Executive Summary

Study on employment associated to the promotion of renewable energies in Spain 2010

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1. Introduction

The energy system, both in Europe and in Spain face serious problems that must be addressed: first of all the energy model based on fossil fuels with a high levels of greenhouse gases emissions has grave effects on climate change, which is easily felt in phenomena like floods, draughts, melting of polar ice sheets, etc. The urgent need to reduce CO2 emissions can no longer be postponed.

Secondly, this energy model has kept the EU and more specifically Spain under high rates of energy dependency. Europe imports over 50% of primary energy whereas in Spain this figure reached 89.2% in 2008 due to fossil fuels and nuclear energy. On one hand this threatens supply assurance, it makes energy prices even more volatile and it increases trade deficit due to the high prices paid for fossil fuels. It also creates serious conflicts, violence and few benefits to oil exporting countries like Nigeria or uranium sources like Niger, which increases inequalities between north and south.

An energy model based on clean, self- produced energies would solve or mitigate such problems and boost the economic sector of renewable energies, which has already developed considerable nationwide potential with an extensive business network, as well as job creation and high added value technology export possibilities.

An energy model based on renewable energies will promote a production model of distributed electricity in which energy is produced in small facilities near consumption locations, something that nuclear power and fossil fuel stations do not allow. This model presents several advantages: production sites are relocated near consumers reducing conveyance losses (around 10% of electricity is loss during conveyance); lower environmental impact due to the use of urban environment (e.g. photovoltaic panels on roofs); democratization of production and access to energy by offering small companies and even consumers the possibility to own the means of energy production, distributing the power accumulated so far in the hands of big energy corporations.

The European Union promotes the change of energy model through its Directive 2009/28/CE on the promotion of the use of energy from renewable sources which sets three compulsory goals for all Member States for 2020: a 20% reduction of greenhouse gases emissions, a 20% reduction of primary energy consumption through energy efficiency and a total share of 20% of renewable energy in final gross energy consumption, as well as a 10% share of renewable energies in transport.

That is why knowing about the current state of affairs and the immediate potential capabilities of renewable energies and determining the number of jobs generated by these energy sources are significant issues for society and governments especially in the context of the current socio-economic crisis. Both purposes are especially relevant for facing the challenge of replacing the current unsustainable model for a new production and energy model and for a low carbon economy.

This study is based on four methodology procedures that complement each other: survey on 925 companies (with an estimate universe of 2,274 companies in this sector); 17 in-depth interviews with experts; 9 study cases on relevant companies (classified by their technology or economic significance); and the analysis of accounts and reports of 22 main companies selected from the Spanish business register ((by number of jobs and turnover). Several secondary sources

available bibliography were also consulted, particularly previous research studies and collective bargain agreements.

Disclaimer

This summary is based on a study carried out with IDAE (National Institute for Energy Efficiency and Diversification) an agency of the Spanish Ministry of Industry, Tourism and Commerce. At the request of the agency and in compliance with Directive 2009/28/CE we have included two technologies that are occasionally classified as renewable by some researchers but cannot be considered as such: large scale hydraulic energy, due to its significant environmental impact in terms of required infrastructure, and waste incineration (solid urban wastes) which implies serious environmental consequences and whose nature is not renewable.

The Spanish trade union confederation CCOO has expressed on several occasions that waste incineration must not be included in the renewable energies pack. The so called "energy reassessment" of waste through incineration is based on a technology that implies serious environmental and public health hazards since it involves the release of dioxins, furans and other dangerous compounds into the atmosphere. In addition this technology does not help the minimization of waste. There are available alternatives as selective collection of organic material for bio-digestion, obtaining of energy and composting. It is more recommendable to focus efforts on specific actions as: eco-design, reduction, reuse and recycling and to develop strategies to avoid the "disposable" culture. These alternatives imply many advantages such as job creation and reduction of emissions among others. Incineration is neither clean nor renewable and in spite of the fact that many agencies and sources include it in the category of new renewable energies as a solution to the energy crisis, we do not subscribe to that point of view.

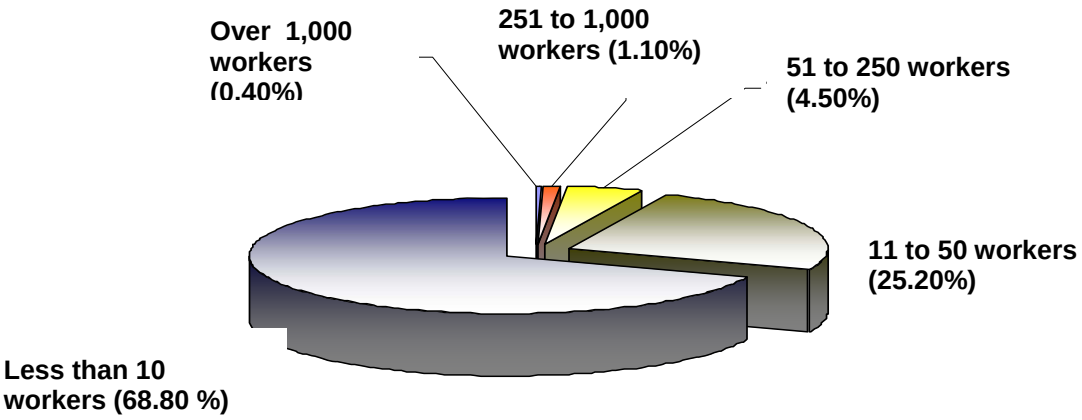
On the other hand, obtained data on jobs in the case of waste incineration must be approached with caution. Interviews with key informants, including the association of employers involved in this activity, reveal that jobs attributable to solid waste incineration (aimed at energy reassessment) represent less than one third of total jobs in those companies. The rest of jobs belong to previous management activities and might be categorized within selection for recycling.

Annex I features a table of jobs including waste incineration

2. Description of business network

The sector of renewable energies is Spain is mostly represented by large number of small companies. Using as a reference the net jobs in renewable energies based on the size of the company, the size of companies staffs varies from 4.4 workers in companies with less than 5 workers up to 2,761 workers that represents staffs of more than 1,000 workers.

Graphic 2.1 Size of renewable energy companies (staff)



Source: *Developed by ISTAS based on own research*

This factor determines the nature of labour relations in the sector to a great extent since the activity of small companies is not ruled by any specific regulation.

However, despite the interesting aspects of this graphic, if we examine the volume of jobs created we will find out that most jobs concentrate in a reduced numbers of big companies, in the same way as in the rest of Spanish economy.

