Research study

Renewable energies and employment generation in Spain. Present and future.

2007

Executive Summary for CENIFER

Developed by:

istas

Instituto Sindical de Trabajo Ambiente y Salud

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1. INTRODUCTION AND OBJECTIVES OF THE STUDY

The constant development of renewable energies is not only a mechanism to mitigate the effects of climate change and protect the environment but also a positive social contribution in terms of employment.

Given the current situation and the accelerated and unpredictable development of this sector, the available estimates on the evolution of renewable energies might be inaccurate for the current scenario. The purpose of this study is to analyse such data and revise the estimates for 2010 and 2020.

AIMS

- Estimating the number of direct jobs required by each sub sector or technological branch of renewable energy (wind, photovoltaic, thermal with high temperatures, thermal with low temperatures, biomass and biofuels) for its adequate development in a short (2010) and long (2020) term.

- Assessment of professional categories by type of technology, by professional level (specialists, engineers, architects, non-qualified workers) and when possible by type of activity (operation, installation and maintenance).

2. INSTITUTIONAL FRAMEWORK

A set of active policies have been implemented in Spain in order to comply with international agreements on the reduction of greenhouse gases. One of those policies is the use of renewable energies which has experienced a massive development due largely to the efforts of many organizations, companies and persons involved in this activity.

3. PREVIOUS RESEARCH

Despite the considerable volume of studies carried out in Spain which points to a great interest in addressing job creation in the sector of renewable energies, most of the estimations, including the National Plan for the Promotion of Renewable Energies 1999-2010, are unquestionably developed by IDEA.

There are also a vast number of important international studies which are shown in the following table. Two reference models are used in a great variety of reports, including those drafted by the EU. Those models are the RIOT (Renewable enhanced Input- Output Tables) and SAFIRE (Strategic Assessment Framework for Rational Use of Energy).

4. METHODOLOGY

4. 1 OBJECT OF THE STUDY

This study explores economic, business, and association activities directly involved in the operation of renewable energy sources.

4.2 FIELDWORK

1) In-depth interviews with key informants have developed in two phases:

a) The most relevant links of the sector, trying to cover each of the technologies.

b) Key informants from the business sector: communication managers, directors, heads of HR departments, etc.

2) Record files containing survey information.

The number of enterprises that match the criteria for this study makes up a universe of 1.027 companies. 422 telephone surveys were conducted throughout Spain which in statistical terms implies a margin of error of $\pm$ 3.73 % with an average level of confidence of 95,45%.

5. THE INDUSTRIAL SECTOR OF RENEWABLE ENERGIES

5. 1 DEFINITION OF RENEWABLE ENERGIES

In order to better understand this study it is necessary to start with a description of the different sources of renewable energies. They are defined in general terms as *sources that originate in any process that does not alter the environmental equilibrium of the planet, does not generate irrecoverable waste and whose rate of consumption does not exceed the rate of regeneration of used raw material*.

In this chapter we provide general definitions for the different clean energy sources in order to have a precise understanding of each of the cases to be examined later on. We have defined the following energy sources which can be found in the general report:

Small hydropower	Biomass
wind	Biofuel
Solar Thermal	Biogas
Solar Photovoltaic	Geothermal
Solar Thermoelectric	Tidal

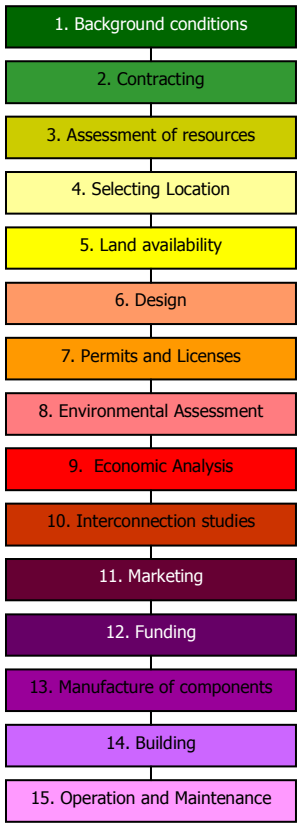
5.2 PRODUCTION PROCESSES OF RENEWABLE ENERGIES

The production processes of renewable energies include a wide variety of phases that involve a vast numbers of employees with different professional profiles; institutions: both public and private; technologies: domestic and imported. There are however many common phases in the development of the different classifications of energies which are shown in the following graph. Since this is a generic chart the sequence of phases may be altered or, in some cases, some specific phases might be omitted.

The general report offers a detailed description of those stages in the chain of values of the aforementioned renewable energies except for the categories of geothermal and wave power due to their early stage of development and limited installed power in the domain.

A specific description for each technology with regard to the manufacture of components has been developed since this category differs markedly for each type of energy. A classification of economic activities involved in the production process has also been developed. This classification is based on the categories of the National Catalogue of Economic Activities (CNAE) by the National Statistics Agency (INE). See Annexes to the general report.

Diagram 1: Stages of development of renewable energies



Source: Developed by ISTAS.

Following a common pattern of the phases for all types of renewable energies we have identified the most important aspects in each phase for each technology. It is important to mention that the legislative aspect has played a significant role and

regulation has been reformed on the basis of the evolution of these energies. A good example of this is Act 661 of 2007 (which replaced Act 436 of 2004), which aims at establishing a legal and economic framework for special electric energy production systems. It also sets up a general methodology for administrative processes and authorizations.

Although the description of most phases is fairly general (except for the manufacture of components), a series of specific diagrams for each type of energy has been developed to illustrate the most important aspects of each phase. For instance the diagram on wind farm energy shows a general sequence on the horizontal axis, but on the vertical one it shows a breakdown of the different activities.

The following diagram is an example of this:

