Installations of PV power plants in 2008

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ABSTRACT

The past year was characterised by the realisation of many MW-range solar power plants as well as the highest ever market growth related to large-scale photovoltaic systems. These systems were constructed in several regions, some of which saw significant increases in cumulative installed power. In the European Union, progress was observed among countries such as Italy, Czech Republic and France; the German market, however, decreased slightly. In terms of capacity of installed power output, Germany's figures were almost unchanged from 2007's figures, despite the market explosion in Spain. This paper provides a round-up of the major PV installations of 2008.

Introduction

Very few scientific studies or reliable journalistic research articles related to large-scale photovoltaic plants were published over the past few years. Four studies are worthy of mention, however: journalistic research studies published in *Photon* magazine in 2005 [1] and 2008 [2]; a study commissioned by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety [3]; and a study performed by the Task 2 working group of the IEA-PVPS programme [4]. Unfortunately these reports cover only specific types of photovoltaic plants and/or a particular region, or the evaluated data covers only a relatively small number of PV power plants.

Data that represents the basis for this paper was collected during long-term research related to large-scale photovoltaic power plants, performed by the report's author. Note that only photovoltaic power plants producing more than 200kWp are considered herein. This report is based on detailed data of more than 1,700 large-scale PV plants with a cumulative peak power more than 3.3GWp that were put into service during the last 20 years. Due to the specific situation in the photovoltaic market – the number of large-scale photovoltaic plants is increasing very rapidly, such a fast-moving market makes it very difficult to maintain such a report and keep it totally up to date. In this paper the majority of photovoltaic power plants that were completed by December 31st 2008 are considered; provided press releases or other official statements were made prior to the date of publishing. Because there are no reliable databases, or other national or international sources of information concerning large-scale photovoltaic power plants available, statistical data presented here should be considered as 'conservative'. (As of January 1st 2009, new photovoltaic power plants in Germany must be announced to Federal Network Agency/Bundesnetzagentur.) Based on experience from past years and on comparison with the aforementioned reports, reliability of data presented in this report is estimated to be in the worst case in the range from -10% to -15% for regions with highest market growth and -10% or better for other regions. Uncertainty is factor among all of the absolute data presented in this report.

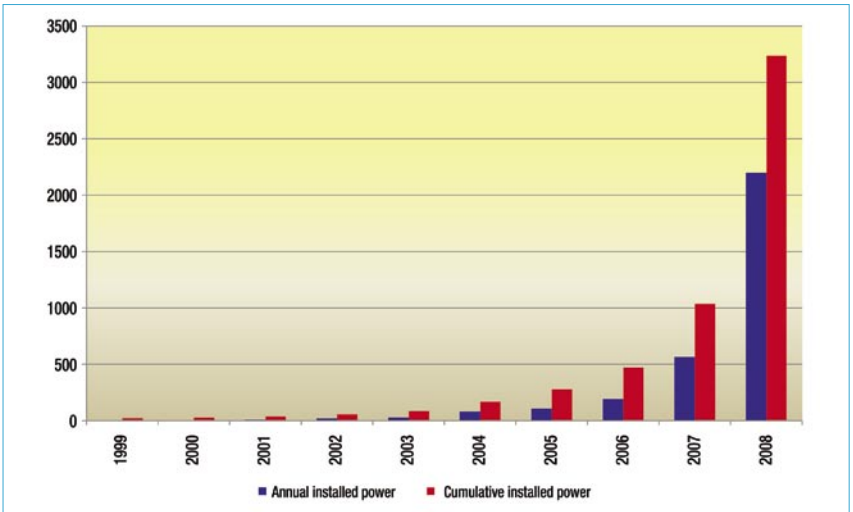

Figure 1. Large-scale photovoltaic power plants: estimated annual and cumulative installed power output capacity in MWp worldwide in the last 10 years.

Annual and cumulative installed power output capacity

2008 showed the largest market growth in large-scale photovoltaic power plants, with more than 2GWp of new power plants constructed and put into service (see Figure 1). Spain was the market leader with more than 1.8GWp installed in the last 12 months. More than 500 large-scale photovoltaic plants are located in Germany, 360 in USA and more than 630 in Spain, clocking an average plant power output capacity (plants > 200kWp) of about 1.9MWp. These countries also represent the most important markets worldwide.

