

Andalusia, Spain

Technology Map: Electricity Energy from Renewable Energy Sources (RES.-E)



Estepona, Málaga

Foto Imagen © Turismo Andaluz S.A.

The region	Andalusia
Number of inhabitants(*)	7.606.848
Size (in km²)	87.597
Capital	Seville
Provinces	Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga, Sevilla

Short description: The Autonomous Community of Andalusia is an extensive territory in southern Spain that counts on a Mediterranean climate and vegetation. Andalusia is a region of services. In fact, 64.7% of the total productive activity belongs to the service sector, with a huge importance placed on the tourism subsector (more than 21 million tourists visited the Autonomous Community of Andalusia in 2003); the industrial sector represents 15.4% (emphasis on the growth of the agrofood and energy industries); the building sector is also of great importance in Andalusia representing 12,3% of the total economy; the primary sector represents 7.6% (agriculture, stock-farming and forestry exploitations, fishing in a lesser regard). Andalusia is a region of high potential in renewable energy sources, consisting of biomass (17% of the Andalusian territory is natural protected area), solar energy (the Andalusian territory has the greatest solar irradiation index in Europe), and wind energy; however, its potential for hydraulic energy is more limited than in other European regions.

Share of RES (total primary energy)(*): 5,2 %. Objective 2010: Andalusia 15%, Spain 12%, European Union 12%.

Share of RES-e (total electricity)(*): 7,9% (of the total amount of electricity produced in Andalusia).

Objective of electricity production by RES: Andalusia: 31,8%, Spain: 29,4%, European Union: 22%, by the year 2010.

The partner organisation: The Andalusian Energy Agency (Agencia Andaluza de la Energía), an autonomous organisation addressed to the Regional Ministry of Innovation, Science and Enterprise, Andalusian Government (Consejería de Innovación, Ciencia y Empresa, Junta de Andalucía), in charge to developing autonomous policies aimed at optimising, in economical and environmental terms, the energy supply of Andalusia. The Agency will absorb the public company SODEAN S.A. (Sociedad para el Desarrollo Energético de Andalucía), assuming more powers and offering greater participation of economical and social market actors.

The Andalusian Energy Agency is born with the basic objectives of improving the quality of the energy services in Andalusia, collaborating in the development of the generation, transport and distribution infrastructures and promoting the diversification of energy sources and the reduction of polluting emissions through the promotion of renewable energies and cogeneration technologies.

One of the Agency priorities aims at promoting technological innovation and R&D projects in the Andalusian energy sector, opening an international cooperation line for the transference to other countries in which Andalusia relies on the experience, as for example, those ones related to solar photovoltaic energy or biomass.

By ending, the new organisation is also in charge of, among other functions, managing the different financing lines of the Andalusian Regional Government in the energy area and elaborating the annual reports on the fulfilment of the Andalusia¹n Energy Plan.

^(*)Datos provisionales a 31 de Diciembre de 2004

Data updated as of 31st December 2004 (cumulative)	Number of plants	Totalled installed capacity (MW)	Production (MWh/year)	Typical installation size	Main present funding mechanism	Short term perspective (2006**)	Mid/Long term perspective (2010)	Main barriers
Wind	29 wind parks particularly concentrated in Cádiz (20). The rest in Huelva (1), Málaga (3), Granada (3) Jaén (1) and Almería (1)	442.8 MW	1,000,000	0.8-2MW	Electricity Law 54/97 of 27 November of the Spanish Electric Sector Royal Decree 436/2004, of 12 March, which establishes the methodology for the updating and systemisation of legal and economical regime of electricity production in special regime.**** Order ZEDE 30 September 2002 Market 6.95 c€/kWh Tariff 6.70 c€/kWh	Very high 2,700 MW	Very high 4,000 MW	Grid connection, Supply of Electrical equipment and turbines (foreseen 2006)
Wood Biomass- Biomass from the olive oil sector and greenhouse wastes	9 plants (2 using wood, 6 using olive oil and 1 using greenhouse wastes)	103.6 MW		1.7-25 MW	Electricity Law 54/97. Royal Decree 436/2004 b.6. pruning: Tariff 6.70 c€/kWh Market 6.95 c€/kWh b.8. industrial olive marc: Tariff 5.98 c€/kWh Market 6.23 c€/kWh	Médium-High 164 MW	Medium-High 250 MW	Problems of supply and storage, Transport costs of the biomass, price difference of the fuel (olive marc) at a European level.
Biogas (Water & waste treatment plants: Solid urban waste plants)	12 plants (9 water & waste treatment plants, 3 SUW)	12.1 MW		0,5 -1 MW	Electricity Law 54/97. Royal Decree 436/2004 b.7. biogas: Tariff 6.70 c€/kWh	Medium 25.34 MW	Medium 68 MW	The Spanish system supports other technologies like cogeneration and the production