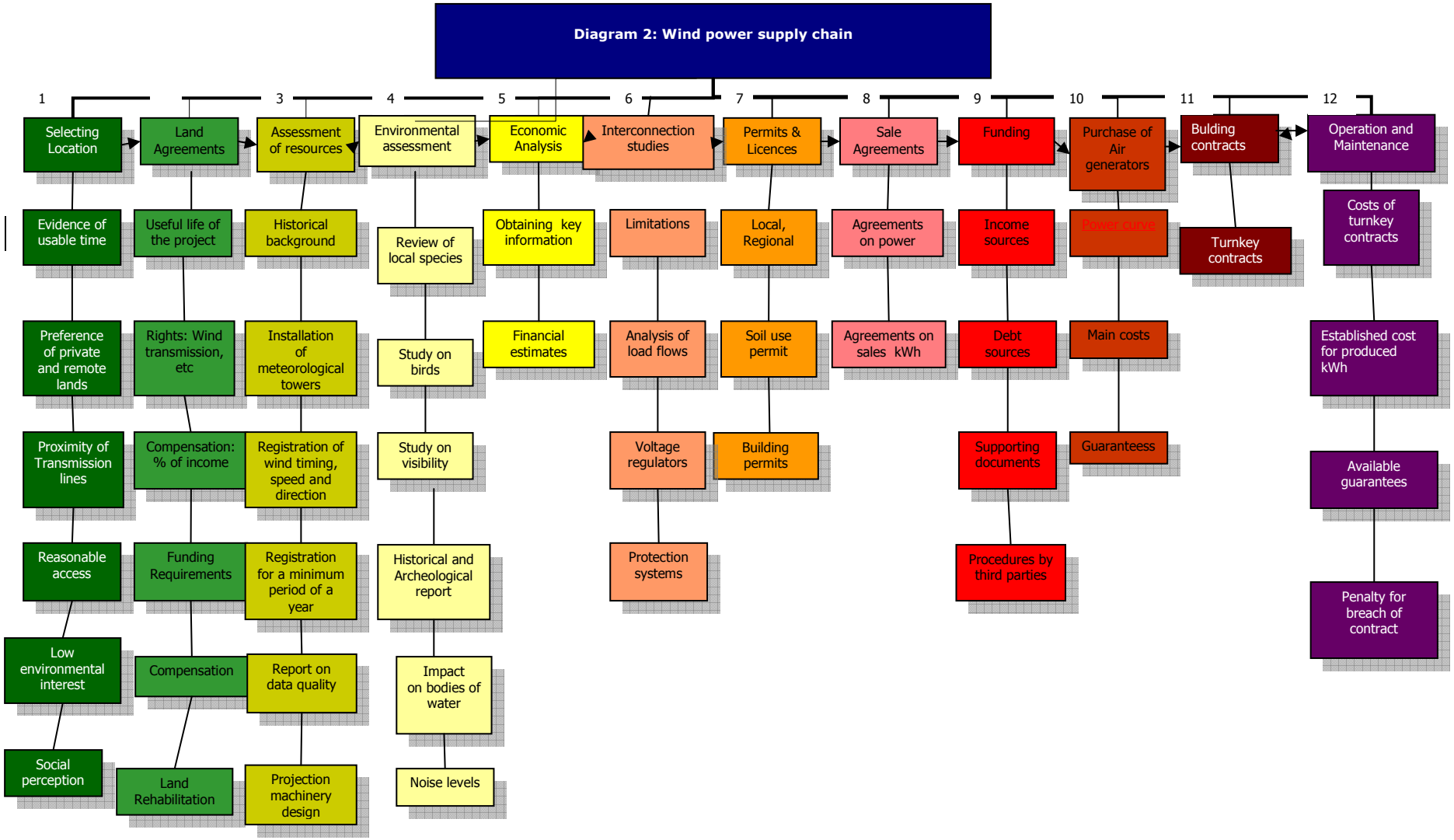


Diagram 2: Wind power supply chain
1
Selecting Location
Evidence of usable time
Preference of private and remote lands
Proximity of Transmission lines
Reasonable access
Low environmental interest
Social perception
3
Land Agreements
Useful life of the project
Rights: Wind transmission, etc
Compensation: % of income
Funding Requirements
Compensation
Land Rehabilitation
4
Assessment of resources
Historical background
Installation of meteorological towers
Registration of wind timing, speed and direction
Registration for a minimum period of a year
Report on data quality
Projection machinery design
5
Environmental assessment
Review of local species
Study on birds
Study on visibility
Historical and Archeological report
Impact on bodies of water
Noise levels
6
Economic Analysis
Obtaining key information
Financial estimates
7
Interconnection studies
Limitations
Analysis of load flows
Voltage regulators
Protection systems
8
Permits & Licences
Local, Regional
Soil use permit
Building permits
9
Sale Agreements
Agreements on power
Agreements on sales kWh
10
Funding
Income sources
Debt sources
Supporting documents
Procedures by third parties
11
Purchase of Air generators
Power curve
Main costs
Guaranteess
12
Bulding contracts
Turnkey contracts
Operation and Maintenance
Costs of turnkey contracts
Established cost for produced kWh
Available guarantees
Penalty for breach of contract

6 CHARACTERISTICS OF THE SECTOR IN RELATION TO FIELDWORK

This study includes the following information

1. Views of the sector's associations.
2. Views of the sector's enterprises.
3. Data obtained from surveys in enterprises.
4. Conclusions.

This report includes the most significant issues.

6.1 BUSINESS NETWORK ACCORDING TO SECTOR LEADERS

1. The perception of the situation by the enterprises and associations is clearly positive with a high growth rate except for the case of small hydropower.
2. The development of renewable energies has been influenced by many factors, among them institutional support.
3. The current model of development which has boosted renewable energies is partly the cause of some negative consequences like those regarding the funding of projects, the dependence on the offer of industrial equipment and the limitations of commercial viability.
4. The attitude of the enterprises varies depending on the type of enterprise and the market in which they deploy their activity.
5. The internal market is made up of a great number of SMEs and is divided by regions, some of which are starting to show limitations in the creation of the more developed energies, particularly the windpower sector.
6. The international market, controlled by big corporations offers great opportunities to diversify some technologies that would not prove profitable in developed countries. It also offers wider versatility for the industry since it will not depend on a single market.
7. The business structure in the renewable energy sector is basically divided into two categories of enterprises adapted to the aforementioned markets and whose strategies are clearly different.
8. As in other sectors, there generally exists a process of specialization, vertical integration of activities and subcontracting led by the major enterprises: promoters and manufacturers. Enterprises with less weight in the sector make up an auxiliary industry which proves essential for the full development of this sector and overcome the imitations in equipment manufacture.
9. The main categories of renewable industry in Spain have the necessary technology for national and international expansion.

6.2 DATA OBTAINED FROM SURVEYS IN ENTERPRISES

1. Renewable energy enterprises are spread throughout the different regions and concentrate to a greater extent in traditional industrial regions like Madrid, Catalonia, the region of Valencia, the Basque country and Andalusia. Navarra is the leading region per enterprise/population ratio.
2. The sector of renewable energies is relatively recent with an average lifespan of 16 years and in which one out of every three enterprises has been created after 2.000.

3. Half of the enterprises related to renewable energies combine their activity to some degree with other industrial activities.
4. However, a strong link exists with renewable energies, 65% of the enterprises deploy more than 50% of their activity in this sector.
5. Those enterprises that are fully involved in this sector are either medium-sized or small with an average staff of 44 workers.
6. Most enterprises are involved in three main production lines: solar photovoltaic energy (57,6%), solar thermal energy (43,4%) and wind energy (35,3%).
7. If we focus on the main activity (more than 80% of production in the same sector) these are still the key subsectors with slight variations in the order of importance (wind energy rises to second place).
8. In terms of specific activities most enterprises are involved in installation (52.4%) while 21.6% carry out maintenance operations. A lower percentage (14.7%) includes enterprises involved in equipment sales, whereas some 13% is involved in energy production.
9. One of main characteristics of the sector of renewable energies is that 2/3 of the enterprises are independent organizations.
10. Fully independent organizations are the smallest ones with an average staff of 42 workers per enterprise and at least 85% of them employ fewer than 50 workers.
11. Suppliers are for the most part (67, 5%) national companies although 46.5% of enterprises also have European suppliers.
12. The customers: the sector's production is mostly directed to national clients (70%), although European clients also have some importance (23.5%). The access to international markets is considerably restricted.
13. Investment: enterprises surveyed consider that percentage investment will increase next year up to 19%. Most of the prospect concentrates in companies with a growth rate between 10 and 25%.

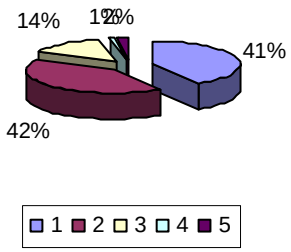
Table 1: Estimated investments

Rank	Percentage %
Less than 10%	30.7
Between 10-25%	53.9
More than 25%	15.3
Average	19.6

Source: developed by ISTAS based on survey analysis

14. A very important factor is the tendency of investments to increase which has been confirmed by 60% of the surveyed enterprises. This encourages the development of this business sector.
15. Investments will mostly extend in the following subsectors: Firstly solar photovoltaic energy, followed by solar thermal and wind.
16. Small enterprises prevail clearly in this sector where almost 80% of the organizations employ fewer than 50 workers per company.

Chart 1: Size of enterprise by number of workers



Keys: 1: fewer than 10 workers. 2: 11 to 50 workers. 3: 51 to 250 workers. 4: 251 to 1000 workers. 5: more than 1000 workers

Source: developed by ISTAS

7. ENERGY SCENARIOS: EVOLUTION AND ESTIMATES (2010-2020)

Spain is among the countries that rely on energy import (78, 3%). Primary energy in Spain shows a similar tendency to that of the EU. For most, the importance of gas is increasing constantly since 1987 whereas the importance of oil is decreasing slowly. Nuclear energy maintains constant levels since 1997.

The final energy consumption for 2003 was 97.2 million tons, which represents an increase of 60% compared to 1990. In 2004 there was a 3.6% increase with respect to 2003, which meant a slight decrease of the growth rate due to milder climate conditions in that year. In 2006, a decrease was registered for the first time in the definitive energy consumption of 0, 8% for a total figure of 102.3 million taps.

Although renewable energies provide a very small share of the energy volume, they are showing a progressive increase. The primary energy balance for 2006 shows a 7% input of renewable energies of which the biggest contribution belongs to biomass, hydropower and wind energy.

7.1 ENERGY SCENARIOS IN SPAIN IN 2010

The Renewable Energy Plan (PER 2005-2010), developed by the Ministry of Industry is the reference framework for the study of the renewable energy scenario in 2010. The plan outlines the goals set in terms of production of primary energy to comply with European agreements.

Table 2: Projected goals for the renewable energy plan 2005-2010

Sectors	2004 as average year			Goal 2010		
	Power (MW)	Prod. (GWh)	E.P. (ktep)	Power (MW)	Prod. (GWh)	E.P. (ktep)
Hydropower (>50 MW)	13.521	25.014	1.979	13.521	25.014	1.979
Hydropower (10 a 50 MW)	2.897	5.794	498	3.257	6.480	557
Hydropower (< 10MW)	1.749	5.494	466	2.199	6.692	575
Biomass centrals	344	2.193	680	1.317	8.980	3.586
Co-combustion	0	0	0	722	5.036	1.552
Solid urban waste	189	1.223	395	189	1.223	395
Wind	8.155	19.571	1.683	20.155	45.511	3.914
Solar photovoltaic	37	56	5	400	609	52
Biogas	141	825	267	235	1.417	455
Solar thermoelectric	0	0	0	500	1.298	509
Subtotal electric areas	27.033	60.097	5.973	42.495	102.260	13.574
Biomass			3.487			4.070
Solar thermal low T (m^2)	700.805		51	4.900.000		376
Subtotal thermal			3.538			4.446
Biofuel (transport)			228			2.200
Total renewable energies			**9.739**			**20.220**
Primary energy consumption			141.567			167.100
Renewable of primary energies			6.88%			12.10%

Source: Renewable Energy Plan (PER) 2005-2010, IDAE 2005

Table 3: Gross electricity consumption by 2010 (GWh)

	Year 2010
Gross electricity consumption	**337.407**
Total generation with Renewable Sources (GWh)	**102.259**
% renewable electricity over gross electricity consumption	**30.3%**

Source: Renewable Energy Plan (PER) 2005-2010, IDAE 2005

Table 4: Final Energy consumption 2010 (ktep)

Final energy consumption REP scenario	Year 2010 (ktep)
Total final consumption	**127.330**
Of final energy consumption **Biofuel** **Gasoline and diesel**	 **2200** **37.735**
Biofuels, gasoline and diesel in transport %	**5,83%**

Source: Renewable Energy Plan (PER) 2005-2010, IDAE 2005

7.2 ENERGY SCENARIOS IN SPAIN (2010)

To analyze possible employment opportunities in the renewable energy sector in 2020, we have studied feasible national energy scenarios for that period and selected two of them: The plan for the electricity and gas sectors 2007-2016, and the European Commission proposal to address climate change and renewable energies for 2020.

