On the other hand, approximately 9% of final energy consumption is derived from biomass.

The residues from forests cleaning represent an important renewable energy source. Thus, in 1999 the only biomass power plant entered in operation in Portugal, more specifically, in Mortágua region, a biomass power plant dedicated to electricity production from forest residues that do not have. This power plant has an electric power of 9 MW and consumes about 8.9 tons of forest residues per hour or about 109 000 tons of residues.

In Marvão there is no heat or power plant production but there is a long tradition in the use of biomass (for domestic heating). Nowadays, most of mechanical wood processing industries in the region are closed due the decreasing of wood demand. Almost all forest residues produced in the harvesting process are left in the field and the major part of residues produced in sawmills are not used for energy purposes. The electricity is produced by the national utilities (EDP) and distributed by the national electric network (REN). According to data from EDP, the number of consumers in 2003 were 2817, distributed for different sectors as shown in the table 1.2.

Table 1.2: Electricity market data in Marvão (2003).

Marvão		
Sector	Number of Customers	Consumption (MWh)
Domestics	2 336	4 422
No Domestics (services)	245	2 107
Industry	65	1 815
Agriculture	171	257
Public Illumination		670
Public buildings		1 827
Total	2 817	11 097

1.1.3 Future trends of energy market in Marvão

There is not yet a clear energy plan in Marvão region. For Portugal, there is a target for install 230 MW power capacity based on biomass by 2010. However this fails also to give a clear picture of the challenges and opportunities facing heating networks in regions such as Marvão which already present a traditional use of biomass as firewood. In most habitations in Marvão and neighbourhood councils fireplaces are the sole air-heating installation. There is hence a need for basic research in this respect. Hence the relative potential of developing a cleaner and more efficient energy system with the available resources and social structures is to be highlighted.

Increasing interest in renewable energies in both national and international market should promote wood energy use and encourage investment in heat and power plants installations based on biomass in Marvão region. There is no plan for construct industrial heat and power plant in the near future.

The industrial sector wood fuel use should increase influenced not only by rising of crude oil and network electricity prices, but also by variations in forestry industry production. Overall, the use of wood energy industry is still expected to increase with larger proportion of the fuel being delivered directly as forest fuel.

1.2 ABRANTES

1.2.1 Location, infrastructure and climate conditions in Abrantes

Belonging to the district of *Santarém*, the municipality of *Abrantes* is located approximately in the centre of *Portugal*. Is limited North by the municipalities of *Vila de Rei* and *Sardoal*, on the South by the municipalities of *Ponte de Sôr* and *Chamusca*, on the West by the municipalities of *Constância*, *Vila Nova da Barquinha* and *Tomar*, and to East by the municipalities of *Mação* and *Gavião*. It is constituted by nineteen municipalities and the total area of the municipality is 714 km².

In climatic terms, the municipality of Abrantes is inserted in a tempered region with characteristics of Mediterranean climate, suffering still influence from the two main water courses, the *Tejo* and the *Zêzere*, inducing alterations to the mesoclimatic and microclimatic level, reducing the thermal amplitude, increasing slightly the rainfall and the accumulation of cold air during the night. This situation is increased by the predominance of forest use.

Of this type of climate it results a hot and dry summer and a wet and soft winter. The insulation is high and the average temperature verified in the hottest months is about 22 °C, the average of the coldest months is about 10°C and with the annual average reaching 16 °C. In July, August and September maximum values of 40.5 °C were registered and in January, minimum values of about 6.5 °C.

The annual precipitation average is on the order of 966.3 mm, being November, January and February the rainiest months of the year. The annual average value of the relative moistness of air is of about 80%, being able to vary from 40% in August to 92% in December. The predominant wind rang from quadrants SW, NW to NE.

In this region, the most representative kind of soils are constituted by: resultant alluviums of the accumulation of detritic materials carried by the *Tejo* floods; schist, amphibolites, mica schist, *grauvaque*, *gnaisse* and migmatite; sandstone, not marly calcareous rocks, sands, gravel pits and clays.

The most representative type of soils is marked by plateaux and hillside situations. They still present situations of deficient draining and erosion or superficial dripping resultant limitations. The ground with capacity of moderate agricultural use normally coincide with the valleys of the rivers, sharing these geographic situations with ground of high agricultural capacity, still that it is of dispersed form, being the latter little representative, limited to the co-alluvial and alluvial zones of the *Tejo* valley. They are therefore completely devoted to the agricultural exploration.



Figure 1-2: Location of Abrantes region.

In 2001, according to census of the INE (Statistics National Institute), the resident population in Abrantes were of 42235 inhabitants, being active 18516 inhabitants resulting in a tax of activity of 43.8%. The municipality population density is 59 inhab/km². The biggest population densities occur in the city of Abrantes and bordering districts, justified for the proximity to the *Tejo*.

Table 1.3: Population and surface area of Abrantes (2001).