The market share of large-scale grid-connected PV power plants as a proportion of cumulative installed PV

Annual installed power output capacity (MWp) 1996 – 2008												
1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2.03	2.2	1.9	2.5	4.9	9.7	20.6	29.1	82.2	109	193	567	2200
17.3	19.5	21.4	23.9	28.8	38.5	59.1	88.2	170.4	280	473	1040	3240
Cumulative installed power output capacity (MWp) 1996 – 2008												

Table 1. Large-scale photovoltaic power plants (>200kWp): estimated annual and cumulative installed power output capacity worldwide from 1996 – 2008.

power has been increasing continuously over recent years. In 2005, for example, market share stood at less than 10% of the annual installed PV power capacity, and by 2007 market share of large-scale PV power plants had risen to almost 25% of the annual installed power [5,6], and it seems that in 2008 market share is even larger. More precise estimations for the past year will be possible over the coming months when reliable data about the annual installed power in 2008 will be more readily available.

Large-scale photovoltaic power plants installed by region

More than 85% of all large-scale photovoltaic plants (power-related) are installed in Europe (2870MWp). The USA has about 7% (245MWp) while Asia accounts for a little less than 4% (130MWp). The most dynamic market performance for the past year was that of Spain. Fast growth in the country has taken place over the last three years with extreme growth in the past year, where in the third and fourth quarters alone about 1GWp of new PV power plants were put in service. In summer 2008, Spain's installed power capacity was estimated at 600MWp [7]. Further progress in Europe (Italy, Czech Republic and France, and Greece as a market with future promise) and in Korea was also observed. Italy hosts more than 60MWp of large-scale PV power plants; however, the future of subsidies in Italy is not yet clear. In Czech Republic and in France, another promising market for 2009, several MW-range PV power plants were put into service. The rest of the world (Africa, South America, Australia...) represents less than 1% of total capacity worldwide; these regions show significant potential for solar energy use in future.

At the end of 2008, more than 85% of all large-scale photovoltaic power plants (power-related) were ground-mounted. Whilst about 23% of all power plants (power-related) have tracking systems (single- or double-axis tracking), 70% have fixed arrays.

MWp	Country	City	Region/province
60	Spain	Olmedilla de Alarcon	Castilla-La Mancha
50	Spain	Puertollano	Castilla-La Mancha
46	Portugal	Moura	Alentejo
40	Germany	Brandis	Saxony
34.2	Spain	Arnedo	La Rioja
30	Spain	Trujilo	Extremadura
30	Spain	Merida	Extremadura
26	Spain	Fuente Álamo	Murcia
24	Korea	SinAn	Southern Jeolla
23.2	Spain	Lucainena de las Torres	Andalusia
23.1	Spain	Abertura	Extremadura
23	Spain	Jumilla	Murcia
22.1	Spain	Almaraz	Extremadura
21.2	Spain	Villarrobledo	Castilla-La Mancha
20.2	Spain	El Coronil	Andalusia

Table 2. Largest photovoltaic power plants (data correct up to December 2008).

Market share

Countries with total power output capacity of more than 10MWp from large-scale photovoltaic power plants (only photovoltaic power plants >200kWp considered here) are listed in Table 3.

In France and Czech Republic, more than 10MWp cumulative power output capacity was installed in 2008. Among Asian countries it is worth mentioning Korea, which has almost 100MWp power capacity installed, most of which were put into service in 2008. Moderate growth was observed also in California, the state with most PV power capacity installed in the USA.

Economic indicators

With a significant increase in power capacity installed, it makes sense to analyse some economic parameters such as power output capacity per capita installed. In regions with the highest power capacity per capita installed, this value ranges from 0.02kWp to 0.35kWp per capita. The most power capacity per capita is installed in the autonomous Spanish regions of Extremadura, Castilla-La-Mancha and Andalusia. Bavaria takes first place in Germany as does Southern Jeolla province in Korea. California has similar levels of power capacity installed as some Spanish regions, but due to high population density the power capacity per capita is still much lower than values in attributed to Spain or Germany. Table 6 shows a breakdown of rough estimated values of installed power capacity per capita in these regions. Please also note that these per capita figures are only valid for large-scale PV power plants >200kWp; total PV power capacity installed per capita in some regions may be much higher than values presented in this paper.