The expected energy scenarios for 2020 have been developed using those studies as a framework reference and are based on our own estimates.

Table 5: Evolution of energy scenarios until 2020

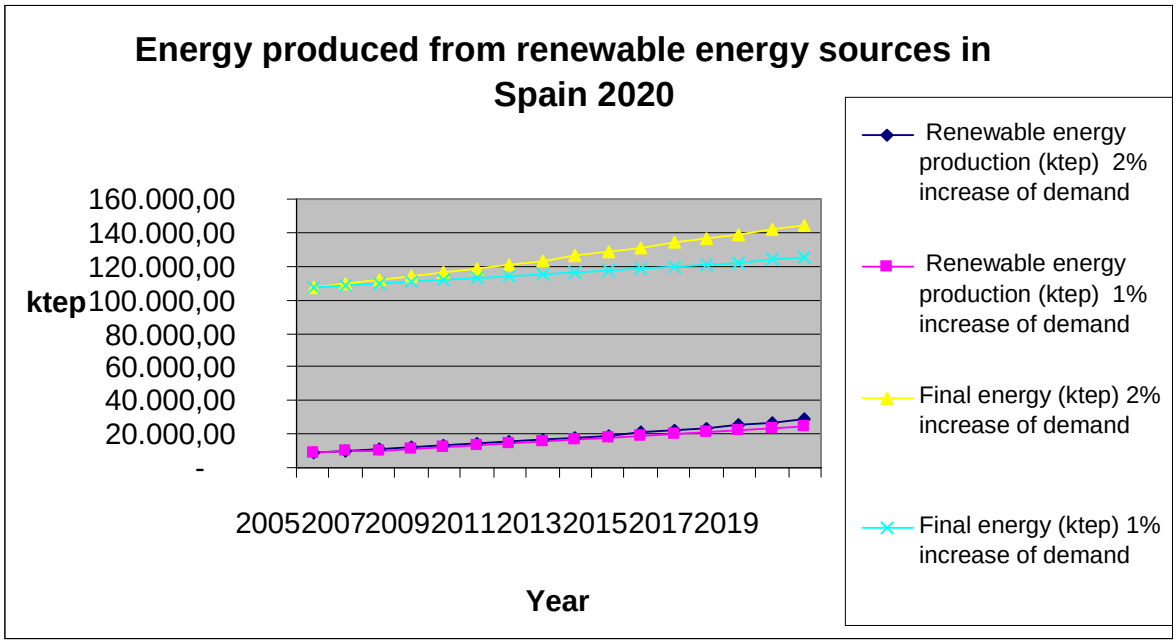
Year	Final energy covered by renewables (%)	Renewable energy production (ktep) 2% Increase of demand	Renewable energy production (ktep) 1% Increase of demand	Final energy (ktep) 2% Increase of demand	Final energy (ktep) 1% Increase of demand
2005	8,00	8.605,36	8.605,36	107.567,02	107.567,02
2006	8,80	9.655,22	9.560,56	109.718,36	108.642,69
2007	9,60	10.743,62	10.534,00	111.912,73	109.729,12
2008	10,40	11.871,70	11.525,95	114.150,98	110.826,41
2009	11,20	13.040,61	12.536,68	116.434,00	111.934,67
2010	12,00	14.251,52	13.566,48	118.762,68	113.054,02
2011	12,80	15.505,66	14.615,62	121.137,94	114.184,56
2012	13,60	16.804,25	15.684,39	123.560,69	115.326,40
2013	14,40	18.148,59	16.773,07	126.031,91	116.479,67
2014	15,20	19.539,99	17.881,96	128.552,55	117.644,47
2015	16,00	20.979,78	19.011,35	131.123,60	118.820,91
2016	16,80	22.469,34	20.161,53	133.746,07	120.009,12
2017	17,60	24.010,09	21.332,82	136.420,99	121.209,21
2018	18,40	25.603,49	22.525,52	139.149,41	122.421,30
2019	19,20	27.251,02	23.739,94	141.932,40	123.645,52
2020	20,00	28.954,21	24.976,39	144.771,05	124.881,97

Source: Developed by ISTAS based upon data put out by the European Commission, Jan. 2008

Although related to an EC proposal still pending on EP approval, we regard this scenario as mandatory for our country within the coming months. That is why we believe it is very possible that in the year 2020, 20% of the final energy consumption will be supplied by renewable energy sources.

To carry out this research it became necessary to estimate the evolution of energy demand. Two possibilities were considered:

- A yearly increase of energy demand of 2%, a figure very close to gas and electricity estimates for 2007-2016.
- A yearly increase of energy demand of 1%, the figure established by the Spanish strategy to address climate change and clean energies 2007, 2012 and 2020 (approved in 2007). This is the most ambitious national scenario developed so far.



Source: Developed by ISTAS based upon data put out by the European Commission, Jan. 2008

7.3 ENERGY SCENARIOS FOR AMBITIOUS GOALS

Spain has enough renewable resources to achieve more energy scenarios than the ones developed to date. The EC proposal is already a step forward in this sense with respect to the plan approved by the Spanish government for the gas and electricity sectors 2007-2016. The proposal is perfectly transferable to energy scenarios with no increase in energy demand by periodically improving energy efficiency and maintaining a renewable production of more than 20%.

An ambitious yet realistic scenario can be drawn with no yearly increase of energy consumption and with an energy balance in which renewable energies would have a share of at least 30% by 2020. The estimates for final energy consumption and produced renewable energy for such a scenario in the period 2005-2020 are shown in the following table.

Table 6: Final energy consumption and renewable energy produced 2005-2020, assuming no increases in energy demands and 30% of renewable energies goals in 2020

Year	Final energy covered with (%)	Final energy ktep	Energy covered by renewable energies
2005	8,00	107.567,02	8.605,36
2006	8,80	107.567,02	9.465,90
2007	9,60	107.567,02	10.326,43
2008	10,40	107.567,02	11.186,97
2009	11,20	107.567,02	12.047,51
2010	12,00	107.567,02	12.908,04
2011	12,80	107.567,02	13.768,58
2012	13,60	107.567,02	14.629,11
2013	14,40	107.567,02	15.489,65
2014	15,20	107.567,02	16.350,19
2015	16,00	107.567,02	17.210,72
2016	16,80	107.567,02	18.071,26
2017	17,60	107.567,02	18.931,80
2018	18,40	107.567,02	19.792,33
2019	19,20	107.567,02	20.652,87
2020	20,00	107.567,02	21.513,40

Source: Developed by ISTAS

Produced renewable energy for the three energy scenarios for 2020:

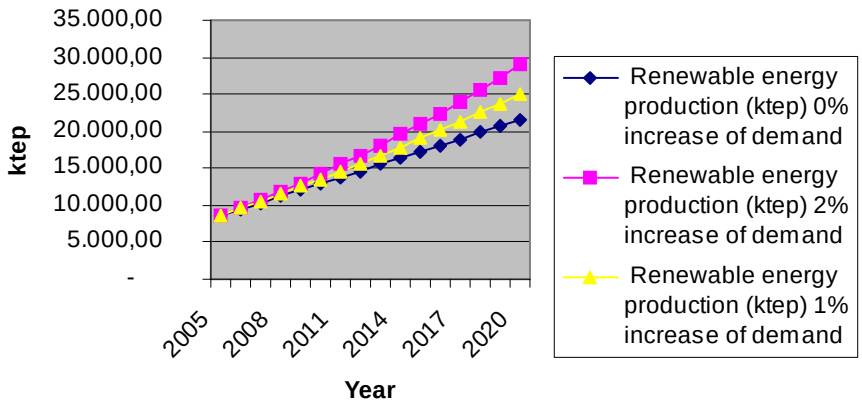
- 30% goal of renewable energy in 2020 with no increase in energy demand.
- 20% of final energy from renewable sources in 2020 and a 2% yearly energy demand.
- 20% of final energy from renewable sources in 2020 and a 1% yearly energy demand.

Table 7: Renewable energy produced in the three energy scenarios for 2020

Year	30% Renewable energy production (ktep). 0% increase of demand	20% Renewable energy production (ktep). 2% increase of demand	20% Renewable energy production (ktep). 1% increase of demand
2005	8.605,36	8.605,36	8.605,36
2006	9.465,90	9.655,22	9.560,56
2007	10.326,43	10.743,62	10.534,00
2008	11.186,97	11.871,70	11.525,95
2009	12.047,51	13.040,61	12.536,68
2010	12.908,04	14.251,52	13.566,48
2011	13.768,58	15.505,66	14.615,62
2012	14.629,11	16.804,25	15.684,39
2013	15.489,65	18.148,59	16.773,07
2014	16.350,19	19.539,99	17.881,96
2015	17.210,72	20.979,78	19.011,35
2016	18.071,26	22.469,34	20.161,53
2017	18.931,80	24.010,09	21.332,82
2018	19.792,33	25.603,49	22.525,52
2019	20.652,87	27.251,02	23.739,94
2020	21.513,40	28.954,21	24.976,39

Source: Developed by ISTAS

Chart 4: Final energy covered with renewable energies in the different scenarios



Source: Developed by ISTAS

8. DATA ON EMPLOYMENT

8.1 CURRENT SCENARIO

For the purpose of this study direct jobs are those regarded as necessary to develop each of the facilities involved in the production of renewable energy, starting by the manufacture of components, including design, engineering, administrative tasks and installation, operation and maintenance.