Abrantes	
Total surface area (km ²)	714.00
Forestry area (km ²)	492.66
Total Population	42 235
Population density (inhab/km ²)	59

The Abrantes region presents a social-economic dualism associated to the different states of development of urban areas, more developed in the economic activities (industry and services) generating typically urban behaviours in the populations, and agricultural areas, less developed, supported in an agriculture of familiar nature, normally of support to the economy of the family unit complementing other activities, accenting the human desertification in these zones. The agricultural activity is distinguished however as the main activity of the primary sector. The olive grove is the more common agricultural occupation. This region has strong expression in the forestry sector, representing the forest about 69% of the territory area, thus monetizing poor soils, being the most common species the pine, the eucalyptus and the cork oak. This type of occupation has been stimulated, especially the eucalyptus, due to the proximity of the pulp and paper companies: CELBI, CAIMA and SOPORCEL.

In the primary sector is also present some activity in the extraction and inert exploration. The secondary sector in 2002 occupied about 24% of the population. The tertiary sector is the most important in the region using in 2002 69% of the active population.

In Abrantes an average area of 16.1 ha exploration is verified, having the majority of the explorations less than 5 ha. The small explorations have in average 3.7 ha, normally associates to a familiar agriculture practice. There are several explorations with more than 20 ha, more occur in relatively high number with superior areas ha, with a more intensive production character.

1.2.2 Present energy market – industry, household, municipal, service sector in Abrantes region

In Abrantes there is one thermoelectric power plant in Pego, called Pego Power Station, with net capacities of 270 MW, operating with coal since 1993.

The Caima *Energia* – Energy management and exploration Enterprise (from Caima Cellulose group) operates a biomass power plant with an installed electric capacity of 7 MW that using a local wood fuels as a raw material for energy production.

According to data from DGGE, the total electricity consumption in 2003 were 122882 MWh distributed for different sectors as shown in table 4.

Table 1.4: Electricity market data in Abrantes (2003).

Abrantes		
Sector	Number of Customers	Consumption (MWh)
Domestics	21 328	42 616
No Domestics (services)	2 166	24 964
Industry	573	34 410
Agriculture	1 681	5 309
Public Illumination		7 227
Public buildings		8 356
Total	25 748	122 882

1.2.3 Future trends of energy market in Abrantes

In Abrantes region such as in Marvão, the interest in wood energy use should increase due to the investment in heat and power plants installations based on biomass and renewable energies in global market. In the near future there is not known plans for construct no new industrial heat or power plant in Abrantes. However, it is expected some increasing in wood fuel consumption due to the intention from some industries operating in the region, as the case of Caima Industry, in increase their production capacity, witch should increase the annual use of wood fuel.

2 IDENTIFICATION OF KEY PLAYERS

2.1 MARVÃO

2.1.1 Authorities – environmental, agriculture, forest, industry, R&D, finance

The national authority responsible for sustainable development, environmental protection and residential housing policies and land use planning is the Ministry of Environment Territory Ordinate and Regional Development (MAOTDR). This ministry has the function of supervises the Environment Institute (IA) and the Commission of the Coordination and Regional Development of Alentejo (CCDRA), among other institutions,. The CCDRA is endowed with administrative and financial autonomy, adds and integrates the abilities in the planning areas and regional surrounding development, order of the territory, conservation of the nature and biodiversity, which aim to promote biodiversity, quality of life and sustainable use of natural resources, in close collaboration with local people and institutions in the scope of the respective geographic area, and support to the local autarchies and its associations, in view of the integrated regional development.

Ministry of Agriculture, Rural Development and Fisheries (MARDF) administrates policy and financial support in order to stimulate the development of sustainable agriculture, sustainable use of renewable resources and rural development implementation. MARDF supports and manages programs for developing biomass residues, biogas and biodiesel productions and has especial program for develop bioenergy production.

MARDF participates in funding a variety of organisations involved in forest and bioenergy developments. The Directorate General of the Forest Resources (DGRF) is part of MARDF that is involved in the National and Regional Forest Research development. The Regional Forest Agencies advises and manages plan for carry out forest improvement actions, assess the development of regional forest resources and implement forest legislation. The Forest Research Institute produces high quality scientific research about forestry, forests, trees and forest soils to industry, decision makers and the general public. It promotes sustainable management and utilization of forests throughout high level scientific research.

The main objective of the DGRF is the promotion of the sustainable development of the forest resources and the spaces associates and also the synergetic resources of internal waters, through the knowledge of its evolution and enjoyment, guaranteeing its protection, conservation and management and promoting the balances inter-sector, the responsible of different agents and one adjusted organization of the forest spaces.

The National Forest Station (EFN) is the forest research unit of the National Institute of Agrarian and Fisheries Research (INIAP) dealing with forest and wood sciences and technologies and natural resources management. The mission statement of the EFN is to maintain and develop the forest research, information, professional training and advice to support management and policy decisions within the Ministry of Agriculture and Private Forestry Organisations. Its mandate covers a vast range of disciplines from sociology to economics, anatomy to genetics and wood quality and processing, ecology and silviculture to forest management and forest protection. This range of expertise is obtained by fostering collaborative arrangements with national and foreign forest research institutions and with various University Departments as well as the diversification of scientific staff background.