Most important markets

The most important world market in 2008 was Spain. In the EU, despite the relative decrease in market share, Germany is worth mentioning. Korea was an important Asian market in 2008, displaying a significant increase in market share in the past year. Korea is also the only non-European country with three PV power plants among the world's 50 largest PV installations. Among Asian countries, Korea is the only

Country	Power output capacity (MWp)	Market share (%)
Spain	>2020	63
Germany	>650	20
USA	245	7
Korea	100	3
Italy	60	2
Japan	21	<1
Czech Republic	15	<1
Belgium	12	<1
France*	11	<1

Table 3. Large-scale photovoltaic power plants of countries with more than 10MWp power output capacity installed. (*Not inclusive of overseas territories.)

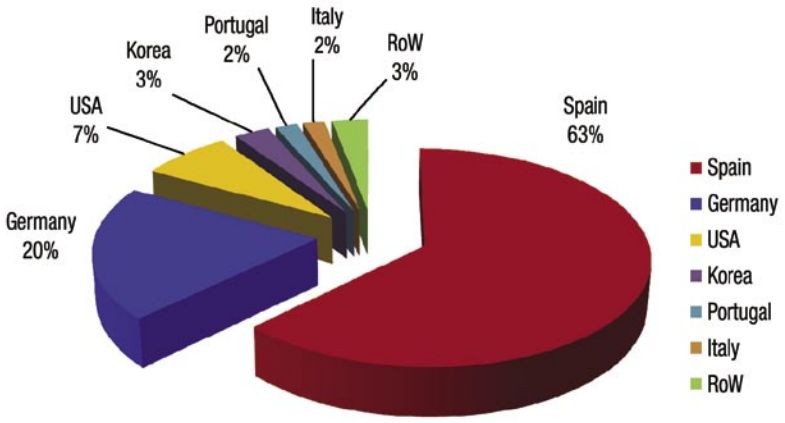

Figure 2. Large-scale photovoltaic power plants – market share by country up to December 2008.

Courtesy: Suravia, S.A.

Figure 3. Olmedilla de Alarcon, Cuenca, Spain, a 60MWp installation, was the largest PV power plant constructed in 2008.

one that boasts well-defined feed-in tariffs, so even further progress of the Korean market might be expected [9]. In the USA, growth had been moderate yet constant in the last few years; however, the majority of the country's PV installations are concentrated in relatively few federal states, a point that is illustrated clearly by the fact that California has been the country's PV market leader for more than a decade. From a long-term point of view, India looks to be becoming a promising market for Asia. Due to actual feed-in tariffs in Germany and Spain, large-scale roof-mounted PV plants will tend to dominate the EU's output this year and beyond. Similar regulations also exist in France, where the first large-scale MW-range PV roof-mounted plants were put into service in the last year. Further plans for large numbers of MW projects are already being planned.

Conclusion

In the period from 2005 to 2007, annual growth in large-scale photovoltaic plants was on average 100% annually. In 2008, market growth related to large-scale PV power plants was almost 400%. Average installed plant power has increased from 400kW in 1997 to 1.9MWp in 2008. Expectations for 2009 include a general market decrease, but in particular regions market growth can be expected, even taking the current economic climate into account. Promising markets within the EU in 2009 include France, Greece and Czech Republic, while for some other countries it is also believed that strong market growth will continue, although in most cases the outlook is

Country	Power output capacity 2007 (MWp)	Power output capacity 2008 (MWp)
Spain	270	>2020
Germany	452	>650
Italy	18	60
Portugal	12	60
Czech Republic	2.1	15
France*	<2	13
Belgium	3.3	12

Table 4. Large-scale photovoltaic power plants: comparison of estimated installed power capacity for some EU countries in 2007 and 2008 [8]. (*Including overseas territories.)

Country	Power output capacity 2008 (MWp)	EU market share (%)
Spain	>2020	71.5%
Germany	>650	22.5%
Italy	60	2%
Portugal	60	2%
Czech Republic	15	0.5%
Belgium	12	<0.5%
France*	11	<0.5%
Netherlands	11	<0.5%

Table 5. Large-scale photovoltaic power plants – estimated EU market share. (*Not inclusive of overseas territories.)

Region	Country	Power (kWp) per capita
Extremadura	Spain	>0.3
Castilla-La-Mancha	Spain	0.29
Andalusia	Spain	0.054
Bavaria	Germany	0.024
Southern Jeolla province	Korea	0.023

Table 6. Large-scale photovoltaic power plants: power capacity installed per capita (kWp) (estimated).