Most jobs concentrate in companies with more than 1,000 workers, 38.7% of total workers. Companies with 11-50 workers and 251-1,000 workers also represent a significant number of jobs in this sector, approximately 19%.

On the other hand, despite the overwhelming presence of smaller companies (over 94%), they only represent around 9.8 % of total jobs.

3. Jobs generated in the sector of renewable energies

3.1 Qualitative introduction: evolution of the sector and job sources

In-depth interviews with experts of this sector and case studies in different companies show the following aspects about jobs in this sector and their evolution:

Main activities related to jobs

Jobs created in the renewable energies sector concentrate for the most part in construction and installation processes and to a lesser extent in operation and maintenance tasks. Engineering, product development and innovation represent lower job numbers. Specific data are available in the survey chapter.

R+D+i

This sector shows high levels of cooperative research, both in big and small companies. All the companies included in case studies participate in different R+D+i projects with other companies (many of them foreign companies), and with universities.

Engineering companies are currently training and offering specialized courses to project and R+D engineers who are directly trained at work or promote the university-business cooperation to create knowledge and expertise for projects in renewable energies facilities.

We observe a clear diversion of expertise and R+D+I development from other sectors like the automobile industry or other fully developed sectors.

Halt in the wind power and photovoltaic subsectors

The current stagnation of different technologies, which is particularly significant in wind and photovoltaic energy, had an immediate effect on jobs related to those subsectors.

Operation and maintenance

The gradual increase of accumulated installed power has progressively raised the number of jobs associated to operation and maintenance. These jobs are independent of fluctuations in the pace of implementation of new technologies and become more clearly defined: most of these jobs belong to specialized and qualified occupations.

According to collected data by the survey, there were 8,395 jobs in this activity in 2010, which account for 12% of total jobs.

3.2 Jobs: main results of the survey

Renewable energies employ a total of 27,961 workers in the 925 companies surveyed. Considering that the sample covered interviews with 40.67% of companies in this sector and estimating the values by the weight of each company, the volume of workers employed in renewable energies in Spain could be estimated in 68,737.

Table 3.1 Jobs by subsectors of activity 2

	Abs.	%	Total jobs (Estimates)
Wind power	12,468	44.6%	30,651
Solar Photovoltaic	7,953	28.4%	19,552
Solar Thermal	2,749	9.8%	6,757
Common activities for all sectors	1,734	6.2%	4,263
Biomass	1,298	4.6%	3,191
Large and small size hydropower	439	1.6%	1.078
Biofuels	392	1.4%	964
Biogas	270	1.0%	664
Concentrated solar power	208	0.7%	511
Geothermal	169	0.6%	415
Other	109	0.4%	268
Heat Pump	75	0.3%	184
Small wind power	67	0.2%	165
Ocean energy	30	0.1%	74
TOTAL	27,961	100%	68,737

Source: *Developed by ISTAS based on survey*

Regarding the subsectors of activity there is a clear predominance of the wind sector in terms of job creation in the renewable energy sector with 44.6% of total jobs.

The second most important job provider is the solar photovoltaic sector which covers 28.4% of total jobs, followed by the solar thermal sector with 9.8%.

The remaining subsectors of activity – except for biomass with a 5% share of total jobs- remain with low levels that barely represent 1 - 2% of workers in Biofuels, hydro and minihydro. Other activities are below these levels.

Total jobs 2010: direct and indirect

We have used a job generation quotient to derive indirect jobs estimates from direct jobs in each sector of activity.

This coefficient is based on direct and indirect jobs estimates by the Association of Renewable Energy producers[1].

Table 3.2 Indirect jobs by subsectors of activity

	Direct jobs	Coefficient	Indirect jobs
Wind power	30,651	0.8	24,521
Solar Photovoltaic	19,552	0.45	8,798
Solar Thermal	6,757	0.45	3,041
Common activities for all sectors	4,263	0.65	2,714
Biomass	3,191	0.88	2.808
Large and small size hydropower	1,078	0.45	485
Biofuels	964	1.025	988
Biogas	664	1.025	681
Concentrated solar power	511	0.6	307
Geothermal	415	0.39	162
Heat Pump	184	0.45	83
Small wind power	165	0.8	132
Ocean energy	74	0.52	38
TOTAL	**68,469**		**44,758**

Note: *The category "Other" is not included due to impossibility of setting an adequate quotient*

Source: *Developed by ISTAS based on own research*

We could thus summarize that jobs in the renewable energies sector (both direct and indirect) amount to 113,227[2].

1 "Study on the macroeconomic impact of renewable energies in Spain" APPA 2009.
2 Considering waste incineration the figure would rise to 115,493 jobs.

Distribution of jobs by departments

A high percentage of the staff is employed in production tasks. Industrial production and installation account for more than half of the staff in companies, namely 51.7%.

Table 3.3 Distribution of staff by departments

	%
Industrial production	34
Production: installation	17.7
Project development	14.7
Promotion, marketing, sales	9.5
Administration	9.2
Management and coordination tasks	6.7
Research, development and innovation (R+D+i)	4.7
Other	3.4

Source: *developed by ISTAS based on own survey*

The high percentage of workers in the Project Development area (14.7%) is remarkable, given the particular characteristics of this.

"Promotion, Marketing Sales" and "Administration" departments have a relative importance with less than 10% of staff employed in each of them: 8,469 jobs.

Types of contract

83.7% of staff in the renewable energy sector is on permanent employment contract; the remaining workers are on temporary contract (14.1%), Training/ Experience (0.9%) or are self-employed (1.2%)[3].

Table 3.4 Type of contract

TYPE OF CONTRACT	% renewable sector Spain
Permanent	83.7
Limited duration	14.1
Training/practice	0.9
Self-employed	1.2
By project	0.1

Source: *developed by ISTAS based on own survey*

According to these data permanent contracts are the mainstream contract modality at all levels, although their proportion decreases in lower professional categories.

Table 3.5 Type of contract by professional level

	Permanent	Fixed duration	Training / practice	Self-employed
Management/ Senior enginners	93.6	3.4	1.1	1.8
Engineers	91.3	6.4	1.1	1.1
Supervisors	95.3	3.2	0.2	1,3
Officers (qualified)	74.9	23.7	0.6	0.6
Assistant operators (non-qualified)	62.2	35.1	2.2	0.5

Source: *developed by ISTAS based on own survey*

However, we should note that probably as in most economic sectors, the existence of subcontracted companies that perform less added value tasks that require lower qualification and their profiles remain concealed.