For fulfilling its mandate, the research programme of the EFN includes projects on forest ecology, breeding, silviculture, forest protection and management of temperate forests and other non-wood resources, ecological processes of fresh water bodies and policy, social and economic aspects of forestry. Although diversified the main thrust of the institution is directed at: crop growing management; yield models; factors which affect stand stability; maintenance of site productivity; forest protection.

The broadening of the scope of research to include non-wood benefits, environmental and socio-cultural aspects, reflects the current awareness of the need for non-industrial forestry development to cater for the increasing demands of ecological and social services. The main strategy focuses on finding mechanisms to reconcile measurable production with other externalities and establishing utility criteria for the various attributes which can be employed in the decision making process. To comply with this policy and broaden the scope of EFN, a strategy has been developed wherein, for each main topic, consisting of four major groups of activities - research, training, library and information services, and a consultancy service.

The Ministry of Economy and Innovation (MEI) is responsible for national implementation of energy and climate strategies, and efficiency of energy markets. MTI Division for Renewable and Energy Efficiency is in charge of fiscal instruments for renewable energy policy and the main national authority for energy conservation, efficiency, promotion of renewable and energy technology. The MTI is supportive of biomass energy, also due to its potential to aid the industry to reduce emissions in the time frame required by the Kyoto Protocol and European Union (EU) Emissions Trading.

The Directorate General for Geology and Energy (DGGE) is the agency of the Portuguese Public Administration part of the Economy Ministry of Economy and Innovation with responsibility for the conception, promotion and evaluation of the politics related to the energy and the geologic resources, in the optics of the sustainable development and security of the energy supplying. In the mission of the DGGE it is included, of course, the necessity to sensitize the citizens for the importance of those politics, in the picture of the economic and social development that it desires for the country, informing them on the available instruments for the execution of the decisions politics and divulging the results of its accompaniment and execution. Some regions have also established Regional Energy Agencies, which aim to promote energy efficiency and utilization of RES within their own territories.

The National Institute for Industrial Engineering and Technology (INETI) is an institute involved in research, demonstration and technological development and is also part of the Economy Ministry. Its vocation is to increase the potential for innovation and quality of the national technological system. It publishes information in order to foster sustainable economic growth. INETI has a biomass section within its renewable energy sources department. As a result of its participation in international projects, INETI is a partner able to provide effective assistance towards internationalization of Portuguese companies within the global economy.

Ministry of Public Works, Transport and Communications (MOPTC) is responsible for transport policy and energy use. MTC representatives participate in MTC led workgroups on advancement of renewable energy use and energy efficiency in transport sector.

The Marvão municipality government is the most important administrative and decision making bodies. The Regional Council aims to promote impartial development initiatives and

sustainability in collaboration with national, local industry and other institutions. It is responsible for coordination and management of regional funds, regional territory planning, protection regional interests and creating local infrastructures.

2.1.2 Industry – forest, energy, agriculture, transportation

In Marvão there is no organisation involved in education R&D in bioenergy, and the bioenergy market is not yet established.

The Directorate General for Forest Resources (DGRF), based in Lisbon, hosts a network of forest research institutes with wide interests including development of bioenergy. APFDP advises forest producers.

2.1.3 Associations

There are many Agricultural and Forest industry associations, in national and regional levels, that work together in network in order to promote biomass utilization for energy production.

The Portalegre's District Forest Producers Association (APFDP) provides services and educational material for dissemination and promotion of the best practice in forest industry and management and use of woodchips nationally, with the added focus on Portalegre region.

2.1.4 Legislation, taxes, etc...

Investment-related support programmes are the main energy policy instruments to promote the use of renewable energy in Portugal. In Portugal, investment subsidies programmes to support renewable energy projects only exist at national level.

From 1994 to 1999, the ENERGIA Programme was a financial instrument of the Ministry of Economy that support projects in the energy sector under the 2nd Community Support Framework (QCA II) for the period 1994-1999. ENERGIA was partly funded by the European Commission (Structural Funds), the Portuguese Government and the private investors.

Within the ENERGIA Programme, subsidies for renewable energy projects were included in measure of Valorisation of Energy Endogenous Potential and SIURE (Incentives System for the Rational Use of Energy), within the intervention area "Renewable Energy". Subsidies granted through measure 2 and measure 3 had different characteristics. The Valorisation of Energy Endogenous Potential measure granted a refundable subsidy at zero interest rate to projects in the fields of biomass, wind, small-hydro and geothermal energy. In both cases, the subsidy was function of the energy, technical and economic value of the project, its regional and environmental impacts and the adequacy of costs to the type of operation.

The granting of subsidies is currently in a transition phase to the next Community Support Framework (QCA III), through the Operational Programme for the Portuguese Economy (POE), in operation from 2000 to 2006.