The new jobs can be classified by the part of the production process they belong to.

The production process has been divided into two main categories:

- **Operation and maintenance:** jobs required to carry out operation and management of the plant. These jobs would be permanent throughout the lifespan of the energy plant.
- **Building and installation:** this category includes the jobs required to start up new energy plants. Employment will remain stable as long as renewable energy facilities are being set up.

First conclusions

1) Most of the jobs in this sector concentrate on the categories of building of new facilities, installation and maintenance followed by equipment manufacture.
2) Subcontracting makes it difficult to calculate the number of newly created jobs. Subcontracted work required lower qualifications and are usually directed by the criteria of those sectors where they were initially registered.
3) The sector is now becoming more stable in terms of building and installation jobs. Operation and maintenance jobs (requiring specific qualification) acquire more significance.
4) Expected technical development will presumably concentrate on:
    - Development of off-shore wind farm projects.
    - Commercial implementation of solar thermoelectric energy.

8.1.1 Staff and evolution of labour force

- Most of the surveyed enterprises (nearly 80%) had staffs with fewer than 50 workers. There exists a small group of bigger enterprises which raises the average number of workers per company to 87.
- Estimates on the number of workers in the enterprises of the sector reach 89.001 for 2007 including administrative departments, sales, projects and operation/production tasks. Of those 67.000 were construction, operation and maintenance jobs (A-type activities in table 8) and around 22.000 were administrative, sales and project/engineering jobs (B activities in table 8)
- 8.013 jobs belong to the Operation and Maintenance category (OM) and 80.988 jobs fall into Construction, Installation and Others (CIO).

Table 8: Employment in 2007 in Renewable Energies

Direct jobs	OM	CIO	Direct jobs	Activities A	Activities B	Direct job (ratio 1.12)	TOTAL direct and indirect
89.001	8.528	80.473	89.001	67.374	21.627	99.681	188.682
100%	9,58%	90,42%	100%	75,7%	24,3		

Developed by ISTAS

The total distribution of direct jobs (OM + CIO) by types of renewable energy is shown in the following table.

Table 9: Distribution of employment by subsectors of renewable energy

Subsector of renewable energies	Nº of workers	renewable energies % in total employment
Wind	32.906	36,97
Small hydropower	6.661	7,58
Solar Thermal	8.174	9,28
Solar Thermoelectric	968	1,08
Solar Photovoltaic	26.449	29,9
Biomass	4.948	5,65
Biofuels	2.419	2,17
Biogas	2.982	3,45
Others (1)	3.494	3,92
Total renewable energies	89.001	100
(1) Hydrogen, geothermal		

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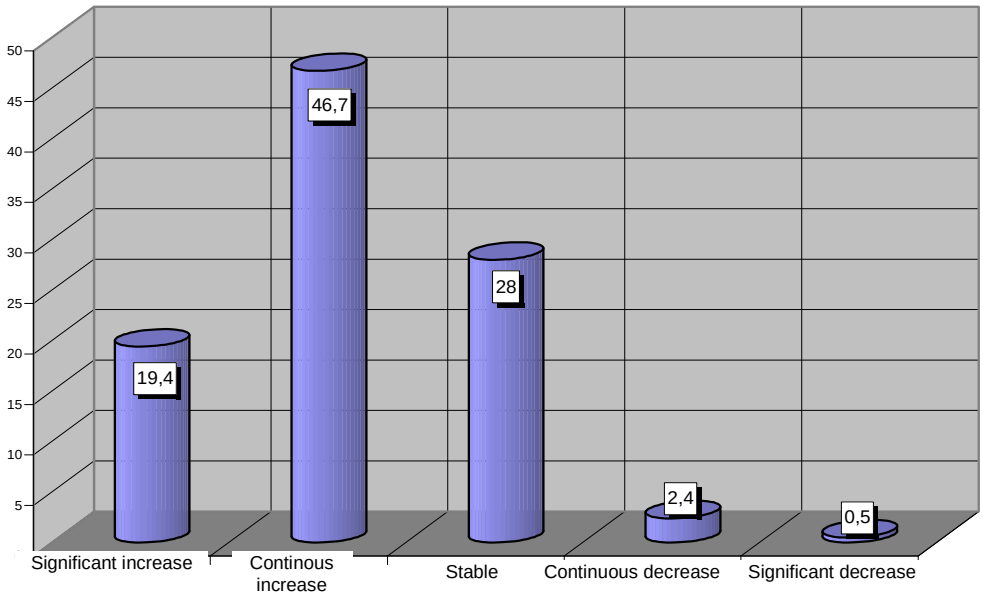
- The results show an increase in the number of jobs in two out of three surveyed enterprises. That increase is significant in one out of five enterprises.

Chart 5: Evolution of employment in the last five years
% of enterprises



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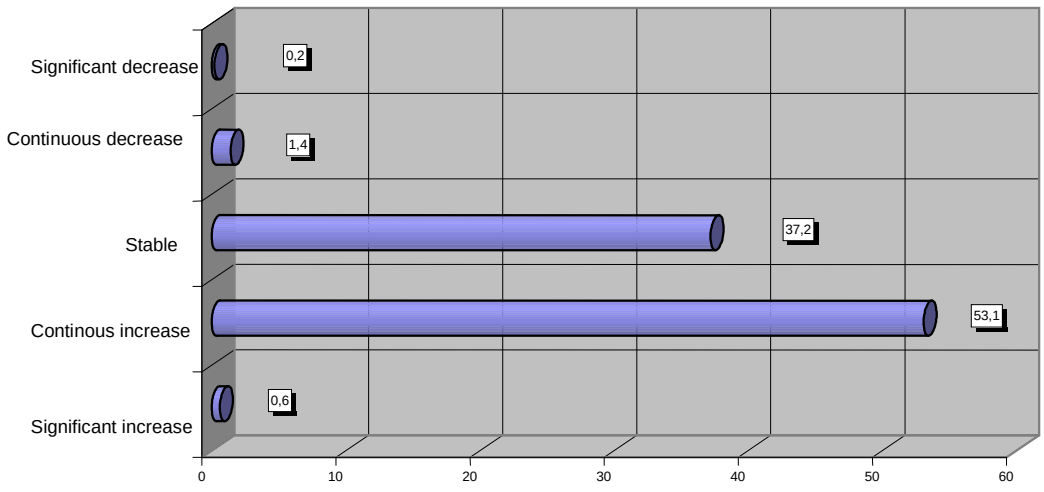
It is significant that the general impression among the surveyed enterprises regarding employment expectations is that they will maintain a continuous growth in the next year.

Chart 6: Employment expectations 5-10 years
% of enterprises



Developed by ISTAS

8.1.2 Distribution by departments

Table 10: Distribution of staff by different departments (%)

	Size of the enterprise by number of workers					
Phase	<10 workers	11-50 workers	51-250 workers	251-1.000 workers	> 1.000 workers	All enterprises %
Production	33,5	45,4	48,5	44,5	45,5	40,9
Marketing	8,9	12,6	11,1	13,9	3,0	10,8
Management	14,7	13,2	11,5	12,3	9,7	13,5
Project development	19,7	18,6	20,3	20,5	40,8	19,8
Direction-coordination	18,9	9,8	8,5	8,8	1,0	13,2

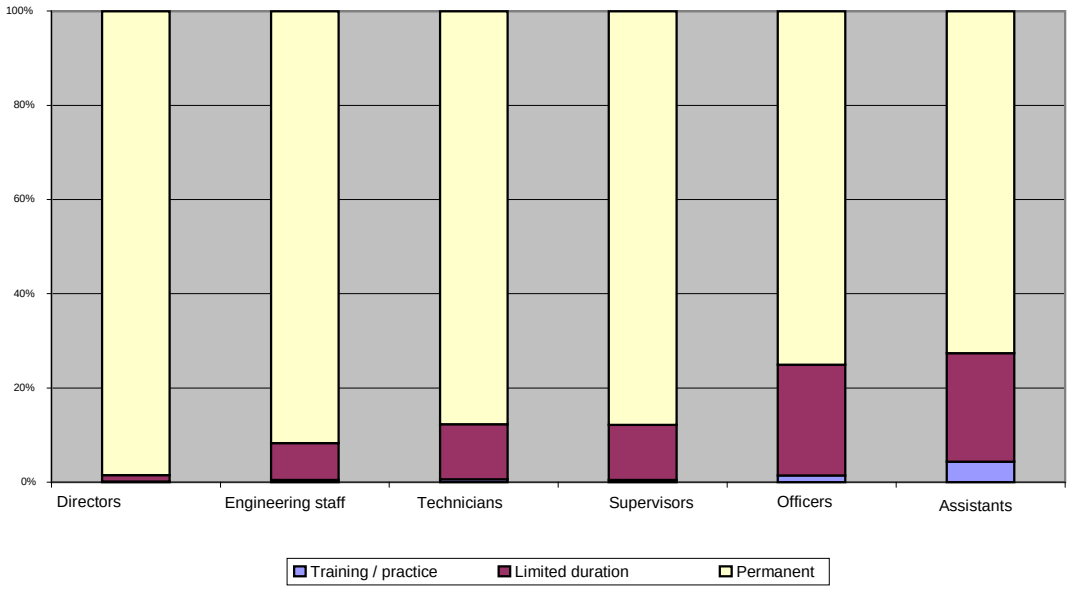
Developed by ISTAS

It is important to point out that project development, an activity that generally represents 20% of total jobs, rises up to 41% of the staff in big enterprises.