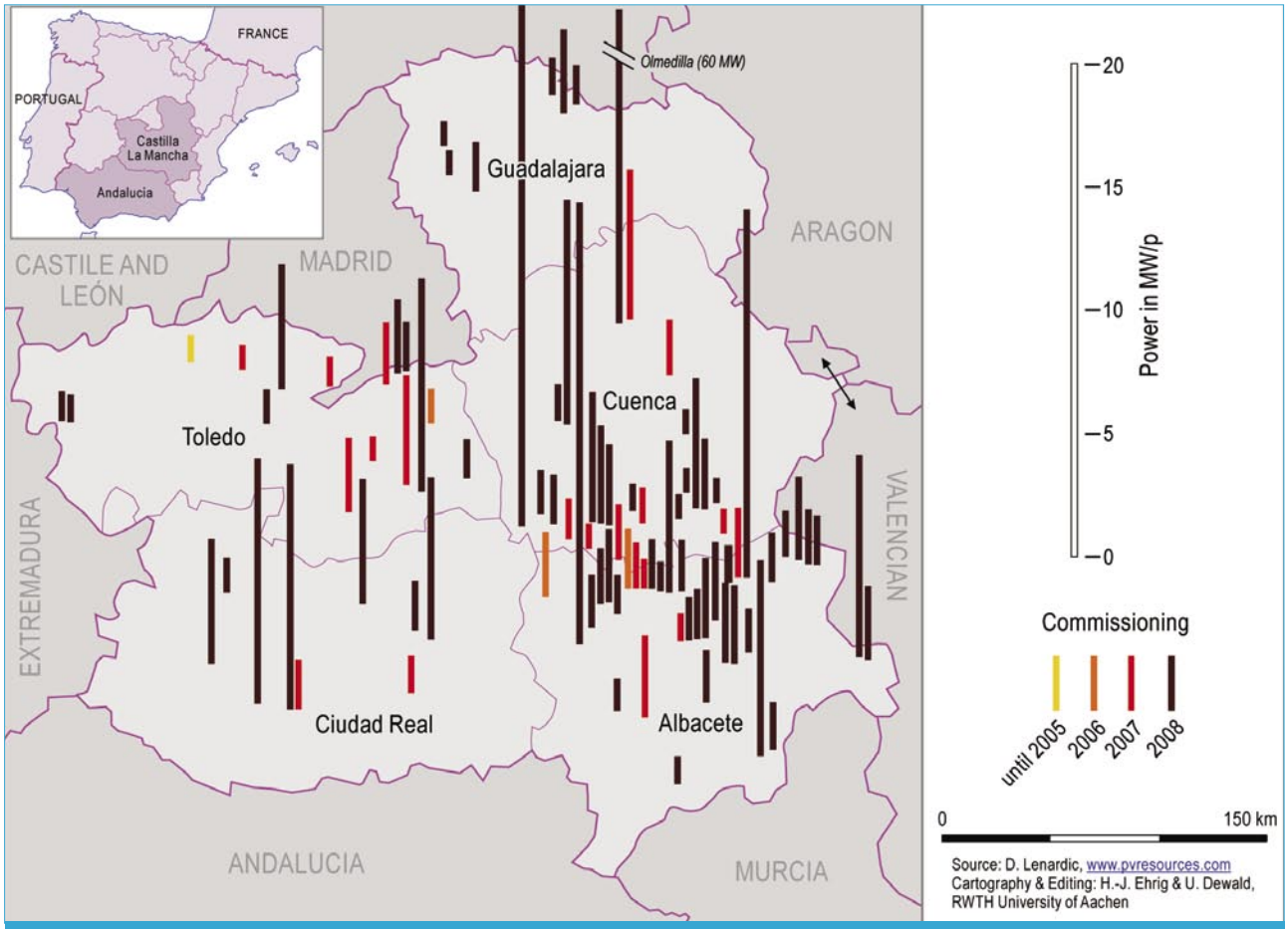

Figure 4. Locations of MW-range power plants in the Spanish region of Castilla-La-Mancha as at December 2008.

Map courtesy: Ulrich Dewald, Hans-Joachim Ehrig, RWTH University of Aachen.