There is an incentive for cleaning forest area supported by the municipalities to the forest association in order to prevent forest fire. In Abrantes region, for example, the price per each

hectare cleaned vary from 400 to 600 € for manual cleaning and 90 to 125 € for mechanical cleaning.

2.2 ABRANTES

2.2.1 Authorities – environmental, agriculture, forest, industry, R&D, finance

Beside national level authorities, there is a regional association called Abrantes, Constança and Sardoa agriculture association which work narrowly with forest owners and forest industry operators in order to improve the forest area management and help to prevent forest fire in the whole Abrantes region.

3 ASSESSMENT OF BIOFUEL HARVESTING POTENTIAL IN THE REGION

3.1 MARVÃO

3.1.1 Forest resources – forest area and timber production volume

According to data of the third National Forest Inventory's Revision from DGRF, the forest occupies about 38% of the total Portugal continental territory. The woody area has, inclusively, conditions to increase, case the extensive unproductive and uncultivated areas, witch occupy 2.3 millions ha, approximately, are used. About 87% of the forest area belongs to the private companies, being the remaining area belongs to State (3%) and uncultivated (10%).

Marvão has just a small percentage of total Portuguese forest area. It has around 0.11% of whole Portuguese forest area. The total forest area in Marvão is about 3566 ha, distributed for different forest type as shown in the table 3.1.

At the national level, the maritime pine is the forest species that occupies greater area, about 976 thousand hectares and, in its major part, it is located in the Centre and Coastal North of the Country. It is a species of great economic importance, being the sustentation of sawmills, pulp and paper industries, panels and accumulations. On the other hand, in Marvão cork oak is the forest species that occupies greater area, as shown in the following table 3.1.

Table 3.1: Forest area, species distribution, and existing main trees volume of Marvão and Portugal (Source: DGRF 1995).

Forest species	Marvão		Portugal	
	Area (ha)	Volume (x 1000 m ³)	Area (ha)	Volume (x 1000 m ³)
Maritime pine (<i>Pinus Pinaster</i>)	681	57.89	976 069	98 805
Cork oak (<i>Quercus Suber</i>)	1 450	24.65	712 813	-
Holm oak (<i>Quercus Rotundifolia</i>)	137	2.33	461 577	-
Eucalypt (<i>Eucalyptus</i>)	98	4.31	672 149	37 090
Spanish chestnut (<i>Castanea sativa</i>)	627	12.54	40 579	2 089
Oak	336	5.71	130 899	4 781
Umbrella pine (<i>Pinus Pina</i>)	12	0.18	77 650	4 970
Others	225	-	129 395	5 838
Total	3 566	107.61	3 201 131	153 573

Although, the data above do not correspond to the actual forest area in Marvão region, so it needs to get the most recent data in order to know the real situation about the forest resources.

The total annual timber production volume in Marvão region was estimated and shown in the table 3.2.

Table 3.2: Estimative of annual timber production volume in Marvão.

Forest species	Timber production (m ³ /year, green)
Maritime pine (<i>Pinus Pinaster</i>)	4 086.00
Cork oak (<i>Quercus Suber</i>)	1 305.00
Holm oak (<i>Quercus Rotundifolia</i>)	-
Eucalypt (<i>Eucalyptus</i>)	1 176.00
Total	6 567.00

3.1.2 Forest industry – companies and their products

In Portugal, wood, pulp and paper industries use biomass for electric and thermal energy production there are many years ago. In total, all together, they represent an installed burning capacity of 1676 MWth based on biomass and had consumed, in 2003, about 35300 TJ of biomass primary energy (73% of its total fuel consumption), 83% of which are black liquor (by-product of the paper production), 15% are eucalypt and pine barks and other industrial by-products and the remains 2% are residues from agro-industries.

According to information collected in Marvão there are a few numbers of enterprises working on forest and forestry industries. One of them visited by IST group is Pires Barbacena sawmill. Data and information gathered about the actual and past production capacity of this enterprise is shown in table 3.3.

Table 3.3: Production of the enterprise operating in forest industry in Marvão.

Owner company	Products	Actual Capacity (ton/year)	Past Capacity (ton/year)
Pires Barbacena sawmill	pine saw timber	520.00	1560.00

The owner buys the wood by trees (pine) in the forest. He is responsible for cutting and transportation the stem wood to sawmill facility. Around 25 to 30% of the trees (branches, tops and needles) are left in the forest land. This enterprise has capacity to process 1560 tons of pine stem wood per year but nowadays they reduced the annual production capacity to 520 tons due to decreasing demand of wood for constructions in the region.

In the figure 3-1 are shown the pictures took in Pires Barbacena sawmill facility.



Figure 3-1: Pine stems wood with and without bark.

3.1.3 Potential of forest industry residues – bark, sawdust, shavings, etc...

Data collected at Pires Barbacena sawmill is shown in table 8. The total annual forest residues production of whole Marvão municipality is not available. As said above, many enterprise working on forest industries are not operating nowadays.