Data updated as of 31st December 2004 (cumulative)	Number of plants	Totalled installed capacity (MW)	Production (MWh/year)	Typical installation size	Main present funding mechanism	Short term perspective (2006**)	Mid/Long term perspective (2010)	Main barriers
					Market 6.95 c€/kWh			of compost.
Solar Photovoltaic connected to the grid	251 installations (213 installations certified by the PROSOL programme, 38 installations certified by IDAE)***	6752,8 kWp***		5 kWp - 15 kWp in Prosol, and 5 kWp – 100 kWp in IDAE	Electricity Law 54/97. - Order of 22/6/01 (Boja nº 86 of 28/7/01) - Royal Decree 436/2004 Tariff b.1.1.: P<100 kW: Tariff 41.66 c€/kWh P>100 kW: Market 22.09 c€/kWh, Tariff 21.4 c€/kWh	Medium 4.5 MWp	Medium 16.4 MWp	Administrative barriers concerning connection to the electricity grid
Small hydro <10 MW	62	204.3 MW		0.5 kW-10kW	Electricity Law 54/97 Royal Decree 436/2004 Market 6.95 c€/kWh Tariff 6.70 c€/kWh	Low 107.2MW(****)	Low 133.2MW(****)	Lack of resources
Other RES E: Solar thermal high temperature for electricity production		0 MW			Electricity Law 54/97 Royal Decree 436/2004 Market 22.09 c€/kWh Tariff 21.84 c€/kWh	High 100 MW	High 230 MW	

(*) Source: Andalusian Economical Report, 2003. Sources: Andalusian Statistical Institute, National Statistical Institute.

(**) Andalusian Energy Plan (Plan Energético de Andalucía) 2003- 2006.

(***) Source: I.D.A.E. Data updated as of 31st December 2004.

(****) Royal Decree 436/2004: Elaboration of prices made by SODEAN S.A. taking into account the average daily market prices in 2004

(*****) Objectives refer to the Special Regime of the Andalusian Energy Plan (Plan Energético de Andalucía) 2003-2006.

Wind

Past: The Autonomous Region of Andalusia was the pioneer in Spain in wind installations. In 1982 the first prototype was installed on the coasts of the Strait of Gibraltar and the first large wind park (30 MW) was installed at the end of 1992 in the same location. From 1995 the development of new installations has been halted due to problems concerning to the social-environmental impact and land planning.

Present: The sector is in the process of change. The legislation at a regional level (ZEDE Order, Electrical Evacuation Areas, 30/09/2002, BOJA nº124 of 24 October 2002) is allowing the organisation of the sector and the planning of new installations, foreseeing a huge growth in the next two years, which has begun, duplicating the installed power during the last year.

Important companies: ENDESA, Desarrollos Eólicos S.A., Gamesa Energía S.A.

Other stakeholder & market actors in the region: SODEAN S.A. (Sociedad para el Desarrollo Energético de Andalucía), Consejería de Empleo y Desarrollo Tecnológico, Junta de Andalucía, becoming nextly Agencia Andaluza de la Energía (Andalusian Energy Agency) carries out planning technical studies of regional wind energy map for the Andalusian Government. Agencia Andaluza de Innovación (Andalusian Agency for Innovation) former Instituto de Fomento de Andalucía, IFA (Institute for Economic Promotion of Andalucía).

The main barriers & strategies to overcome them: Limitations to the electricity grid: Agreements being made between the operator of the system and the Ministry of Economy for the implementation of new infrastructures.

Administrative concessions and land planning: New legislation on land planning

Sufficiency supply of electrical components and turbines in due time.

Short-term perspectives (until 2006): The objective of the Andalusian Energy Plan (PLEAN) foresees 2,700 MW installed.

Mid/long-term perspectives (until 2010): The PLEAN foresees 4,000 MW installed.



Wind Farm "La Herrería". Tarifa, Cádiz

Wood Biomass

Past: The first plant in Andalusia to use wood biomass was installed in the 1980s by ENCE S.A. (Empresa Nacional de Celulosa) using bark from the eucalyptus tree and black lyes.