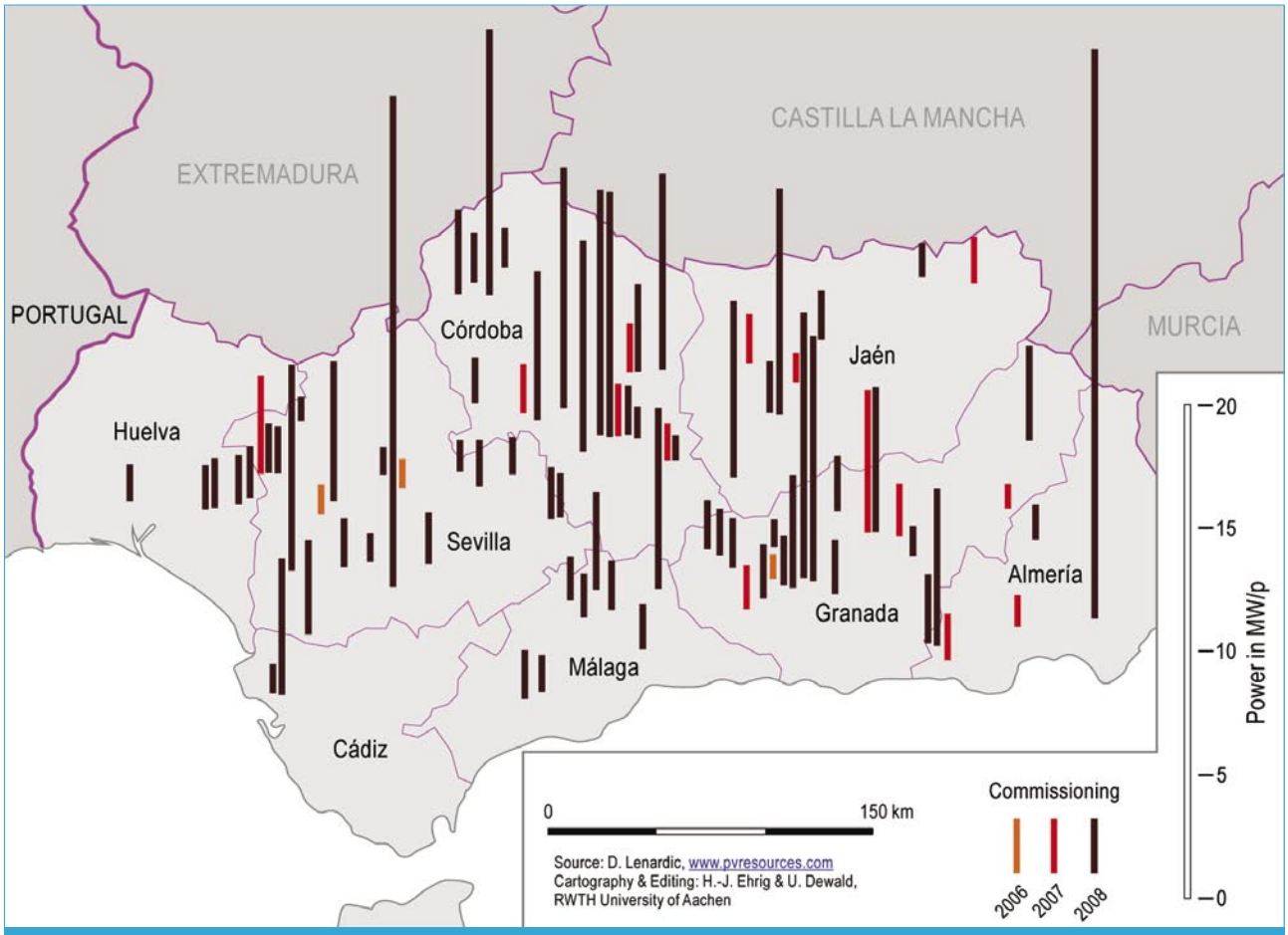

Figure 5. Locations of MW-range power plants in the Spanish region of Andalusia as at December 2008.

Map courtesy: Ulrich Dewald, Hans-Joachim Ehrig, RWTH University of Aachen.

not clear (Italy, for example) and therefore unpredictable, due to bureaucratic obstacles. All data presented in this report are calculated on data as available in December 2008, so slight changes of all presented data and statistical values in the forthcoming months cannot be excluded. Analysis of additional economic indicators related to large-scale PV plants, such as investment, CO_2 emission reduction and electricity prices will be published in a report to be made available in the forthcoming months.

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Denis Lenardic holds a degree in electrical engineering from the University of Ljubljana, Slovenia. From 2004 to 2008 he served as Chairman of the Slovene national section of the IEC »TC82« Technical Committee. He has been systematically collecting data regarding large-scale photovoltaic power plants for several years.

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