Table 3.4: Annual production volumes available in industrial wood residues.

Company Name	Municipality	Description of production	Annual production (tons)		
			Bark	Sawdust	Shavings
Pires Barbacena	Marvão	Sawmill	17.33	17.33	17.33

In the figure 3-2 are shown the pictures of pine barks and shavings took in Pires Barbacena sawmill facility.



Figure 3-2: Pine Barks and shaving produced in Pires Barbacena sawmill.

3.1.4 Potential of logging residues from final felling (tops, branches, etc...)

According to information collected, in generally, the biomass residues production in the final felling (branches tops and needles) varies from 25 to 30% of the whole green tree. For eucalypt, for example, it is estimated that the annual harvest quantity should be about 12 cubic meters per hectare and for pine the rate is about 6 cubic meters per hectare annually. For the total forest area in Marvão the estimative of the annual potential of logging residues for the main forest species is shown in table 3.5.1

Table 3.5: Estimative of biomass residues production by main species in Marvão.

Forest species	Residues production (m ³ /year, green)
Maritime pine (<i>Pinus Pinaster</i>)	1 225.80
Cork oak (<i>Quercus Suber</i>)	391.50
Holm oak (<i>Quercus Rotundifolia</i>)	-
Eucalypt (<i>Eucalyptus</i>)	352.80
Total	1 970.10

3.1.5 Potential of stumps and stem wood loss

Presently almost all stumps are left in the forest land. There is a good potential in residues production that should be available for energy use in the future.

3.1.6 Potential of small wood from thinnings

According to information from DGRF the small diameter trees represent a good potential of the total biomass residues potential in Portugal. Data available from national inventory shows that about by thinning operations, it is possible to harvest about 10 to 12 tons of pine biomass residues per hectare and for the eucalypt this amount should reach 27% of the total harvest residues.

The total removal amount by thinning for the two regions reported in this study is no well known.

3.1.7 Potential of agrobiomasses: reed canary grass, straw, etc...

There is some potential in agrobiomasses production, nevertheless, data are not available at the moment.

Eliminado: t.

3.2 ABRANTES

3.2.1 Forest resources – forest area and timber production volume

According to data gathered in Abrantes's municipality from agriculture association office, the forest occupies about 69% of the total Abrantes's municipality area. Almost all forest area belongs to private owner and pulp mill industries. There are thousands of small forest owners especially in the north side of Abrantes municipality.

The total Abrantes forest area represents approximately 1.54% of whole Portuguese forest area. It is about 49265 ha, distributed for different forest type. Considering the main tree species, the cork oak is the forest species that occupies greater area (38%) followed by eucalypt (34%) and maritime pine (26%), as shown in the table 3.6.

Table 3.6: Forest area, species distribution and existing tree volume of Abrantes (Source: Municipio Abrantes, 2004).

Forest species	Abrantes	
	Area (ha)	Volume (x 1000 m ³)
Maritime pine (<i>Pinus Pinaster</i>)	12 809 (26%)	1088.78
Cork oak (<i>Quercus Suber</i>)	18 721 (38%)	318.26
Eucalypt (<i>Eucalyptus</i>)	16 750 (34%)	737.02
Others	985 (2%)	-
Total	49 265	2144.06

The estimative of the total annual timber production volume in Abrantes region is shown in the table 3.7.

Table 3.7: Estimative of annual timber production volume in Abrantes.

Forest species	Timber production (m ³ /year, green)
Maritime pine (<i>Pinus Pinaster</i>)	76 855.00
Cork oak (<i>Quercus Suber</i>)	16 849.00
Holm oak (<i>Quercus Rotundifolia</i>)	-
Eucalypt (<i>Eucalyptus</i>)	201 005.00
Total	294 909.00

3.2.2 Forest industry – companies and their products

In Abrantes, wood, pulp and paper industries use biomass for electricity and thermal energy production. The Caima pulp mill industries and some small enterprises working in cork industries are the most significant enterprise in Abrantes region. There are no important sawmill enterprises operating in Abrantes. Almost all the residues produced by these industries are used in their own production processes.

The Caima - Indústria de Celulose, S.A. integrates the industrial unit of pulp and paper production and it is responsible for the annual production of 105 thousand tons of pulp and paper.

In 2004, the Caima Industry produced 107764 tons of white eucalypt pulp (see table 3.8); it is expected to increase its production in 10% until the end of 2006, passing to the 115000 tons annual capacity. The Caima Industry is one low cost producer, its essential manufacturer activity characteristic and key factor of success for its current positioning in the international market of pulp and paper.

Table 3.8: Production from the enterprise operating in forest industry in Abrantes.

Owner company	Products	Capacity (ton/year)
Caima - Indústria de Celulose, S.A	Pulp and paper	107 764
Sofalca Cork industry	Cork sawdust	1 600
	Branches/plywood	200

4 PROBLEMS

4.1 THE PROBLEMS WHICH LIMIT THE USAGE OF BIOFUELS

Market characteristics in Portugal associated with the lack of supply guarantee constitute important non technico-economic factors hindering the biofuel penetration in some sector like tertiary and district heating (using small plants).