Present: There are currently two plants in Andalusia. There is a cogeneration plant with an installed power of 27.5 MW located in San Juan del Puerto in the province of Huelva, belonging to ENCE (Empresa Nacional de Celulosa-the National Cellulose



Ence, Province of Huelva

Company), which uses residues from raw material for the manufacturing of paper pulp (bark and residues from the eucalyptus tree). The other plant, with an installed power of 4.21 MW, belonging to TRADEMA S.A. is located in Linares in the Andalusian province of Jaén, and uses residues from wood used in the manufacturing of agglomerated planks/panels.

The vapour cycles have a greater level of technological maturity.

Important companies: ENCE S.A. (Empresa Nacional de celulosa), TRADEMA S.A.

Other stakeholder & market actors in the region: Valoriza Energía S.A. (Spain), Biomass Standard Kothen GmbH (Germany), Foster Wheeler Inc (USA) as boiler/store manufacturers. ECYR Grupo ENDESA (Endesa Cogeneración y Renovables), BECOSA (Bética de Cogeneración S.A.), ABENGOA.

The main barriers & strategies to overcome them: Currently the use of forestry residues is not viable due to the high obtaining cost of this material. The promotion of these residues through subsidies that should be channelled by the administration to the forest sector need to be studied. There is a lack of maturity in some technologies of energetic biomass conversion, as well as a lack of reliable logistics to assure the fuel supply at a viable price for the producer of the plant (referring to agricultural and forestry residues).

The strategies to overcome these barriers:

A stable framework and sufficient remuneration of the energy produced is needed.

The sector demands an increase in the premiums aimed at biomass.

Short-term perspectives (until 2006): The objective of the PLEAN is to obtain an installed biomass power of 164 MW in 2006.

Mid/long-term perspectives (until 2010): The objective of the PLEAN is to obtain an installed biomass power of 250 MW in 2010.

Biogas

Past: The potential for the generation of biogas in Andalusia is 611 kptep that represents 20.2 % of the total biomass potential. The main sources of biogas are Solid Urban Waste (9.7 % of the total biomass potential in Andalusia), Mud (Sludge) from Water and Waste Treatment Plants (Estaciones Depuradoras de Aguas Residuales, EDAR) (7.7 %) and Stock-farming wastes (2.8 %). In previous years several installations using biogas from Stock-farming wastes (mainly from pigs) have been made in Spain, but they have had technical problems and there are



Water & waste treatment plant, Copero, Sevilla

currently no installations of this type in Andalusia. The Universities in Andalusia are very interested in this technology. In 1997 the first installation using biogas for electricity generation was constructed in a SUW plant in Andalusia. Two installations of 0.5 ME each one were installed in Seville in the year 2000.

Present: Plants in operation:

Water and Waste Treatment Plants: though the small size of the Water and Waste Treatment makes some projects not viable, there are currently 9 installations in Andalusia whose total is 6,456 KW. The average size of the plant is 500 kW. The installations are promoted by the electricity companies, and the Water and Waste Treatment Plants are the only suppliers of mud (sludge) and consumers of heat. SUW: there are currently 3 SUW installations that have a total power of 5,646 kW which use gas from dumps. In this case the promoter companies manage the dump, whose priority partner is the City Hall.

- A plant is under construction in Medina Sidonia (province of Cádiz) of 9 MW that generates electricity using organic material from the SUW through digesters. The operation of this plant is envisaged shortly.

Pilot projects:

- There is a pilot "Biogas and Energy" plant of 5 MW in Puente Génave (province of Jaén) for the generation of biogas using two stage olive pomace (main source of biomass in Andalusia). Large scale exploitation has been delayed two years and its operation is foreseen for 2007.

Important companies: The main company that supplies the technology for using biogas from dumps is CLP ORGANOGAS, S.L. (United Kingdom). The engines that burn the biogas are mainly from an Austrian company (JENBACHER ENERGIE AG) and a Spanish company (GUASCOR S.A.).

Other stakeholder & market actors in the region: SINAIE, ECYR-ENDESA.