Analysis of jobs from a gender perspective

Different social fields show effective ways to identify gender. Historically labour has been one of the areas with the greater imbalance.

Women's unmistakable massive access to work is not exempt of complications. This study attempts to explore women's work in the field of renewables through a purely descriptive and quantitative perspective.

Table 3.6 Distribution of jobs by gender

	Sample	Estimates over total
Women	7,434	18,275
Men	20,527	50,462
Total	27,961	68,737

Source: *developed by ISTAS based on own survey*

The first factor to emerge is the notable difference in participation between men and women in this sector. Women represent 26.6% of labour force.

Labour force breakdown by departments shows traditional labour division by gender, almost 64% of women work in administration jobs. Other areas as Promotion/Marketing/Sales" and to a lesser extent "Project Development" and "Research, development and innovation" show relatively high percentages of women whereas areas directly involved in industrial production and installation show lower percentages of women.

Table 3.7 Distribution by gender in different departments (%)

	Women	Men
Administration	63.8	36.2
Promotion, marketing, sales	39.9	60,1
Project development	30.8	69.2
Research Development innovation (R+D+i)	30.5	69.5
Other	22.4	77.6
Management and coordination tasks	16.4	83.6
Production: installation	16.1	83.9
Industrial production	15.2	84.8

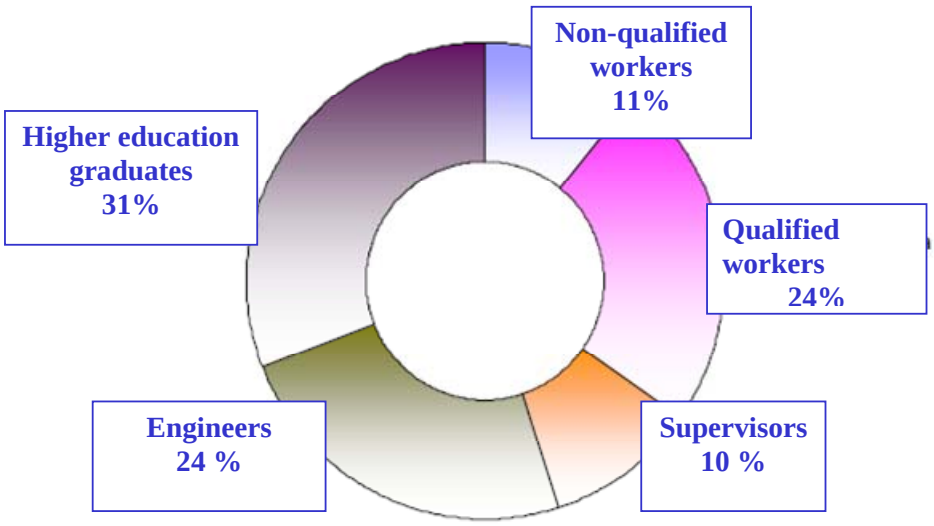
Source: *Developed by ISTAS based on own survey*

Professional qualification

The best way to make out the arrangement of professional qualifications is to include the total volume of jobs in each professional category.

Most workers in this sector are senior engineers higher education graduates, followed by engineers (this group include management officers) and qualified workers. Other parts of this report also suggest a high number of subcontracted companies that render certain lower qualification jobs invisible.

Graphic 3.1 Professional qualifications (Staff)



Source: *Developed by ISTAS based on survey data*

Required qualifications for different jobs are usually based on existing profiles (engineers, electricians, vocational training, and university degrees) adapted to the specific needs of the renewable energies sector (particularly operation and maintenance of facilities).

There are opportunities for professional retraining of workers from existing industries, which is a significant fact in the current economic situation, like the professional retraining of plumbers and electricians from the construction sector to acquire the necessary skills for the development of renewable energies.

4. Energy scenarios: estimates for 2015 and 2020

4.1 Introduction

The Law on Electricity Sector of 1997 conditioned the shift from the existing model of energy planning to a free market and freedom of location for electricity production facilities. From then on, only the electricity conveying system required planning.

Through the years experience has shown that such a significant economic branch as electricity cannot be left at the discretion of the free market. Power and production goals for each technology , energy scenarios based on demand, facilities and fuels must be determined by a democratic system that include all social agents. Renewable energy sources would obviously benefit from such planning.

Planning the electric system would allow a more adequate location of generation plants according to the needs of the conveying network and the areas with highest demands, and not only based on companies' interests. It would also ensure compliance with the goals of energy policy, especially with the reduction of greenhouse emissions and would safer investments for promoters of electricity projects.

We must bear in mind the need for planning the generation of thermal energy that involves renewable sources (solar thermal, biomass, geothermal, etc.) and the promotion of district heating systems in urban areas.

We have studied three possible scenarios for total installed power of renewables for 2015 and 2020. The first scenario (Scenario A) includes the energy scenario of the PANER (New Action Plan for Renewable Energies 2011-2020) that aims at achieving a 20% production of primary energy through renewables by 2020.

The second scenario (Scenario B) considers a more optimistic case with increased installation power from renewables, 30% of primary energy production and increased energy saving and efficiency.

The third scenario (Scenario C) considers a more pessimistic view that involves failing to meet government goals and European Directives on power installation from renewable energies.

4.2 Scenario A

Forecast of energy demand:

Table 4.1 Final energy consumption (ktep)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Final energy consumption	**94,491**	**93,226**	**92,503**	**92,974**	**93,634**	**94,116**	**94,593**	**95,078**	**95,562**	**96,055**	**96,544**	**97,041**
Variation rate compared to previous year	-7.24%	-1.34%	-0.78%	0.51%	0.71%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%	0.51%

Source: MITYC / IDAE

The government's goal to cover electricity demand with renewable energies is laid down by the European Directive and must reach at least 20%. The Ministry's goal is to go beyond that guideline with the following renewable energy consumption for 2015 and 2020:

Table 4.2 Consumption of renewable energies

	2009	2015	2020
Renewable energies for electricity (Ktep)	**6,262**	**9,746**	**13,144**
Hydro > 10 MW (GWh)	21,048	26,129	26,000
Hydroelectric < 10 MW (GWh)	5,200	6,409	7,140
Wind power (onshore) (GWh)	36,615	56,739	71,614
Wind power (offshore) (GWh)	0	300	7,875
Concentrated Solar Power (GWh)	100	7,913	15,353
Solar photovoltaic (GWh)	6,041	9,872	14,316
Biomass (GWh)	2,280	3,723	6,000
Biogas (GWh)	592	1,302	2,617
Ocean energy (GWh)	0	0	220
Geothermal (GWh)	0	0	300
Total renewable energies for production (GWh)	**71,876**	**112,387**	**151,435**
Renewable energies for heating/refrigeration (ktep)	**3,687**	**4,396**	**5,644**
Biomass	3,496	3,997	4,850
Biogas	26,5	63	100
Geothermal	9,094	5	9,46
Solar panels and other heating/refrigeration	156	308	644
Solar panels (thousands of m2)	2,017	4,902	10,000
Renewable energies in transport (ktep)	**1.058**	**2.470**	**3.500**
Bioethanol + bio-ETBE (m3)	276	594	788
Biodiesel (m3)	1,163	2,747	3,927
Bioethanol + bio-ETBE (ktep)	140	301	400
Biodiesel (ktep)	918	2,169	3,100
TOTAL RENEWABLES (Ktep)	**11,480**	**16,411**	**22,047**
% of renewables/ Final energy	**12.1%**	**17.3%**	**22.7%**

Source: MITYC / IDAE

Renewable power required to meet those goals must be:

Table 4.3 Accumulated power in renewables (MW)

	2009	2015	2020
Hydro > 10 MW	14,112	14,112	14,112
Hydro < 10 MW	1,977	2,237	2,550
Wind power	19,144	27,847	35,000
Wind power (offshore)	0	150	3,000
Concentrated Solar Power	232	3,048	5,079
Solar photovoltaic	3,442	5,918	8,367
Biomass	497	620	1,000
Biogas	160	220	400
Ocean energy	0	0	100
Geothermal	0	0	50
Total renewables	**39,564**	**54,152**	**69,658**

Source: MITYC / IDAE

The electricity sector will make the biggest efforts to comply with global objectives in terms of renewable energy consumption. Renewable energies would cover the following percentages:

Table 4.4. Cover of electricity production by renewable energies

	2009	2015	2020
Gross production (GWh)	296,508	339,931	400,420
Total renewable energies for electricity production (GWh)	72,809	113,325	152,835
Energy covered by renewables	**24.6%**	**33.3%**	**38.2%**

Source: MITYC / IDAE

4.3 Scenario B

This scenario includes more ambitious goals in terms of social and environmental sustainability. A greater effort in energy saving and efficiency is expected, as well as more penetration of renewable energies in all sectors.

The ambitious goal in term of energy demand implies important energy saving and efficiency measures to be implemented from 2016 on. No increase of energy consumption in terms of final energy is expected, but until these conditions are met the year-on-year average consumption would reduce gradually as the energy saving and efficiency measures take effect. According to

the forecast by the Ministry of Industry the consequences of the economic crisis will linger into 2012.

In absolute terms final energy consumption in 2020 will remain similar to consumption in 2009.

The evolution of final energy demand is a most significant factor in the achievement of penetration goals

Table 4.5 Final energy consumption (ktep)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Final energy consumption	94,491	93,226	92,503	92,974	93,448	93,822	94,150	94,291	94,291	94,291	94,291	94,291
Variation rate compared to previous year	-7.24%	-1.34%	-0.78%	0.51%	0.51%	0.40%	0.35%	0.15%	0.00%	0.00%	0.00%	0.00%

Source: MITYC / IDAE

Table 4.6 Consumption of renewable energies

	2009	2015	2020
Renewable energies for electricity production (Ktep)	**6,262**	**11,085**	**17,398**
Hydro > 10 MW (GWh)	21,048	26,129	26,000
Hydro < 10 MW (GWh)	5,200	6,839	7,560
Wind (onshore) (GWh)	36,615	61,126	81,845
Wind (offshore) (GWh)	0	1,000	13,125
Concentrated Solar Power (GWh)	100	10,385	27,207
Solar photovoltaic (GWh)	6,041	14,280	28,560
Biomass (GWh)	2,280	6,000	10,800
Biogas (GWh)	592	2,367	5,234
Ocean energy (GWh)	0	55	660
Geothermal (GWh)	0	0	600
Total renewables for electricity generation (GWh)	**71,876**	**128,181**	**201,591**
Renewable energies for heating/refrigeration (ktep)	**3,687**	**5,449**	**7,426**
Biomass	3,496	4,797	6,305
Biogas	26,5	76	130
Geothermal	9,1	36	63
Solar panels and other heating/refrigeration	156	541	928
Solar panels (thousands of m2)	2,017	7,000	12,000
Renewable energies in transport (ktep)	**1,058**	**2,470**	**3,500**
Bioethanol + bio-ETBE (m3)	276	594	788
Biodiesel (m3)	1,163	2,747	3,927
Bioethanol + bio-ETBE (ktep)	140	301	400
Biodiesel (ktep)	918	2.169	3.100
TOTAL RENEWABLES (Ktep)	**11,480**	**19,004**	**28,324**
% of renewables/ Final energy	**12.1%**	**20.2%**	**30.0%**

Source: Own research

In the area of electricity generation renewable power required to achieve the mentioned goals is:

Table 4.7 Accumulated power in renewables (MW)

	2009	2015	2020
Hydro> 10 MW	14,112	14,112	14,112
Hydro < 10 MW	1,977	2,387	2,700
Wind power	19,144	30,000	40,000
Wind power (offshore)	0	500	5,000
Concentrated Solar Power	232	4,000	9,000
Solar photovoltaic	3,442	8,400	16,800
Biomass	497	1,000	1,800
Biogas	160	400	800
Ocean energy	0	25	300
Geothermal	0	0	100
Total renewable energies	**39,564**	**60,824**	**90,612**

Source: Own research

The distribution of required installed power for each type of technology was adjusted to the level of development of each technology and their expected growth always under environmental sustainability criteria.

The distributed energy generation has great significance in the ensuring a sustainable growth of renewable energies installations.

The planning of power in the solar photovoltaic technology took into account the proposal submitted by KPMG[5] for the Spanish Photovoltaic Association (ASIF) about the promotion of self-consumption and distributed generation through the integration of photovoltaic panels in buildings. Distributed energy generation implies great social and environmental advantages and it is the way to achieve 16,800 MW by 2020. The main advantages include the use of urbanized areas without invading rural grounds or other spaces; users would be able to plan their consumption depending on the conditions of electricity generation.

Electric energy generated from biomass and biogas can become, as concentrated solar power energy, a supporting energy to cover high demands with renewable energies. These are fully manageable technologies that could cover the shortages of less functional Systems. Support to generation according to costs could be a possible way to achieve that goal.