8.1.3 Types of contract

Most contracts are generally permanent at all levels, but the proportion of permanent job contracts decreases as professional qualification falls. This is where limited duration contracts emerge as alternative options for the categories of officers and assistants. Subcontracted companies probably have a less stable situation in terms of staff.

Chart 7: Type of contract by professional category



Developed by ISTAS

8.2 EMPLOYMENT ESTIMATES FOR 2010 AND 2020

8.2.1 Job creation 2010

The scenario defined by the Renewable Energy Plan (REP) has been taken as a reference framework. The plan set the goals for renewable energy production in Spain for the period 2005-2010.

Job creation related to compliance with this plan has been analyzed. The results obtained are shown in the following table:

Table 11: Estimates on job creation for 2010 according to REP goals

Type of energy	Installed power 2010 Goals of renewable energy plan	Employment ratio /MW or employment/tep	Direct jobs 2010
Wind	20.155 MW	2,52 emp/MW	50.790
Small hydropower	5.456 MW	4,97 emp/MW	27.116
Solar Thermal	376.000 teps	0,14 emp/tep	52.640
Solar thermoelectric	500 MW	44 emp/MW	22.000
Solar photovoltaic	400 MW	44,98 emp/MW	17.952
Biomass	2.039 MW	13,55 emp/MW	27.628
Biofuels	2.200.000 teps	0,007 emp/tep	15.400
Biogas	235 MW	17,40 emp/MW	4.089
TOTAL			**217.615**

Source: Developed by ISTAS

REP is not regarded as a feasible scenario and hence not likely to materialize. That is why a more probable scenario with an average increase of 10% for each type of renewable energy for 2010 has been considered.

Table 12: Estimates on job creation for 2010 (ISTAS)

Type of energy	Direct jobs 2007	Installed power 2007	Installed power in 2010 ISTAS estimates	Direct jobs by estimated installed power 2010
Wind	32.906	13.060 MW	14.366 MW	36.196
Small hydropower	6.661	1.340 MW	1.474 MW	7.327
Solar Thermal	8.174	795.540 m^2	875.094 m^2	8.991
Solar thermoelectric	968	11 MW	300 MW	1.064
Solar photovoltaic	26.449	569 MW	1.025 MW	29.093
Biomass electric	4.948	365 MW	401,5 MW	5.442
Biomass thermal		4.000 MW	4.400 MW	
Biofuel	2.419	334 ktep	367 ktep	2.660
Biogas	2.982	182 MW	200 MW	3.280
TOTAL	**85.507**			**94.043**

Source: Developed by ISTAS

Employment for 2010 is estimated at some 94.058 jobs.

8.2.2 Job creation 2020

Possible scenarios for the year 2020 have been analyzed and a more feasible option (EC proposal on climate change and renewable energies) has been selected. The proposal is a binding commitment for EU members.

The goal of the proposal is to achieve a renewable energy production of 20% of the final energy consumption in Spain and a 10% replacement of transport fuel with biofuels.

Two different scenarios have been considered:

- Scenario A with an estimate on the yearly increase of energy demand of 2%. Scenario B with an estimate on the yeraly increase of energy demand of 1%.

8. 2. 2. 1 Employment estimates for scenario A

Goal for 2020: 20% renewable. Restriction: 2% yearly increase of energy demand.

Table 13: Evolution of Scenario A

Year	Final energy covered with renewable (%)	Production of renewable energy (ktep)	Final energy (ktep)
2005	8,00	8.605,36	107.567,02
2006	8,80	9.655,22	109.718,36
2007	9,60	10.743,62	111.912,73
2008	10,40	11.871,70	114.150,98
2009	11,20	13.040,61	116.434,00
2010	12,00	14.251,52	118.762,68
2011	12,80	15.505,66	121.137,94
2012	13,60	16.804,25	123.560,69
2013	14,40	18.148,59	126.031,91
2014	15,20	19.539,99	128.552,55
2015	16,00	20.979,78	131.123,60
2016	16,80	22.469,34	133.746,07
2017	17,60	24.010,09	136.420,99
2018	18,40	25.603,49	139.149,41
2019	19,20	27.251,02	141.932,40
2020	20,00	28.954,21	144.771,05

Developed by ISTAS based upon data published by the European Commission and the Spanish government

To calculate job estimates for 2020 we must divide the amount of renewable energy expected for each type of source. Composition per type of source has been made following the patterns of the Renewable Energy Plan with a few modifications.

Table 14: Total renewable energy distribution by type of renewable source for energy scenario A

Type of energy	Installed power 2010, REP* goals	% produced energy 2010 REP	Installed power 2020
Wind	20.155 MW	21,93	32.733 MW
Small hydropower	5.456 MW	6,34	7.036 MW
Solar Thermal	376.000 teps	2,11	7.951.301 m^2
Solar thermoelectric	500 MW	3,85	1.948 MW
Solar photovoltaic	400 MW	3,89	6.439 MW
Biomass electric	2.039 MW	46,00	14.324 MW
Biomass thermal	2.200.000 teps		
Biofuel	235 MW	12,33	3.569 ktep
Biogas	28.785 MW	2,55	381 MW

Developed by ISTAS
* Renewable Energy Plan

To calculate job estimates for 2020 we have taken into account the improvement of efficiency in processes which would result in a reduction of jobs required for each installed energy unit.

Table 15: Job estimates for 2020 by European proposals for Energy scenario A

Type of energy	Installed power 2020	Direct jobs Renewable energies 2020
Wind	32.733 MW	49.427
Small hydropower	7.036 MW	27.936
Solar Thermal	7.951.301 m^2	8.170
Solar thermoelectric	1.948 MW	13.642
Solar photovoltaic	6.439 MW	41.859
Biomass	14.324 MW	101.705
Biofuel	3.569 ktep	24.807
Biogas	381 MW	3.241
TOTAL		**270.788**

Developed by ISTAS

Table 16: Ratios used for division into categories

Type of energy	Building + Installation (%)	Operation + Maintenance (%)
Wind	94	6
Small hydropower	84	16
Solar Thermal	91	9
Solar thermoelectric	96	4
Solar photovoltaic	95	5
Biomass electric	62	38
Biofuel	65	35
Biogas	95	5

Developed by ISTAS based on data published by IDEA and the University of California at Berkeley

Table 17: Total classification of employment by main categories: Building and Installation Operation and Maintenance/ for the energy scenario A

Type of energy	Total jobs 2020	C+I Jobs	O+M Jobs
Wind	49.427	46.462	2.966
Small hydropower	27.936	23.466	4.470
Solar Thermal	8.170	7.435	735
Solar thermoelectric	13.642	13.097	546
Solar photovoltaic	41.859	39.766	2.093
Biomass	101.705	63.057	38.648
Biofuel	24.807	16.125	8.683
Biogas	3.241	3.079	162
TOTAL	**270.788**	**212.486**	**58.302**

Developed by ISTAS

8.2.2.2 Employment estimates for scenario B

This scenario belongs to the European proposal for the production of 20% of renewable energy in 2002 and a yearly increase of energy demand of 1%.

Table 18: Energy Scenario B corresponding to the European proposal on 20% of renewable energies for 2020 version B

Year	Final energy covered with renewable sources (%)	Renewable energy production (ktep)	Final energy (ktep)
2005	8,00	8.605,36	107.567,02
2006	8,80	9.560,56	108.642,69
2007	9,60	10.534,00	109.729,12
2008	10,40	11.525,95	110.826,41
2009	11,20	12.536,68	111.934,67
2010	**12,00**	**13.566,48**	**113.054,02**
2011	12,80	14.615,62	114.184,56
2012	13,60	15.684,39	115.326,40
2013	14,40	16.773,07	116.479,67
2014	15,20	17.881,96	117.644,47
2015	16,00	19.011,35	118.820,91
2016	16,80	20.161,53	120.009,12
2017	17,60	21.332,82	121.209,21
2018	18,40	22.525,52	122.421,30
2019	19,20	23.739,94	123.645,52
2020	**20,00**	**24.976,39**	**124.881,97**

Developed by ISTAS based upon data published by the European Commission and the Spanish government

Table 19: Distribution of total renewable energy by type of source for energy scenario B

Type of energy	Installed power REP goals 2010	% of produced energy REP 2010	Installed power 2020
Wind	20.155 MW	21,93	28.236 MW
Small hydropower	5.456 MW	6,34	6.070 MW
Solar Thermal	376.000 teps	2,11	6.858.928 m^2
Solar thermoelectric	500 MW	3,85	945 MW
Solar photovoltaic	400 MW	3,89	5.555 MW
Biomass electric	2.039 MW	46,00	12.356 MW
Biomass thernal	2.200.000 teps		
Biofuel	235 MW	12,33	3.079 MW
Biogas	28.785 MW	2,55	328 MW