The main barriers & strategies to overcome them: Water and Waste Treatment Plants: There are no barriers in the use of biogas from Water and Waste Treatment Plants. SUW: The Andalusian authorities opt for the use organic material of the SUW for the generation of compost. It is essential that an installation in Cádiz that generates biogas of SUW through digesters get into operation. Stock-farming wastes: The main barrier preventing the use of biogas from stock-farming wastes is that the Spanish system promotes the cogeneration systems, using conventional fuels for the reduction of pig litter. The installation of a demonstration plant in Andalusia is essential for the development of the use of biogas of stock-farming wastes.

Short-term perspectives (until 2006): Total installed power 25,34 MW. Water and Waste Treatment Plants in accordance with the Renewable Energy Promotion Plan (Plan de Fomento de Energías

Renovables PFER) at national level: At short term the amplification of two Water and Waste Treatment Plants is foreseen, which would total 750 kW. There is a project consisting of 4 new installations that would total 1,906 kW. This signifies that there would be an installed power of 9,315 kW. SUW: The amplification of two SUW plants is foreseen at the short term, which would total 6,000 kW new. There is a project consisting of 7 new installations that would total 5,409 kW new. This signifies that there would be an installed power of 16,033 kW.

Mid/long-term perspectives (until 2010): Total installed power of 68.34 MW. The installation of 2 plants (in Cádiz and Málaga) of 9 MW respectively (18 MW) that use biogas generated by organic material of the SUW through digesters is foreseen. The new Water and Waste Treatment Plant and SUW installations are foreseen to begin operating in the short term. Positive long term perspectives are possible in situations where proof is shown of the good operating of biogas plants that use two stage olive pomace, the main source of biomass in Andalusia. In this case, the possible construction of 5 plants using biogas of two stage olive pomace, each one of 5 MW (25 MW) is foreseen in the province of Jaén.

Other Biomass: Biomass from the olive oil industry and greenhouse wastes

Past: The first electricity generation plant using residues from the olive industry dates from 1995.

Present: The actual installed power using biomass from the olive oil industry is 69.7 MW distributed among 6 plants; the fuel used is olive pomace ("orujo") and olive marc ("orujillo"). The technology used for obtaining electricity is the vapour cycle. Some industries of the sector use cogeneration in its productive process. In this case, either an alternative engine or a gas



Gasification Plant at Níjar, Province of Almería

turbine is used, and electric and thermal energy is generated in a simultaneous way. Thermal energy is used in the drying process of the olive pomace. A 1.7 MW gasification plant of greenhouse wastes has been started up in the Province of Almería.

Main companies: Single or joint enterprises of the generation plants: ENDESA, ABENGOA (both belonging to the energy sector), Coopeativa Oleícola El Tejar, Oleoliva, Hnos Santamaría, (Extractors, and industries generating the raw material), Sacyr Vallehermoso (Valoriza Energía), Iberese S.A., BECOSA, Albaida.

Other stakeholder & market actors in the region: Compañía General de Carbones as the main fuel supplier (Spain), Iberese S.A., (Spain) VKK Standardkessel GmbH (Germany), Foster Wheeler Inc (USA) as boiler manufacturers. Geopónika as a promoter company.

The main barriers & strategies to overcome them: The main problems concerning olive pruning in the generation of electricity deal with the collecting, transport and supply of the biomass.

The sales of olive marc and the olive pit to European countries able to pay better prices can cause instability in the internal market.

It is necessary to increase the premiums for the biomass sector.

Short-term perspectives (until 2006): It is foreseen that the electricity production using biomass from the olive industry will be 164 MW by the year 2006.

Mid/long-term perspectives (until 2010): The objective of the PLEAN is to achieve an installed biomass power of 250 MW by 2010.

Photovoltaic Solar Energy

Past: Solar photovoltaic energy is just the cleanest and most reliable way of producing electricity. But its wide dissemination at a commercial level has been limited due to economic reasons: high cost of the kWh produced, compared to that obtained with other conventional technologies (coal, petroleum, etc.).

The installation in Sierra María (province of Almería) (160 kWp) is one of the first well-known pilot projects developed in Andalusia.



Photovoltaic Installation in Aznalcollar, Sevilla

Present: There is currently a great technological maturity in this energy source, consisting of an increase of performance of systems, simplification and reduction of prices in the production of photovoltaic cells, development of more powerful, efficient and reliable inverters. All this in conjunction with regional, national and international financing and/or subsidy programmes, that allow a good penetration of this technology in the global electricity production. The installations in the campus of the University of Jaén (200 kWp), the Science Museum of Granada (15 kWp), as well as 269 installations made through the PROSOL programme since 1997 (22 of which are in public schools in Seville, one photovoltaic tree and two solar exploitations of 173,25 kWp and 496,44 kWp, respectively), and other installations such as the Repsol service stations (15 kWp), are emphasised.