In the same way as in the previous scenario, the electricity sector would assume the biggest efforts to comply with global objectives of renewable energy consumption. The expected cover of electricity production by these technologies is shown in the following table:

5 “Strategic report on the photovoltaic sector in Spain: reaching network parity” KPGM. October 2009.

Table 4.8 Cover of electricity production by renewable energies

	2009	2015	2020
Gross production (GWh)	296,508	339,931	400,420
Total renewable energies for electricity (GWh)	72,809	128,894	202,304
Covered by renewable energies	**24.6%**	**37.9%**	**50.5%**

Source: Own research

Thermal technologies had a more limited development than expected and adequate measures are necessary to promote this area of renewable energies given the advantages of generating thermal energy like their efficiency (higher than the efficiency of electricity generation).

Solar thermal energy could have a great potential if the necessary supporting measures are implemented. This is a technologically consolidated sector and support to house refurbishing projects will render this technology less dependant on new housing projects.

Business association's (ASIT) estimates were taken into account for planning the goal of 12 million square meters of solar collectors by 2020. ASIT estimates that 14 million square meters of solar collectors could be installed by 2020 with the support of a specific regulatory framework for this sector which would favour thermal energy production and not only installation. This would improve the efficiency of equipment and facilities[6].

Biofuel goals are the same as in Scenario A to meet the objectives of the European Directive. This is considered a relatively ambitious goal since the fast growth of this sector could lead to unsustainable practices.

4.4 Scenario C

Although the goals set for each technology in Scenarios A and B could be achieved with adequate support, it becomes necessary to study the possibility that such goals could not be met and the consequences of failure for employment. The reasons for failing to achieve those goals could lie in the lack of institutional support, administrative and financial restrictions, etc. Technology can ensure the necessary power in both scenarios.

Electricity technologies show a positive growth trend as long as they receive institutional support, whereas the thermal area faces more difficulties in their development. It is assumed that those trends would maintain. Compliance with PANER goals for 2020 would imply 80% compliance with electricity goals/ 70% compliance with thermal goals/ 80% compliance with biofuels goals.

6 Information based on in-depth interviews.

Table 4.9 Accumulated power in renewable energies (MW)

	2009	2015	2020
Hydro > 10 MW	14,112	14,112	14,112
Hydro < 10 MW	1,977	1,790	2,040
Wind power	19,144	22,278	28,000
Wind power (offshore)	0	120	2,400
Concentrated Solar Power	232	2,438	4,063
Solar photovoltaic	3,442	4,734	6,693
Biomass	497	496	800
Biogas	160	176	320
Ocean energy	0	0	80
Geothermal	0	0	40
Total renewable energies	**39,564**	**46,144**	**58,548**

Source: Own research

Energy generation by each technology would be the following:

Table 4.10 Consumption of renewable energies

FINAL CONSUMPTION OF RENEWABLE ENERGIES	**2009**	**2015**	**2020**
Renewable energies for electricity (Ktep)	**6,262**	**7,797**	**10,515**
Hydro > 10 MW (GWh)	21,048	20,903	20,800
Hydro < 10 MW (GWh)	5,200	5,127	5,712
Wind (onshore) (GWh)	36,615	45,392	57,292
Wind (offshore) (GWh)	0	240	6,300
Concentrated Solar Power (GWh)	100	6,330	12,282
Solar photovoltaic (GWh)	6,041	7,898	11,453
Biomass (GWh)	2,280	2,978	4,800
Biogas (GWh)	592	1,041	2,093
Ocean energy (GWh)	0	0	176
Geothermal (GWh)	0	0	240
Total renewable energies for electricity(GWh)	**71,876**	**89,909**	**121,148**
Renewable energies for heating/refrigeration (ktep)	**3,687**	**3,077**	**3,951**
Biomass	3,496	2,798	3,395
Biogas	26,5	44,1	70
Geothermal	9,094	4	6,622
Solar panels and other heat/refrigeration	156	215	451
Solar panels (thousands of m2)	2,017	3,431	7,000
Renewable energies in transport (ktep)	**1,058**	**1,976**	**2,800**
Bioethanol + bio-ETBE (m3)	276	475	631
Biodiesel (m3)	1,163	2,198	3,142
Bioethanol + bio-ETBE (ktep)	140	241	320
Biodiesel (ktep)	918	1,735	2,480
TOTAL RENEWABLES (Ktep)	**11,480**	**12,850**	**17,266**
% of renewable energies/ Final energy	**12.1%**	**13.6%**	**17.8%**

Source: Own research

In this pessimistic scenario, the cover of final energy demand by renewable energies in 2020 would reduce to 17.8%.

5. Jobs estimates for 2015 and 2020

Previous notes on trends evolution

The results of in-depth interviews show some trends that will have a significant effect on the future development of the sector and on generated jobs.

Solar thermal: Solar cold

In the case of low temperature solar thermal energy, the improvement and the general implementation of "solar cold" might imply a significant increase of energy supply by this technology and it could also be an important employment niche.

Solar photovoltaic: building integrated photovoltaic and network parity

The change of photovoltaic installation patterns from ground to on deck will imply higher job ratios per installed power in installation and to a lesser extent in maintenance.

If the forecast of companies in this sector are accurate, the evolution of cost of energy generated by this technology will reach network parity in a middle term period, and if this situation is used for self-production, jobs in this subsector would increase significantly.

Distributed generation

Very much in correspondence with the previous statements on photovoltaic energy, distributed generation through a network of small and very small facilities might imply a significant job increase both in electric and thermal subsectors: photovoltaic, biomass, small size wind power.

Jobs estimates

Jobs generated in the renewable energy sector will be classified into two main categories with distinctive growth patterns:

Manufacture and installation: this category includes industrial jobs associated with the manufacture of equipment for the start-up of renewable energy facilities from the very early stages (promotion, engineering, etc), Jobs generated in this area depend directly on the starting of new plants, therefore employment will have a steady trend provided that more renewable energy facilities are set up or that the increasing trend of export observed in the last years continue.

Operation and maintenance: jobs necessary to carry out operation and management tasks. These jobs remain constant through the life period of the energy plant; hence their number increases in an aggregated form year by year.

In this classification manufacture and installation jobs are associated with yearly installed power and operation and maintenance jobs are related to accumulated power.