Developed by ISTAS

Table 20: Employment estimates for 2020 according to EU proposals, Energy scenario B

Type of energy	Installed power 2020	Direct jobs renewable energies 2020
Wind	28.236 MW	42.637
Small hydropower	6.070 MW	24.098
Solar Thermal	6.858.928 m^2	7.047
Solar thermoelectric	945 MW	6.616
Solar photovoltaic	5.555 MW	36.108
Biomass	12.356 MW	87.733
Biofuel	3.079 ktep	21.400
Biogas	328 MW	2.796
TOTAL		**228.435**

Source: Developed by ISTAS

The same ratios as in scenario A have been used in the division for the two main categories: *building + installation* and *operation + management*. The results are shown in the following table:

Table 21: Classification of employment created by main categories: Building and Installation/ Operation and maintenance for energy scenario B

Type of energy	Total jobs 2020	B+I jobs	O+M jobs
Wind	42.637	40.079	2.558
Small hydropower	24.098	20.243	3.856
Solar Thermal	7.047	6.413	634
Solar thermoelectric	6.616	6.351	265
Solar photovoltaic	36.108	34.303	1.805
Biomass	87.733	54.394	33.338
Biofuel	21.400	13.910	7.490
Biogas	2.796	2.656	140
TOTAL	**228.435**	**178.349**	**50.086**

Developed by ISTAS

9. JOBS AND QUALIFICATIONS

9.1 TRAINING NEEDS DETECTED BY EMPLOYERS. STATED CRITERIA

- University and vocational courses cover the training needs for the different technologies.

- Hence it is more advisable to orient senior students of the afore-mentioned educational levels (engineering and vocational training) than to repackage the existing syllabuses.

- Companies also orient their efforts towards worker-training and acknowledge lack of practical training at all levels.

- Despite the heterogeneous nature of the sector there are two major common qualification requirements:
  a) In the field of electricity generation: demand for specialists in medium and low voltage.
  b) Due to international trends: demand for workers with language skills, especially English.

- Companies generally:
  a) try to secure highly qualified workers through permanent contracts and subcontract the rest of the tasks,
  b) complain about the lack of necessary experience of workers given the premature stage of development of the sector,
  c) consider employees' willingness to travel an essential requirement due to the scattered geographical layout of the facilities.

- Professional profiles with particular characteristics:
  a) Expatriates: Workers hired in Spain and sent to carry out tasks abroad, which implies long periods of residence in foreign countries.
  b) International workers: those who work abroad but still reside in Spain
  c) Scholarship holders

- The structure of professional qualifications and the difficulties in finding an adequate profile are illustrated in the following charts.

Chart 8: Professional categories

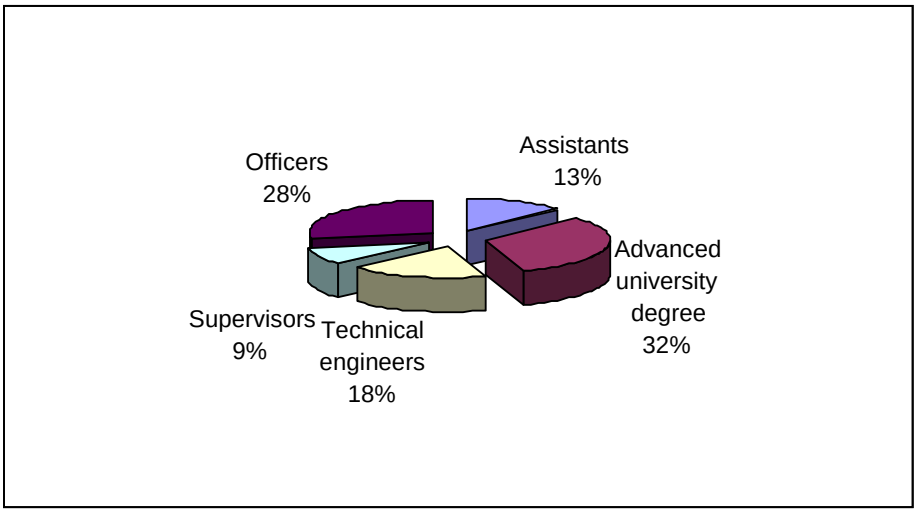


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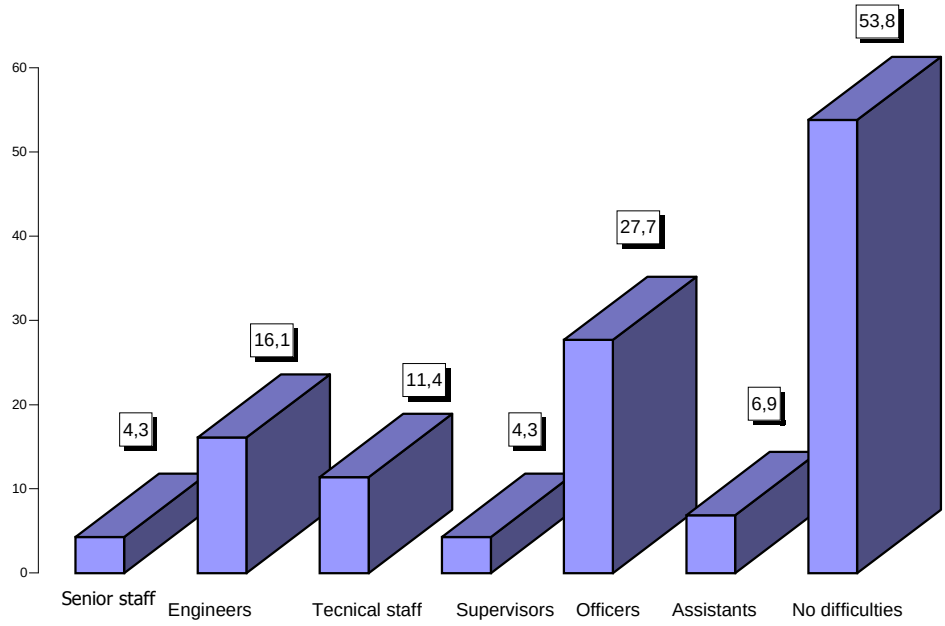
Chart 9: Difficulties in finding an adequate professional profile
% of enterprises



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A full description of professional categories can be found in the following chapter (conclusions) of this document.

10. Conclusions

10.1 General findings

This study implies an approach to employment creation in the sector of renewable energies in Spain, as well as a definition of the posts and qualifications it comprises.

No similar research had been conducted up to now in this field. Important European studies had a more macro-economical approach, but never addressed specific issues dealt with in this study.

Regarding studies on the current development of the sector in Spain, most of them are based on secondary information that in many cases needs to be updated.

Navarra is the leading region in the number of studies on this sector. A series of studies reflect the current state of the business activity in this sector and important aspects of employment creation and qualification.

The detailed description of the processes for the different energy sources has been very useful in identifying the different economic activities for each phase which resulted in 124 activities found in the National Register of Labour Activities. That means that this sector includes a substantial part of the officially registered activities due to the wide variety of technologies and processes involved.

Many of the activities are not exclusively related to the development of renewable energy and they may also be valid for other industrial sectors.

Production processes have been introduced in accordance with the purpose of the study in an attempt to present a specific context for renewable energy jobs and qualifications.

National and regional legislation provide an essential support for this sector which has the necessary resources, business agents and social recognition for its development.

The main challenge for this sector is the creation of an equipment industry (considering limitations and goals) capable of covering the demands and reducing the waiting periods. Support must be given to the creation of an auxiliary supply industry to achieve more adaptation capability than the other bigger industries that represent the core of the sector.

10.2 Employment

10.2.1 Characteristics in 2007

Around 89.000 jobs are estimated to be directly involved in the renewable energy sector. Wind energy (32.906 direct jobs) and solar photovoltaic (26.449) subsectors are the top job providers, followed by solar thermal (8.174) and small hydropower (6.661). The estimate for biomass is 4.948 jobs. Biogas is estimated to have 2.982 and biofuel 2.419 jobs. Solar thermoelectric energy, still in an experimental stage, would account for 968 jobs.

The sector of renewable energy in Spain has a great potential for employment creation in the coming years. Installation, manufacture, operation and maintenance are the areas where employment concentrates massively. Hiring and qualification characteristics of this employment category are important factors to consider.

Employment in the renewable energy sector shows more stability than in the rest of industries. Temporary contracts account for 15% of total whereas for the rest of sectors combined they rise up to 30% (twice as much). Permanent contracts amount to 82% in renewable energy sectors and 1.8% of them are training/practice contracts. Temporary work is probably higher in companies subcontracted by renewable energy enterprises - the negative side of this labour market.

Renewable energy enterprises employ a highly qualified labour force. Half of the labour force are technical engineers, either with high university degrees (32%) or technicians (18%). In small enterprises with fewer than 10 workers the number of engineers with advanced university degree is even bigger (38%).

10.2.2 Estimates on the number of jobs for 2010 and 2020

We have laid out the probable energy scenarios for 2010 and 2020. For the year 2010, we have taken into consideration the Renewable Energy Plan (REP) 2005-2010 and two markedly different energy scenarios have been considered. The first case fully meets the requirements of the REP. The second case will probably fail to meet them.