Important companies: Isofotón S.A., BP Solar España S.A., ATER S.A. (Aplicaciones Técnicas de la Energía) and Gamesa Solar.

Other stakeholder & market actors in the region: There are four Associations of Solar Energy Companies (ASOLAND, EPYME, EUROSOLAR and HELIOS) which represent the installer companies and manufacturers.

The main barriers & strategies to overcome them: The main barriers are of a technical-administrative nature, and the connection to the grid. To solve this problem, the Andalusian Administration has elaborated an Order that establishes the administrative procedures applicable to the photovoltaic installations connected to the low voltage grid, with the idea of simplifying the technical-administrative procedures to be carried out for its construction and exploitation.

Short-term perspectives (until 2006): An installed power of 4.5 MWp is foreseen for the year 2006 in accordance with the predictions of the PLEAN (Plan Energético de Andalucía).

Mid/long-term perspectives (until 2010): An installed power of 16.4 MWp is foreseen for the year 2010 in accordance with the PLEAN (Plan Energético de Andalucía).

Small hydro (<10 MW)

Past: The first Spanish hydroelectric plants were constructed at the end of the nineteenth century. A good part of the initial phase of the Spanish electricity development was linked to the expansion of these types of installations, proof of this is that in 1901 40% of the electricity plants existing in the country were of the hydroelectric type.

Present: The demand of water for agricultural irrigation and drinking uses is a priority in Andalusia compared to other energetic uses. This situation makes the future development of the hydroelectric energy as con-



Minihydro plant of Villafranca, Córdoba

ditioned and limited for the use of large hydro infrastructures being planned, or for those that are still not energetically used and for the use of the highest river beds (channels) in areas of little or no agricultural use. These last uses have a very reduced unitary power, around 1MW or less.

Important companies: Sevillana-ENDESA, Confederación Hidrográfica del Guadalquivir y Sur, Recursos Energéticos S.A., Microcentrales de Andalucía S.A.

Other stakeholder & market actors in the region: Water is managed by the Hydrographic Confederations ("Confederaciones Hidrográficas").

The main barriers & strategies to overcome them: According to the data given by the Hydrographic Confederation of the Guadalquivir River (Confederación Hidrográfica del Guadalquivir) concerning to the gross potential in the Guadalquivir River basin, only 14% can be technically developed (much less than the peninsular average of 46%), of which more than 50% is already actually developed, leaving only a small margin for the implementation of new installations. The objectives marked in this field should be reached through the installation of small plants, since the new resources are scarce and disperse, which makes the cost effectiveness impossible for the installation of larger plants.

The development strategy is based on:

- The use of existing infrastructures that lack electricity use
- The use of volume flows in high river beds (channels) (Sierra Nevada and Sierra de Cazorla)
- Reformation of old abandoned plants
- The use of actual water supply infrastructures

Short-term perspectives (until 2006): The PLEAN (Andalusian Energy Plan) foresees the installation of 24 MW, the equivalent to a total installed power of 107.2 MW.

Mid/long-term perspectives (until 2010): The PLEAN foresees, in a second phase, the installation of an additional 26 MW, which offers a total installed power of 133.2 MW.

Note: Objectives refer to the Special Regime assigned in the Andalusian Energy Plan (Plan Energético de Andalucía) 2003-2006

Thermosolar Energy in Andalusia

Past: Andalusia has been a pioneer in the research and development of thermosolar technology throughout the research of the Andalusian Universities, University of Seville and Solar Station of Almeria (Plataforma Solar de Almería (PSA)), currently depending on CIEMAT (Center of Energy, Environment and Technological Research) Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas.



Photo: Superior School of Industrial Engineering,
University of Seville

Present:

The main concentration technologies in development and implementation in Andalusia are described as follows:

Parabolic Collector Cylinder System: Composed of a parabolic cylinder mirror that reflects the direct solar radiation, concentrating it on a receiving tube located in the focal line of the parabola and in which a fluid circulates into increasing its thermal energy. Its index of incident direct solar radiation is approximately 40 and it is able to operate efficiently until 450°C. The power rank is in between 1 MW_e and 100 MW_e.