Photovoltaic energy experienced a significant halt in new power installation in 2009 for reasons explained above. This was an exceptional situation Existing jobs must not be related to new power installations (only 42MW were installed compared to 2,666 MW installed in 2008). Jobs in this technology will be associated to a general ratio that correlates total jobs with total accumulated power.

We have considered variations of such ratios and of employment distribution by phases of the production process that might be taken into account in the future such as:

- The effect of import and export: 2015 and 2020 are expected to have the equipment export and import as the base year. According to interviews with experts from this sector, wind turbines manufacturers expect to increase their export levels for installations abroad (job estimates would increase in this case); on the other hand experts in solar photovoltaic energy have warned about the risks of bigger import of photovoltaic units (which means national manufacture would fall). A detailed study of the evolution of international markets for each technology could offer better job estimates for the manufacture processes.
- Technological variations: variations concentrate mostly in manufacture, especially for recently implemented technology. A thorough automation and improvement of production processes is expected which decrease the job ratio per unit of installed power. However, commercial running of new applications will imply an increase of labour force needs.

5.1 Jobs estimates for 2015

Installed and accumulated power estimates for 2015 and 2020 produce the following results for 2015:

SCENARIO A (Government's energy scenario)

Table 5.1 Job estimates for 2015 Scenario A.

	Direct jobs	Indirect Jobs	Total Jobs
Wind power	21,434	17,147	**38,581**
Hydropower	4,134	1,860	**5,994**
Solar Thermal	13,986	6,294	**20,280**
Concentrated Solar Power	1,283	770	**2,053**
Solar Photovoltaic	33,617	15,128	**48,745**
Biomass	2,306	2,029	**4,335**
Biofuel	1,116	1,144	**2,260**
Biogas	968	992	**1,960**
Geothermal	641	250	**891**
TOTAL	**79,485**	**45,614**	**125,099**

Source: Own research

79,485 new direct jobs would be created, 11,016 jobs more than in the first months of 2010. This would imply a 16% increase of jobs.

Photovoltaic technology would be the sector to generate more jobs, followed by wind power and solar thermal. Compared to what we currently observe, the wind sector would lose jobs due to a decrease of installed power in 2015 (app. 1,000 Mw less). We must bear in mind that future job estimates only include the Spanish energy mix (exports are not considered).

Technologies which expect relatively more job creation are geothermal and solar thermal that would grow 37% and 165% respectively, due largely to the expected increase of installed power.

For indirect jobs estimates we have used the same coefficient we use for indirect jobs at the moment.

SCENARIO B (ambitious environmental energy scenario)

Photovoltaic technology expects to create more jobs since this scenario confers special significance to the generation of this type of energy for self-consumption in the household sector, which implies job creation.

Table 5.2 Job estimates 2015, Scenario B

	Direct jobs	Indirect jobs	Total Jobs
Wind power	26,033	20,826	**46,859**
Hydropower	5.982	2,692	**8,674**
Solar Thermal	22,975	10,339	**33,314**
Concentrated Solar Power	2,456	1,474	**3,930**
Solar Photovoltaic	47,716	21,472	**69,188**
Biomass	4,111	3,618	**7,729**
Biofuel	1,116	1,144	**2,260**
Biogas	5,442	5,578	**11,020**
Geothermal	2,411	940	**3,351**
TOTAL	**118,242**	**68,083**	**186,325**

Source: Own research

Wind power is the second most important sector by the number of total jobs. Jobs increase in this scenario compared to 2010 since installed power in 2015 is slightly bigger and this would create jobs in the operation and maintenance phase.

The increase in the number of jobs in solar thermal energy compared to scenario A is also significant.

SCENARIO C (pessimistic scenario):

This scenario includes a reduction of yearly installed power and total accumulated power with the following consequences for employment.

Table 5.3 Job estimates 2015, Scenario C

	Direct jobs	Indirect jobs	Total
Wind power	17,148	13,718	**30,866**
Hydropower	3,327	1,497	**4,824**
Solar Thermal	9,790	4,406	**14,196**
Concentrated Solar Power	1,027	616	**1,643**
Solar Photovoltaic	26,893	12,102	**38,995**
Biomass	1,844	1,623	**3,467**
Biofuel	892	914	**1,806**
Biogas	775	794	**1,569**
Geothermal	448	175	**623**
TOTAL	**62,144**	**35,845**	**97,989**

Source: Own research

This scenario shows the possible consequences for employment of failure to meet government goals to comply with the European Directives.

Total job losses in the renewable energy sector would amount to 28%. The most affected technologies would be wind and solar photovoltaic energy.

5.2 Jobs estimates for 2020

SCENARIO A (Government's energy scenario)

This scenario would generate 124,265 direct jobs, an 81.5% increased compared to 2010 since total accumulated power for 2020 would exceed the current 90%; the manufacture and installation phase would growth relatively less since yearly installation would remain constant.

Table 5.4 Job estimates 2020

	Direct jobs	Indirect jobs	Total jobs
Wind power	30,309	24,247	**54,556**
Hydropower	5,983	2,692	**8,675**
Solar Thermal	28,180	12,681	**40,861**
Concentrated Solar Power	2,093	1,256	**3,349**
Solar Photovoltaic	47,527	21,387	**68,914**
Biomass	4,304	3,788	**8,092**
Biofuel	1,512	1,550	**3,062**
Biogas	3,927	4,025	**7,952**
Geothermal	430	168	**598**
TOTAL	**124,265**	**71,794**	**196,059**

Source: Own research

Jobs in the manufacture and installation phase in solar thermal energy would increase considerably (378%) since this technology is expected to take off in the next years. In the case of offshore wind power there are no available data on generated jobs by accumulated power since such facilities do not exist in Spain at present. Ratios from wind energy were used as approximation figures (wind energy jobs are obtained in aggregated form). However we must bear in mind that jobs in this technology might be undervalued. Offshore wind power farms require more intensive labour force that onshore wind power farms (the other phases of the production process would be basically similar).

SCENARIO B (ambitious environmental energy scenario)

Total generated direct jobs would be 202,764 which almost triple the current jobs in the sector (296%). As in the estimates for 2015 the sector with more job generation would be photovoltaic technology with 95,431 direct jobs due to distributed power generation on houses' roofs. The wind sector would keep a very significant job creation rate with 57,502 direct jobs, due largely to offshore wind power farms. These technologies along with solar thermal and to a lesser extent biomass would be the top job providers in 2020.

Table 5.5 Job estimates 2020, Scenario B.