We have chosen the latter because two years way from 2010 the level of investment and the development of the facilities cannot guarantee compliance with REP. Yet the assumption of a 10% average increase for each type of renewable energy appears to be fairly reasonable. We must bear in mind that some sources like photovoltaic energy will probably exceed that percentage.

To calculate employment estimates for 2020 we have consulted such documents as the Plan for the Development of the Electricity and Gas Sectors 2007-2016 and the EC proposal on climate change and renewable energies for 2020. The latter has been chosen for the analysis of employment creation due to its evident feasibility. Two possible scenarios have also been considered for 2020 designated Scenario A, with a 2% yearly increase of energy demand, and Scenario B with an estimated 1% increase.

Before commenting on numerical estimation, certain methodological issues must be explained:

1) Estimates on the evolution of employment are based on forecasts for the coming years (2010 and 2020) and are obviously uncertain, since they did not exist from the beginning, and were still doubtful by the end of this study.
2) The main cause for these uncertainties is the impossibility to develop reliable theories on the evolution of the economy, the energy demand, the efficiency of production and the progress of technologies used in the renewable energy sector.
3) Employment volume/energy unit ratios vary significantly throughout the different energy sources; hence no generic term of energy has been used, we have introduced specific references to each category instead.
4) Energy scenarios have been developed on the basis of political commitment to achieve certain goals. Political will has not been adequately supported by legislative and budgetary measures to ensure that public and private funds are invested according to plans and demands, so
5) After introducing several correcting coefficients for each phase of the estimation we have reached the following conclusions which summarize the data shown in charts and tables.

Regarding the estimates on employment creation we may estimate that some 94.057 direct jobs will exist in the Spanish renewable energy sector by 2010. Wind and photovoltaic sectors will be the top job providers with 36.196 and 29.093 jobs respectively. Estimates for 2020, which are based upon two different scenarios of energy demand (scenario A with 2% yearly increase and scenario B with only 1%), calculate roughly 270.788 and 228.435 direct jobs for the respective scenarios.

Table 22: Employment in 2007, 2010 and 2020 by types of energy

Type de energy	Employment 2007	Employment forecast 2010 ISTAS	Employment 2020 Scenario A*	Employment 2020 Scenario B*
Wind	32.906	36.197	49.427	42.637
Small hydropower	6.661	7.327	27.936	24.098
Solar Thermal	8.174	8.991	8.170	7.047
Solar thermoelectric	968	1.065	13.642	6.616
Solar Photovoltaic	26.449	29.094	41.859	36.108
Biomass	4.948	5.443	101.705	87.733
Biofuel	2.419	2.661	24.807	21.400
Biogas	2.982	3.280	3.241	2.796
Other	3.494			
TOTAL	89.001	94.058	270.788	228.435

*Scenario A assuming a yearly increase in energy demand of 2%; Scenario B assuming a yearly increase of energy demand of 1%.

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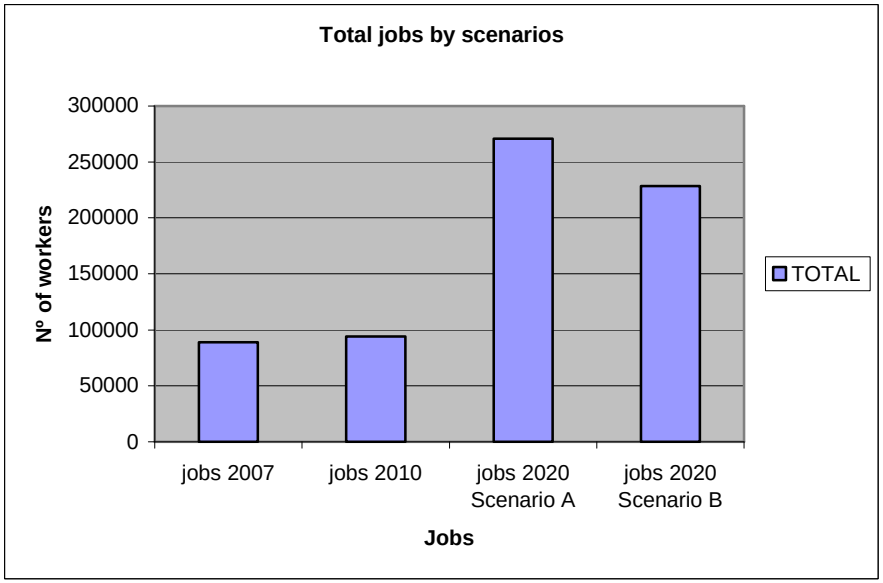
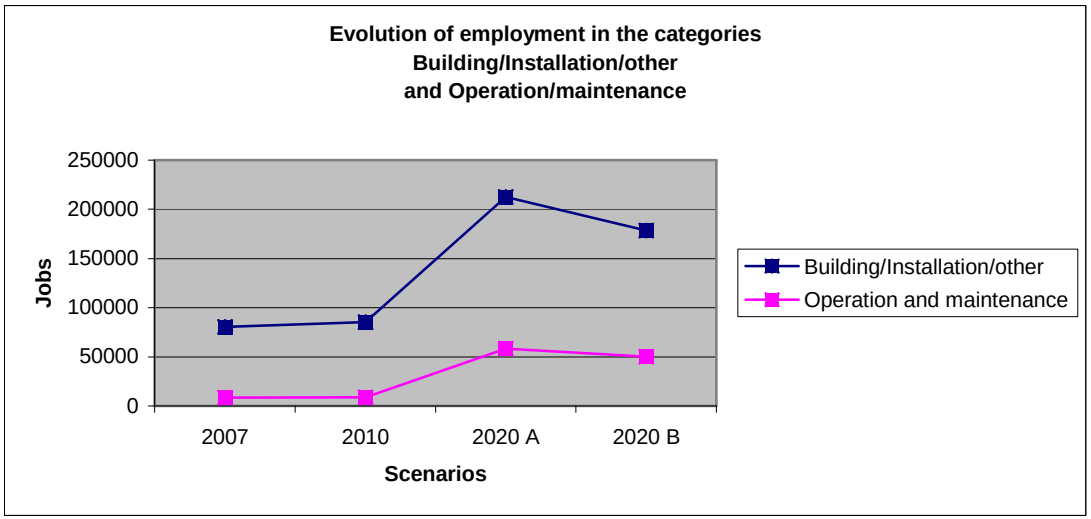
On the other hand it is important classify employment into two different categories: Building, Installation and other (BIO) and Operation and Maintenance (OM).

Table 23: Comparative table of employment in the different scenarios BIO and OM for each energy

Type of energy	Jobs 2007	BI	OM	Jobs 2010	BI	OM	Jobs 2020. Scenario A	BI	OM	Jobs 2020. Scenario B	BI	OM
Wind	32.906	30.932	1.974	36.197	34.025	2.172	49.427	46.462	2.966	42.637	40.079	2.558
Small hydropower	6.661	5.595	1.066	7.327	6.155	1.172	27.936	23.466	4.470	24.098	20.243	3.856
Solar Thermal	8.147	7.438	736	8.991	8.182	809	8.170	7.435	735	7.047	6.413	634
Solar Thermoelectric	968	929	39	1.065	1.022	43	13.642	13.097	546	6.616	6.351	265
Solar Photovoltaic	26.449	25.127	1.322	29.094	27.639	1.455	41.859	39.766	2.093	36.108	34.303	1.805
Biomass	4.948	3.068	1.880	5.443	3.375	2.068	101.705	63.057	38.648	87.733	54.394	33.338
Biofuel	2.419	1.572	847	2.661	1.730	931	24.807	16.125	8.683	21.400	13.910	7.490
Biogas	2.982	2.833	149	3.208	3.116	164	3.241	3.079	162	2.796	2.656	140
Other	3.494	2.979	515									
TOTAL	89.001	80.473	8.528	94.058	85.243	8.814	270.788	212.486	58.302	228.435	178.349	50.086





Developed by ISTAS

10.3 Professional profiles

Improvement in workers' competence and qualification is an essential requirement for the development of a sector or branch of economy based on a high value added production and an important reliance on technology.

The differing levels of development of the studied technologies makes a clearer definition of jobs and qualifications in those branches with a longer lifespan, although special attention must be paid to subsectors that expect increases in a short/medium term.

The diversity of economic/social players and institutions involved makes it difficult to implement the necessary reforms in time to face the dynamic demands. This is especially true for the renewable sector due to the importance of innovation and its exceptionally young labour force.

That is why continuous training is considered a basic element for the creation of qualified and well paid jobs.

Enterprises, workers and authorities must unite in their efforts to define and assess specific posts and provide the necessary resources for training in the appropriate qualifications.

Based on the study of field data and technical analysis of production for this sector we have developed a set of professional profiles described in detailed in the Annex: Definition of Professional Categories.

Given the current state of development of the sector, those jobs related to design, assembly and start up of facilities (investment works) will have a relatively higher importance for the creation and maintaining of employment than jobs related to operation and maintenance. However, we must keep a different perspective of these two blocks to avoid mistakes in the assessment of the social impact of employment, and the creation of new professional categories in this sector.