Some of the projects that have been developed with this type of technology are prototypes that are working in the Solar Station of Almeria (Plataforma Solar de Almería). Among these projects the DISS Project is emphasised in which the direct steam generation has been researched through these systems.

Central Receiving Tower System: Composed of a series of individual concentrators called heliostats that direct the concentrated solar radiation towards a central receiver in which the conversion of solar energy into thermal energy takes place. Its degree of concentration (600) is higher than the parabolic collector cylinder systems, allowing working temperatures of above 1000 °C in nominal conditions. The power range of this type of plant is between 10 MW_e and 200 MW_e. Projects like Solgas, Colón-Solar, CESA and SSPS-CRS of the Solar Station of Almeria and the PS 10 Plant in Solúcar are examples of implementations of this technology.

Parabolic Disc: Composed of a reflector in shape of paraboloid of revolution, a receiver located in the centre of the parabolic and a system of electricity generation that sets up an unique block with the receiver. In this case, the parabolic concentrates the solar radiation on the receiver that transforms it into thermal energy for finally obtaining mechanical energy. There are systems with a concentration index higher than 3000, reaching working temperatures of around 800°C. The range for usual power of this type of installations is between 5kW_e and 25 kW_e.

There are currently various high temperature solar energy projects in Andalusia. Their main characteristics are described following:

PS 10 Project promoted by SOLUCAR SOLAR S.A (in Sanlúcar La Mayor, Seville):Thermoelectric solar plant made up of a field of 624 heliostats, each one of 121 m², with technology from a central receiving tower using saturated steam as working fluid. It has a nominal power of 11 MWe that will generate an

annual net production of 24.2 GWh of electricity in solar operation, which offers environmental benefits of 9.300 tons annually of avoided CO₂ emissions. The installation costs of the plant are less than 3.000 €/kW.

ANDASOL Project promoted by MILENIO SOLAR S.A (in Guadix, Granada): Project of 672 cylindrical parabolic collectors (eurothrough type) (150 metres in length and 5.8 metres wide), whose total installed power is 50 MWe including a thermic storage capacity of 9 hours. The project offers environmental benefits of 218.000 tons annually of avoided CO₂ emissions. The installation costs are 250 million Euros.

Disco-Stirling Systems: The DISPA-Stirling Project which forms part of an extended project called EnviroDish has allowed placing an experimental installation in the Superior School of Engineering of the University of Seville. The system has a nominal power of 9.2 kW_e and a concentration relationship of 2500. In addition, the Plataforma Solar de Almería currently counts on, among its testing installations, parabolic discs developed in the DISTAL II and EuroDISH projects, using a Stirling engine as a generating system for electricity.

The main barriers and strategies to overcome them: The technologies are relatively new and have little commercial experience, although demonstration and research projects have confirmed their possibilities. Actually the development of these types of projects in Spain are linked to the sale price of electricity, forecasting a huge growth in the upcoming years due to the new regulator framework introduced by Royal Decree 436/2004.

Electric Law 54/97.

Royal Decree 841/2002

Royal Decree 436/2004:

Regulated sale price: 22 c€/kWh

Market sale price. No experience

Short-term perspectives (until 2006): In accordance with the provisions set by the Andalusian Energy Plan for 2006, an installed power of 100 MW is predicted.

Mid/long term perspectives (until 2010): In accordance with the provisions set by the Andalusian Energy Plan for 2010, an installed power of 230 MW is predicted.

Important companies: Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) (Center for Energy, Environment and Technological Research of the Ministry of Education and Science, Protermosolar Association, AICIA, GHERSA, IBERESE, University of Seville (Thermodynamic and Renewable Energy Sources Group, and Automatic and Control, Superior School of Industrial Engineering) University of Almería, electricity companies (ENDESA, IBERDROLA, GENESA), industries (INABENSA, GHERSA, IBERESE) and engineering companies (MILENIO SOLAR S.A, FICHTNER Germany, SBP, INITEC Spain).

Manufacturers: SOLÚCAR SOLAR S.A-GRUPO ABENGOA, INANBENSA, FLABER SOLAR INT

Other stakeholders and market actors in the region: Andalusian Energy Agency (Agencia Andaluza de la Energía) and Associations of Solar Energy Companies, SODEAN has promote research at several Thermo-Solar projects, as Sol-Gas, Colón-Solar.