	Direct jobs	Indirect jobs	Total jobs
Wind power	57,502	25,876	**83,378**
Hydropower	4,217	1,898	**6,115**
Solar Thermal	22,872	13,723	**36,595**
Concentrated Solar Power	4,426	1,992	**6,418**
Solar Photovoltaic	95,431	83,979	**179,410**
Biomass	7,540	7,729	**15,269**
Biofuel	1,512	1,550	**3,062**
Biogas	6,277	2,448	**8,725**
Geothermal	2,987	1,553	**4,540**
TOTAL	**202,764**	**140,748**	**343,512**

Source: Own research

SCENARIO C (pessimistic scenario):

Jobs would increase 41% in this pessimistic scenario. Comparison of technologies shows the same results as in Scenario A.

Table 5.6 Job estimates 2020, Scenario C

	Direct jobs	Indirect jobs	Total
Wind power	24,247	10,911	**35,158**
Hydropower	4,807	2,163	**6,970**
Solar Thermal	19,726	11,836	**31,562**
Concentrated Solar Power	1,674	753	**2,427**
Solar Photovoltaic	38,022	33,459	**71,481**
Biomass	3,443	3,529	**6,972**
Biofuel	1,211	1,241	**2,452**
Biogas	3,142	1,225	**4,367**
Geothermal	301	157	**458**
TOTAL	**96,573**	**65,274**	**161,847**

Source: Own research

Compared to scenario A, jobs would be reduced in 32%; compared to scenario B there would be a 51% reduction over of total jobs.

This energy scenario includes the possibility of an 80% compliance with goals and 70% in thermal categories which represents a slight deviation for scenario A, if the installation of new renewable power were slower than expected, there would be job losses.

6. Assessment of economic impact

Economic and job results summarize a thorough examination of the reports submitted by 22 selected companies. The following table includes the main macro-economic figures.

Table 6.1 Main macroeconomic figures.

	Added	Average by company	
	Millions of Euros	% over total income	Millions of Euros
Total income	13,793.82	100	626.99
Total net business turnover	11,975.41	84.45	544.38
Other running incomes	512.55	7.14	23.30
Financial income	1,305.85	8,42	59.36
Procurements	7,418.75	52.36	377.21
Personnel costs	1,048.74	8.74	47.67
Other running costs	1,226.33	11.79	55.74
Financial costs	1091,34	10.67	49.61
Added value	4,057.60	25.18	184.44
Productivity (Euros/worker)			395,720.04
Profits for capital	255.94	3.09	12.80
R+D+i costs	61.72	0.59	10.29
Exports	4,827.95	27.97	603.49

Note: Macro-economic average figures are calculated for companies whose data are available. Average productivity is calculated by weighing the level of productivity in each company considering their relative weight over total net turnover.

Source: Based on data collected from company records in the Business Register.

Total income for the 22 companies included in this part of the study amounts to 13,794 billion Euros. Therefore companies' contribution to the whole economy in terms of gross production is approximately 0.66%. This relative weight confirms the significance of this sector for the economy.

Data obtained from the 22 selected companies allow us to conclude that in terms of added value the participation of the renewable energy sector in the whole of Spanish economy is notably inferior. In fact for the 22 studied companies generated added value represents 0.37% of GDP. Difference in participation between production and added value shows that the renewable energy sector has supply purchase and contracted external services indicators above the average of Spanish economy.

Table 6.2 Relative weight of 22 renewable energy companies selected on added value basis

Millions €	Spanish economy	22 selected renewable energy companies	%
GDP	**1,088,502**	**4,057.60**	**0.37**

Source: Developed by ISTAS on the basis of data obtained from the annual reports of the selected renewable energy companies (Business Register) and data from the National Statistics Agency (aggregated data on Spanish economy).

Export coefficient

As shown by the study of the 22 companies, the sector of renewable energies has a bigger tendency to export than the average Spanish economy. These 22 companies show an export coefficient that doubles the average. The total volume of exports in those companies amounts to 4.83 billion Euros whereas Spanish economy's export tendency is around 13.5%. We must bear in mind that these are the 22 bigger companies in the sector, both for their size/staff and for their turnover, hence their export coefficient exceed the export tendency of the renewable sector as a whole.

Table 6.3 Export coefficient of 22 selected renewable energy companies

	Spanish economy	22 selected renewable energy companies
Total exports/ income (%)	13.8	27.5

Source: *Developed by ISTAS on the basis of data obtained from the annual reports of the selected renewable energy companies (Business Register) and data from the National Statistics Agency (aggregated data on Spanish economy).*

Investment efforts R+D+i

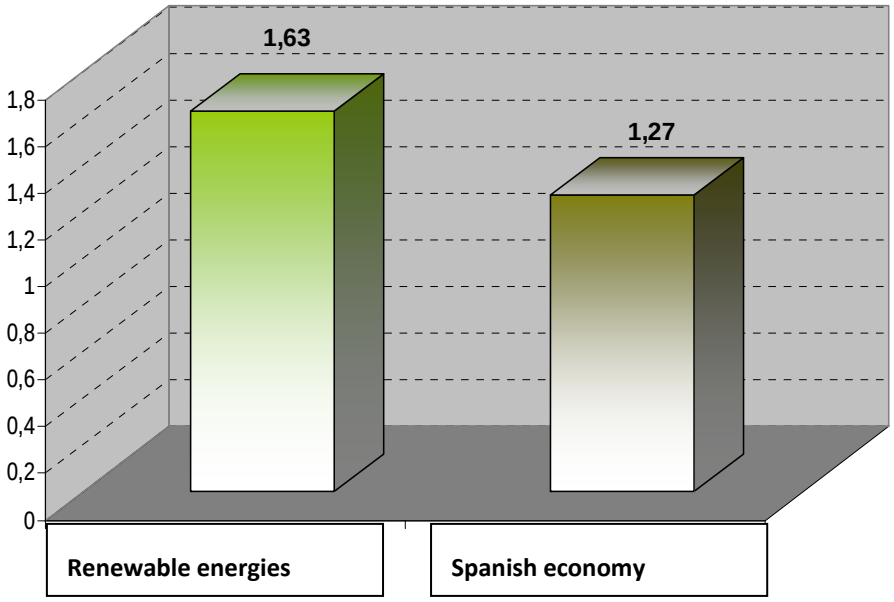
Data obtained from the 22 selected companies also show the R+D+i investment efforts in those companies are significantly higher than those for the whole of Spanish economy. Again we must bear in mind that these companies are probably the ones with greater R+D+i investment efforts in the renewable sector. However there are considerable reasons to believe that the figures registered in company records are understated and might not reflect accurately investment efforts, since the inclusion of R+D+i expenses included in companies' reports is discretional . Such data were not always available in the records of studied companies.