Table 24: Definition of professional categories

A. DESIGN, PLANING AND ASSEMBLY OF FACILITIES	B. RUNNING OPERATIONS FOR RENEWABLE ENERGIES	C. DESIGN, PLANNING AND OPERATION (BIOMASS AND ORGANIC WASTE)
CHARACTERISTICS: Activity related to investments is in many cases similar to activity deployed in public works. There is a professional group that overlaps almost all project teams in most big building works: Design engineering staff, salespersons with technical expertise and organizational skills, coordinators or project operation managers, experts in purchase negotiations and subcontracting, ground supervisors and equipment fitters. This group of professionals share common technical and managing skills and abilities that make them easily interchangeable through the different departments /sectors.	**CHARACTERISTICS:** Running activities are related to the operation and management of the renewable energy facilities. These professionals share technical and managing skills that make them easily interchangeable through the different departments/ sectors. We have summarized this for the energy improvement facilities.	**CHARACTERISTICS:** Professionals involved in energy production through biomass and organic waste do not share the same technical and managing skills with those working on other renewable energies. They have a more common profile with those who work on biomass and organic waste treatment for other industrial uses, especially organic fermentation.
Project Engineer	Head of maintenance dept.	Production Manager (Bioenergy)
Renewable energies Project designer	Maintenance technician	Planning manager
Renewable energies sales manager	Head of the technical operation department	Quality manager (Bio energy)
Technical director (renewable energy)	Technical operation engineer	Technical engineer (Bio energy)
Head of purchase department		Head of maintenance dept. (Bio energy)
Project Assembly manager (renewable energies)		Head of the Bio energy plant
Site manager (Set up)		Factory technician
Equipment Fitter (renewable energies)		Department supervisor
Logistic manager		Department Operator
		Head of the operation department

Developed by ISTAS

Professional categories					
A. Design and set up of facilities		**B. Exploitation of renewable energies**		**C. Design, planning and operation (biomass and organic waste)**	
Post	**Description**	**Post**	**Description**	**Post**	**Description**
Project engineer	Their main responsibility is to work out structural aspects of components, sections, materials, estimates. They also define and design the parts of a specific renewable energy facility based on a previous unspecified project.	**Head of Maintenance**	Main tasks: Maintenance and improvement of technical instructions in the maintenance and repair processes Coordination of mechanical tasks and development of new processes. Preparation of preventive maintenance plans by technical standards set by the initial design, the technical department, the technical operation department and component suppliers. They are also responsible for occupational health and safety in the maintenance area.	**Production Manager (Bio energy)**	They are in charge of a set of facilities, logistics and plants that provide biofuel to a vast distribution network, linked to the enterprise as a part of it or as a related organization. Their main tasks are: Increasing of technical capability and finding new ways to improve efficiency and quality. Developing design and creativity in new processes. Introducing technical innovations in organic distillation technology. Improving processes and organization in the factory.
Renewable energies Project designer	Project designers work in technical departments under the instructions of project engineers. They develop project plans, assembly instructions and technical specifications. Clients submit a pilot scheme checked by project engineers and project designers set up the necessary elements for office databases and supervising tasks on established designing procedures.	**Maintenance technician**	The maintenance technician is responsible for: Checking the standard parameters for the control equipment and facilities, their maintenance and correct operation and requiring repair whenever necessary. Their task is mostly preventive and is based on the operation plan. Many renewable energy sectors require works at height for the maintenance and repairing operations so safety standards impose big restrictions on the working procedures.	**Planning manager**	In charge of a set of facilities, logistics and plants that provide biofuel to a vast distribution network, linked to the enterprise as a part of it or as a related organization. Their main tasks are: Developing a production masterplan (detailing supplies, periods of service and amount of production to meet the demands of the distribution network) Verifying the feasibility of presented plans in terms of production capacity and resources, choosing to subcontract certain activities if possible. Carry out the production master plan along with Plant managers and controlling performance in order to obtain reliable information to satisfy distribution requirements
Renewable energies sales manager	Their main responsibility is to sell renewable energy projects and facilities through the creation of a professional brand image. They keep track of service channels and control project specifications, costs and service terms. They also promote a company image of professional excellence and reliability through a network of independent of offices and external technical agencies by establishing long term relations as a quality guarantee in the field of renewable energies. The main goal of the sales department is to achieve the signature of contracts with clients through independent offices and technical agencies.	**Head of the technical operation department**	They are responsible for developing procedures and operation plans in renewable energy facilities. They allocate to each facility the operation standards and tolerance limits. They work jointly with the managers of the energy distribution network and maintenance and repair services.	**Quality manager (Bio energy)**	In charge of a set of facilities, logistics and plants that provide biofuel to a vast distribution network, linked to the enterprise as a part of it or as a related organization. Their main tasks are: Ensuring products from distillation organic material (both produced by the facility or by third parties) meet the offered specifications. Ensure quality, as a result of the production process, from the very start of operations (this includes plans for chemicals tests and control of the process).

Technical director (renewable energy)	Their main responsibility is to increase technical competitiveness of the organization and to open new business possibilities by developing design and creativity en renewable energy facilities. They are also responsible for improving processes and cooperation between departments: design and specification of projects and orders, purchase logistics, and assembly of renewable energy facilities.	**Technical operation engineer**	They are responsible for surveillance, start or stopping of operation in a facility by procedures and operation plans, standards and tolerance limits set by the Technical Department. In many cases they share their functions with the head of maintenance.	**Technical engineer (Bioenergy)**	In charge of a set of facilities, logistics and plants that provide biofuel to a vast distribution network, linked to the enterprise as a part of it or as a related organization. Their main tasks are: Computerizing, maintaining, measuring and improving technical instructions and manufacturing processes in a continuous cycle. Cooperating in the development of new software to plan and control production and distribution. Setting output standards (through measuring techniques). Computerizing and automating controls. Checking and documenting irregularities.
Head of purchase (commercial) department	Responsible for: Negotiating the purchase of products with supplying companies on request by the Assembly Management. They work to achieve a series of price and quality goals set by the enterprise. Seeking new suppliers as alternatives to improve set goals and achieve customers' satisfaction. Controlling purchases for the different building sites Acting as links between departments in the enterprise that purchase of products and services and their suppliers (building and assembly tasks).				
Project Assembly manager (renewable energies)	Responsible for: Coordinating the logistical and assembly teams with the purchase, distribution and delivery departments to ensure that services and products bought by the company meet the required deadlines, prices and commitments for each project. Reducing safety risks. Early detection of errors. Achieving efficiency in both internal and external assembly works through cooperation with suppliers of services (cranes, external assembly teams and assembly elements). Working to achieve adequate training of technicians and teams involved in the project. Facilitating a fluent communication with inspectors, facility engineers, public authorities and electricity companies.			**Head of maintenance (Bio energy)**	In charge of a set of facilities, logistics and plants that provide biofuel to a vast distribution network, linked to the enterprise as a part of it or as a related organization. Their main tasks are: Planning of tasks for the maintenance staff in each of the bioenergy plants in a specific location. Maintaining and improving technical instructions for the current processes of maintenance and repair workshops. Coordinating mechanical tasks and developing new processes in their area of activity. They are also in charge of occupational health and safety of the mechanic work teams.
Site manager	Responsible for: Coordinating with services and products departments to finish the works within the established deadline and with the recommended materials, meeting quality standards and observing the estimated assembly costs.			**Head of the Bioenergy plant**	Their main responsibilities are: The coordination of processes and sections in the distilling plan for the distribution of biofuel to guarantee the necessary supplies required by the distribution network within the established deadlines and quality standards. The training of intermediate supervisors for the coordination of personnel and resources in each of the phases of the process: supplying the process, achieving the planned profits and covering intermediate phases established by control standards.

Equipment Fitter (renewable energies)	Equipment fitters are in charge of assembling the different parts and components of the renewable energy facilities following set technical specifications and complying with deadline and quality standards. They work under the supervision of the assembly manager with strict technical and security standards. Many renewable energy facilities require assembly works at heights which results in tight safety restrictions on work procedures.			**Factory technician**	Their responsibility is to control the execution of the Production Master plan (detailed products and production line necessary to meet the existing demands). They are also responsible for ensuring that the facility has short term production capability and resources and must recommend subcontracting to the head of the plant if necessary. They must obtain reliable information on deadlines and quality of manufacture according to the submitted production master plan.
Logistics manager	Their main tasks are: Coordinating transport services and storing facilities (own and external) to guarantee supplies on time and ensure compliance with the specific requirements for the different sites involved in the development of the project.			**Department supervisor**	Responsible for: Reaching the established production goals within deadlines and quality standards by coordinating an adequately trained work team and observing health and safety standards. Watching over compliance with machinery and equipment maintenance plans and checks. Assigning tasks to their staff and coordinating with other supervisors to guarantee compliance with production master plan. To carry out control and tests of products by quality and laboratory standards.
				Department Operator	Responsible for: Carriage of resources and feeding of raw material into the facilities by established rules and under supervisors' control, complying with production, quality and health and safety standards. Compliance with the instructions of the maintenance plans and operation tests of their facilities, machinery and work equipment.
				Head of the operation department	This post only exists in big companies. It implies specific responsibilities in the coordination of a big group of wind energy facilities. They may also coordinate operations with electricity companies in charge of the distribution network. They are responsible for developing plans and operation procedures in renewable energy facilities. They assign operation standards and tolerance limits to each facility according to project specifications. They coordinate with the managers of the energy distribution network and the maintenance and repair services.

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