Conclusions Renewable Energy Sources connected to the grid in Andalusia

MAIN MARKET ACTORS:

The main market actors are the following:

Companies of the sector:

GRUPO ABENGOA S.A., ATERSA, BECOSA Bética de Cogeneración S.A., BPSOLAR ESPAÑA S.A., Confederación Hidrográfica del Guadalquivir y Sur, Compañía General de Carbones, DESARROLLOS EÓLICOS S.A., ECYR Endesa Cogeneración y Renovables, ENCE S.A. Empresa Nacional de Celulosa (National Cellulose Company), ENDESA Sevillana-Endesa, GAMESA ENERGIA S.A., IBERESE S.A., ISOFOTON S.A., Microcentrales de Andalucía S.A., Recursos Energéticos S.A., TRADEMA S.A.

Associations: ASIF, Asociación Protermosolar, ASOLAND, EPYME, EUROSOLAR, HELIOS, representing the installer and manufacturing companies.

Institutions and market actors:

Andalusian Energy Agency (Agencia Andaluza de Energía), Regional Ministry of Innovation, Science and Enterprise (Consejería de Innovación, Ciencia y Empresa) of the Andalusian Regional Government (Junta de Andalucía) former SODEAN S.A. (Sociedad para el Desarrollo Energético de Andalucía, Consejería de Innovación, Ciencia y Empresa, Junta de Andalucía); Local and Regional Energy Agencies; Innovation and Development Agency (Agencia de Innovación y Desarrollo – formerly the Institute of Economic Promotion of Andalusia (Instituto de Fomento de Andalucía); IDAE Instituto para la Diversificación y el Ahorro de la Energía (Institute for Diversification and Energy Saving), Ministry of Industry, Tourism and Labour; Chambers of Commerce; Andalusian Research Centres; CENTER; CIEMAT Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas; Ministry of Education and Science (installations in the Solar Station of Almeria (Plataforma Solar de Almería)); Centro de Innovación y Tecnología de la Energía (CIT) (Centre for the Innovation and Technology of Energy); Architect and Engineering Schools of Andalusia, Confederation of Andalusian Enterprises (Confederación de Empresarios de Andalucía); Olive Cooperatives; Electricity Companies; INTA Instituto Nacional de Técnica Aeroespacial (National Institute for Technical Aerospace); Engineers (Valoriza Energía, SINAIE, Geoponika, BUYO S.A, Instalaciones Moral y López S.A, SUGIMAT S.L, Biomassas del Sur; Towns; Regions; Andalusian Universities.

CONCLUSIONS - RENEWABLE ENERGIES CONNECTED TO THE GRID IN ANDALUSIA:

The Autonomous Community of Andalusia currently presents a RE percentage of 5.2%, as of 31st December 2004, with the objective of reaching 15% by the year 2010, as stated in the Andalusian Energy Plan (Plan Energético de Andalucía PLEAN) 2003-2006. The RE percentage over the total electricity produced in Andalusia is 7,9%.

The RE technologies that currently offer the highest growth index are:

Wind energy, with an installed power of 442.8 MW as of 31st December 2004, and whose installed power has duplicated in 6 months (233.9 MW installed as of 31 May 2004). The average size of the installations have varied substantially from 600 kW, and currently machines of 2 MW are being installed. The Andalusian Energy Plan (Plan Energético de Andalucía) foresees an installed power of 4.000 MW in Andalusia for the year 2010. The Andalusian Regional Government is promoting, through the ZEDE Order, the development of renewable resources, taking into account environmental criteria.

High temperature Solar Energy, is the great novelty. There are currently two new projects in Sanlúcar la Mayor (Seville) and Granada, predicting an installed power of 230 MW for the year 2010. Although this

Biomass: RE technology has an average-high growth potential, especially for the sub-sectors of biomass from the olive oil industry and wood (installed power foreseen for the year 2010 is 250 MW), biomass energy presents growth problems. The sector demands greater premiums for this type of energy and there still exists problems of aprovisionamiento y derivados from transport costs.

Photovoltaic Energy presents a considerable potential in Spain, and a growing potential is expected for Andalusia in the upcoming years.

RES-Technologies: The Andalusian Regional Government is currently working on an Order for Renewable Energy Subsidies that includes a wide group of actions, including energy saving and efficiency projects, like renewable energy and cogeneration production, transport and energy distribution networks, audits, viability studies and informative and divulgative actions, and the integration of several subsidies, like the PROSOL Order. This system will offer a unique incentive programme for businesses, administrations and other actors involved.