The lack of supply guarantee is a strong barrier for the implementation of new biomass projects. In Portugal, in some cases, existing biomass plants have switched to gas or oil due to this problem.

The forestry policy is much more oriented to the production of raw material for wood industries and not oriented for biomass energy production. Instruments to incentive biomass development are not sufficient and sectorial policies are not coordinated to produce real positive effect in biomass penetration.

The introduction of natural gas in Portugal and the public strategy to create a market for this new fuel has already influenced negatively the penetration of biomass in almost all market sectors.

Beyond all the factors mentioned above, there are others limitation related with:

- topographical conditions not favourable for harvesting forest residues;
- inexistence of adequated equipments;
- inexistence of market;
- high number of small private forest owners;
- transport and storage costs are very high.

5 ASSESSMENT OF THE BIOFUEL MARKET POTENTIAL IN THE REGION

5.1 MARVÃO

5.1.1 Current and future potential of biofuel consumption

In Marvão region, as sad before, there is no heat or power plants nor industries that use forest residues in industrial scale. For this reason, almost all the forest residues are not used for energy production.

According to the information, the biomass residues produced by the enterprise operating in wood industry in Marvão, specially barks from pine wood are sold to other enterprises that will use this residues in diverse application such as garden care services, infantile park, horse sport centre among others.

5.1.2 Evaluation of biofuel price – forest industry residues and logging residue chips, agrobiomasses

According to information from DGRF the mean price for solid cubic meter of wood for energy use in Portugal in 2004 varied as sown in the table 5.1.

Table 5.1: Mean price of wood for energy use in Portugal in 2004.

Wood type	Price (€/m ³)
Eucalyptus	12,57
Maritime pine	19,72
Oak	27,12
Chestnut	23,56

Information collected about prices of some forest industry residues in Marvão is shown in table 5.2.

Table 5.2: Price of pine wood residues in Marvão.

Company Name	Products	Price
Pires Barbacena	Bark	10 (€/m ³)
	Sawdust	10 (€/m ³)
	Shavings	23 (€/ton)

5.1.3 Promising biofuel consumption sites – names and locations

In Marvão region there are not power or heat plants, but several public buildings and infrastructures such as hotel, swimming pool or schools that currently use oil or propane gas boiler for water or space heating can be considered as promising sites for wood fuel consumption, using small or medium size biomass boilers.

In the section 8 will be described with more detail some of the sites mentioned above.

5.2 ABRANTES

5.2.1 Current and future potential of biofuel consumption

In Abrantes, major part of the forest residues is being used for the industries already existing in the region. One of this is Caima pulp mill industry that consumes the eucalypts barks to generate vapor for heat and electricity production.

The Caima Energy (Group Caima Cellulose) operates a 7 MW biomass power plant in Constância. This transaction is the first step in the creation of a partnership between EDP and Celulose do Caima to promote greater efficiency in the integration between the forestry activity, that produces biomass, and the energy production activity, which uses this natural resource as a raw material. This integration will have the additional benefit of addressing one the main contemporary concerns in Portugal – the forest fires – by allowing a better management of the country's woodland.

The Caima industry integrates the industrial unit of pulp and paper production and it is responsible for the annual production of 105000 tons of pulp and has inclusive interest to increase its production capacity to 10% until the end of 2006, passing to the 115000 tons annual capacity.

5.2.2 Evaluation of biofuel price – forest industry residues and logging residue chips, agrobiomasses

According to information collected in Abrantes at the Agriculture association office the mean price for per tons of wood fuel varies from 17.50 to 20 €. This price is lower than that is practice in Mortagua, witch is about 31 €.

5.2.3 Promising biofuel consumption sites – names and locations

In Abrantes region exist some industries such as Caima Cellulose Group that can be considered as a promising sites for wood fuel consumption in large scale. As said above, there is a plan to increase its pulp production capacity to 10% until the end of 2006, witch should increase the consumption of industrial round wood and consequently biomass residues usage to generate energy (steam and electricity) for their needs.

6 DESCRIPTION OF BIOFUEL HARVESTING TECHNOLOGY AT THE MOMENT

6.1 HARVESTING TECHNOLOGY FOR TIMBER – CUTTING AND DELIMBING, TERRAIN HAULAGE AND ROAD TRANSPORT

In Portugal, almost all the forest work is realized in mechanical way, with the resource machine (harvesters), being the remaining work made in manual way using saw motor among others equipments. The major volume of work in forest exploration is guaranteed by rendering of national services already existing in the market.



Figure 6-1: Forwarder working in the forest (source: www.logistica-florestal.pt).

Industrial roundwood can be transported to the pulp and paper mill or to sawmill by wood truck or train. In Portugal, most of the wood is transported by truck and the remain is transported by train.