Table 6.4 R+D+i expenses over GDP (%)

	Spanish economy	22 selected renewable energy companies
R+D+i over GDP (%)	1.27	1.63

Source: *Developed by ISTAS on the basis of data obtained from the annual reports of the selected renewable energy companies (Business Register) and data from the National Statistics Agency (aggregated data on Spanish economy).*

Graphic 6.1 R+D+i investment efforts of renewable energy companies and the economy as a whole (R+D+i/GDP expenses, %)



Source: *Developed by ISTAS on the basis of data obtained from the annual reports of the selected renewable energy companies (Business Register) and data from the National Statistics Agency (aggregated data on Spanish economy).*

Salaries

The average salary in the selected companies amounts to 32,817 Euros, which exceeds by 52% the higher average national salaries and in 32% the average salary for the industrial sector, which is consistent with the sector's higher qualification of labour force, its higher productivity and bigger R+D+i investments efforts, and its export tendency.

Table 6.5 Average salary in companies

	22 selected renewable companies	Industrial Sector	Spanish economy
Average yearly salary (Euros)	**32,816.79**	**23,942.55**	**21,638.86**

Source: *Developed by ISTAS on the basis of data obtained from the annual reports of the selected renewable energy companies (Business Register) and data from the National Statistics Agency.*

The average salary of the 22 companies is notably higher to the average salary in the renewable energy since smaller companies were not included in the study.

7. CONCLUSIONS

Jobs in renewable energies 2010

The volume of direct jobs in renewable energy sector in Spain is around 68,737 jobs and indirect jobs are estimated to be s0me 44,758. These figures confirm the importance of this sector in terms of jobs. This sector is expected to be a significant job source in the future.

We can observe that jobs in this sector depend directly on yearly installed power, on the halt of renewable energies in 2009 (caused by the financial crisis, administrative difficulties and regulatory instability) that implied significant job losses compared to 2007. For this sector to generate jobs it becomes necessary a midterm and long-term planning within a stable regulatory framework that ensures new power installation.

Existing jobs in each type of energy: Jobs concentrate mostly in the following technologies (in decreasing order):

- Wind energy with the biggest job numbers (30,651) and total weight of 43.6%
- Solar Photovoltaic, with 19,552 workers for 28% of total jobs
- Solar Thermal, with 6,757 workers for a 9.6% of total jobs
- Biomass with 3,191 workers for almost 5% of total jobs
- The remaining subsectors present notably lower percentages.
- Common activities to all subsectors account for 6.1% of total jobs employing 4,263 workers.

Characteristics of generated jobs

Professional qualification and research and innovation efforts are key aspects for the development of renewable energies, we have therefore examined these issues in detail.

Professional skills required for the development of renewable energies may be acquired by updating existing professional profiles from other industries. This factor implies a great opportunity for professional rationalization of profiles in the construction sector; the most affected by the ongoing crisis with massive job losses. A good example is the professional requalification of electricians and plumbers.

The structure of qualification in this sector allows us to conclude that the average level of qualification in this sector is higher than the average for the whole industrial sector in Spain. Approximately 55% of workers are either higher education graduates or engineers. Engineers make up for almost one fourth of the staff (including management officers) and operators (qualified workers). Training has become a strategic activity for the further development of renewable energies.

One fifth of the companies employ part of their staff in R+D+i tasks and 13% of companies have their own R+D+i department. This percentage increases with the size of the company.

Regarding types of contract 83.7% of workers are on permanent employment contracts, 14.1% on temporary contracts, 0.9% on training/experience contracts and 1.2% are self-employed.

These figures need further comment due to a probable high level of subcontracting –common to other business sectors- which conceals different job profiles.

Workers with lower qualification have a bigger proportion of temporary contracts; assistant operators (non-qualified workers) make up for 38% of temporary contracts. Job insecurity increases with company size up to 1,000 workers, in which this trend stops due to the large number of workers on permanent contracts.

Women represent a total estimate of 18,275 workers in this sector for 26.6% of total jobs. This percentage is lower than the average of women for the whole economy and very similar to the average percentage of female workers in industry.

Distribution by departments reflects traditional labour division: 64% of female workers are employed in offices tasks. A smaller female representation is observed in industrial production and installation tasks.

Business fragmentation in this sector, the great number of workers in medium sized and small companies and the generalization of subcontracting and deregulation of the electricity sector call for a regulation of these jobs through a sector agreement, either in the electricity sector or in the whole of the renewable energies sector.

Jobs estimates for 2015 and 2020

The possible scenarios for 2015 and 2020 might be classified with a cover of energy demand by renewable sources of 22.7 % for scenario A, 30% in scenario B and 17.8% in scenario C. The three scenarios are technically feasible and their accomplishment will depend largely on supporting policies to renewable technologies and on energy saving and efficiency in the upcoming years.

Job estimates for 2015 include 79,485 direct jobs in the government projected scenario; 118,242 direct jobs in the environmentally sustainable scenario and 62.144 direct jobs in a pessimistic scenario of failure to meet government goals.

Job estimates for 2020 include 124,265 jobs for the government scenario, some 202,764 direct jobs for the environmentally sustainable scenario and approximately 96,573 jobs for the pessimistic scenario of failure to meet government goals.

Annex I: Jobs including waste incineration

The total number of workers employed in the 925 companies surveyed for this study amounts to 28,537. Considering that the sample included 40.67% of all companies in this sector and drawing estimated values based on the weight of each company the total volume of workers in renewable energies companies in Spain would amount to 70,152.

Table A1. Distribution of jobs by subsector including waste incineration

	Abs.	%	Total jobs (Estimates)
Wind power	12,468	43.6	30,651
Solar Photovoltaic	7,953	27.9	19,552
Solar Thermal	2,749	9.6	6,757
Common activities for all sectors	1,734	6.1	4,263
Biomass	1,298	4.5	3,191
Waste incineration	576	2	1,415
Large an small size Hydropower	439	1.5	1,078
Biofuel	392	1.4	964
Biogas	270	0.9	664
Concentrated Solar Power	208	0.7	511
Geothermal	169	0.6	415
Other	109	0.4	268
Heat pump	75	0.3	184
Small size wind power	67	0.2	165
Tidal	30	0.1	74
TOTAL	28,537	100	70,152

Source: *Developed by ISTAS based on own surveys*