Most of stem wood transportation from forest to some industries is made by truck. The maximum trucks weigh capacity in Portugal is 40 tonnes. Normally wood trucks are equipped with a removable grapple loader.



Figure 6-2: Forwarder and wood truck for industrial roundwood.
(source: www.logistica-florestal.pt)

Formatada: Francês (França)

Código de campo alterado

Formatada: Tipo de letra: 12 pt, Tipo de letra de script complexo: 12 pt, Francês (França)

Formatada: Francês (França)

6.2 HARVESTING TECHNOLOGY OF WOOD FUEL – FOREST INDUSTRY RESIDUES AND LOGGING RESIDUE CHIPS

There are many kind of heavy forest machinery available in Portugal for forest residues and logging harvest, as that is shown in the figure 6-2. These kinds of machinery are used by Forestech enterprise for harvest and process wood chips in Algarve region and sell to pulp mills and other industries for energy use.

Residues from forest industry are usually used in the same mill area but in some situations it is need to be transported to long-distance. The residues are transported to the site consumption using trucks that are usually used to transport forest residues.



Figure 6-3: Harvester and wood chipper machines (source: Forestech).

6.3 HARVESTING TECHNOLOGY OF AGROBIOMASSES – STRAW AND REED CANARY GRASS

There is some potential in agriobiomasses production.

The statistical data about the total capacity of agriobiomasses production in Marvão region is not available.

7 RECOMMENDATION FOR THE REGIONAL BIOFUEL STRATEGY

7.1 TARGET FOR 2010 AND 2015 FOR WOOD FUEL USE – FOREST INDUSTRY RESIDUES AND LOGGING RESIDUE CHIPS

Currently there is a target of implementing up to 7000 MW of renewable energy projects until 2010. Most of this capacity will be sought by the use of wind energy.

According to informations, Portuguese Government is currently working in the launching of a new competition for the attribution of up to 100 MW electricity production from industrial forest residues, that will have to be launched until the final of the year 2005. On the other hand, Government wants to increase from the existing 9 MW biomass power plant (Mortágua) to 250 MW biomass power plant using forest residues.

8 SELECTION OF CASES STUDIES

8.1 MARVÃO

Several meetings have been organized with technicians from Marvão municipality head staff in order to identified some potential sites that can be considered as case studies. Three sites have been pre-selected as suitable for small/medium size heat plants. All of them have heat system installed consisting by boilers fueled by fueloil in one system and propane in two other systems.

8.1.1 Case study 1 – Hotel Albergaria El Rei D. Manuel

The hotel Albergaria El Rei D. Manuel (Figure 8-1) is a four start hotel located in Marvão village. It has 15 rooms and 30 beds (<http://www.turismarvao.pt>). In this hotel, a diesel boiler is used for supply hot water during the whole year.

The average fuel consumption of the boiler varied from 32 liters per day in 2004 to 37 liters per day in 2005. In the case study report will be given more detail about the whole system, where can be found information about the evolution of the fuel consumption along the year.



Figure 8-1: Hotel Albergaria El Rei D. Manuel.

8.1.2 Case study 2 – Municipal Swimming Pool

In the figure 8-2 is shown a picture of the boiler used in the swimmingpool heating water system. It is a Prextherm 300 boiler model fueled by propane. It has a nominal power of 327 kW and 92% efficiency.

The swimming pool is opened all the year except in August when they close for holiday. Description of the whole system will be presented later.



Figure 8-2: Boiler of the Municipal Swimmingpool in Marvão.

8.2 ABRANTES

Some meetings with local technicians, working in the municipality head office and agriculture association, were organized with the aims to identify potential sites that can be considered as a case study. One school and a municipal swimmingpool have been identified as places with a good potential to be considered as case studies in Abrantes.

8.2.1 Case study 3 – Municipal swimming Pool

In the figure 8-3 is shown a picture of the boilers used in the swimming pool heating system. There are two boilers (model Roca G 400/215) fueled by propane. The nominal power is about 250 kW for each boiler.



Figure 8-3: Boiler of the Municipal Swimmingpool in Abrantes.

8.2.2 Case study 4 – School with heat system installed

Located in Pego, Abrantes, this primary school is composed by four classrooms, distributed in two floors (two classrooms per floor).

There is a biomass boiler, fuelled by firewood, that heat water and supply hotwater to the classrooms.

The complete description of the heat system will be done in the case study report.



Figure 8-4: Primary school in Abrantes.

9 REFERENCES

Cabrita, I. and allia, “Energy RR&D Priority Setting at the Institute of Energy Technologies of INETI in Portugal”, Workshop on Biomass PSI, Lisbon, 1999.

Collares-Pereira, M., “Energias Renováveis. A Opção Inadiável”, Lisbon, 1998.
Forum – Energias Renováveis em Portugal, December 2002.

Plano de Orientação Preventiva, Municipio de Abrantes, Junho 2004.

10 APPENDIX - LIST OF ORGANIZATIONS AND CONTACT DETAILS

Ministry of Environment Territory Order and Regional Development

Rua de O Século, 51
1200-433 Lisboa
Phone: +351213 232 500
Fax: +351 213 232 531

Ministry of Agriculture Rural Development and Fisheries

Praça do Comércio
1149-010 Lisboa
Phone: +351 213 234 652/3
Fax: +351 213 234 604
Email: gabinistro@madrp.gov.pt

Ministry of Economy and Innovation

Rua da Horta Seca, 15
1200-221 Lisboa
Phone: +351 213 245 400
Fax: +351 213 245 440
Email: gmei@mei.gov.pt

Ministry of Public Works Transport and Communications

Palácio do Conde de Penafiel
Rua de S. Mamede, 21
1149-050 Lisboa
Phone: +351 218 815 100
Fax: +351 218 863 827

Directorate General of Geology and Energy

Av. 5 de Outubro, 87
1069 - 039 Lisboa
Phone: +351 21 792 27 00
Fax: +351 217 939 540

Directorate General of Forestry Resources

Avenida João Crisóstomo, 26-28
1069-040 Lisboa, Portugal
Phone: +351 213 124 800
Fax: +351 213 124 988
Email: info@dgrf.min-agricultura.pt

National Forest Station

Quinta do Marquês, Av. da República
2780-159 Oeiras
Phone: +351 214 463 700
Fax: +351 214 463 701
Email: secretariado@efn.com.pt

National Statistical Institute

Av. António José de Almeida
1000-043 Lisboa
Phone: + 351 218 426 100
Fax: + 351 218 426 380
E-mail: ine@ine.pt

Environment Institute

Rua da Murgueira, 9/9A
2610-124 Amadora
Phone: + 351 214 728 200
Fax: + 351 214 719 074

Forestis – Portuguese Forest Association

Rua de Santa Catarina, n.º 753
4000 - 454 Porto
Phone: +351 222 073 130/1
Fax +351 222 073 139
Email: forestis@mail.telepac.pt

Portalegre District Forest Producers Association

Parque de Leilões do Gado EN 246
Apartado 123
7301-901 Portalegre
Phone/Fax: + 351 245 366 880
E-mail: apfdportalegre@iol.pt

North Alentejo Forest and Farming Producers Association

Rua 1º de Maio, Alter do Cão
7440-097 Alter do Cão
Phone: + 351 245 619 068
Fax: +351 245 619 070
E-mail: aprofna@iol.pt

Commission of the Coordination and Regional Development of Alentejo

Parque de Leilões do Gado EN 246
Apartado 80
7301-901 Portalegre

Sawmill Pires Barbacena Lda

Portagem-S. Salv. Aramenha
7330-328 São Salvador de Marvão
Phone: + 351 245 993 172

ARECBA – Agência Regional de Energia do Centro e Baixo Alentejo

Praceta Rainha D. Leonor, n.º.1
Apartado 70
7801- 953 Beja
Phone: (+351) 284 326 736
Fax: (+351) 284 326 332

E-mail: geral@arecba.pt

Associação dos Agricultores dos Concelhos de Abrantes, Constância, Sardoal e Mação

Estrada Nacional 118

Rossio ao Sul do Tejo

2200-067 ABRANTES

Phone: (+351) 241 331 143

Fax: (+351) 241 331 096

E-mail: assagriabt@mail.telepac.pt

Sofalca – Sociedade Central de Produtos de Cortiça Lda.

Apartado 7 - Rossio ao Sul do Tejo

2206-909 ABRANTES

Phone: (+351) 241 732 165

Fax: (+351) 241 732 210

E-mail: sofalca@mail.telepac

CELBI – Celulose Beira Industrial, SA

Figueira da Foz, Leirosa-Marinha Ondas

3080-484 Marinha Ondas

Phone: (+351) 233 955 600

Fax: (+351) 233 955 607

E-mail: storacelbi.dt@mail.telepac.pt

CAIMA – Industria de Celulose, SA

Rua Joaquim A. Aguiar, 41, 3E, Lisboa

1070-150 LISBOA

Phone: (+351) 213 864 348

Fax: (+351) 213 863 160

E-mail: caimacel@mail.telepac.pt

SOPORCEL – Sociedade Portuguesa de Papel SA

Figueira da Foz, Lavos

3090-458 Lavos

Phone: (+351) 233 940 411

Fax: (+351) 233 940 502

E-mail: mkt@soporcel.pt

Webpage: www.portucelsoporcel.com

ALBERGARIA EL REI D. MANUEL

Largo do Terreiro

7330 MARVÃO

Phone: (+351) 245 909150

Webpage: <http://www.turismarvao.pt/>

Mortagua's Biomass Power plant

Mortagua municipality

Webpage: <http://www.cm-mortagua.pt>

Center of Biomass for Energy

Código de campo alterado

Formatada: Cor do tipo de letra: Azul, Francês (França)

Zona Industrial de Vale Feijão
Apartado 49
3221 – 119 Miranda do Corvo
E-mail: cbe@mail.telepac.pt