

The Photovoltaic Sector in France

National survey report

Year 2010

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Introduction

As part of the International Energy Agency Photovoltaic Power Systems Programme (AIE/PVPS), working group no. 1 has the principal aim of collecting data from each of the member countries in the programme each year in order to prepare a summary, which is published under the title of ***Trends in Photovoltaic Applications***.

The present document is the French contribution to the preparation of this report.

After being approved by ADEME, this version will be translated into English. It will then be published on the AIE/PVPS web site at www.iea-pvps.org under the heading, “**National survey report of PV power applications in France 2010**”.

It was produced by Philippe Jacquin, (www.phkconsultants.com), on behalf of ADEME.

**INTERNATIONAL ENERGY AGENCY
CO-OPERATIVE PROGRAMME ON PHOTOVOLTAIC
POWER SYSTEMS**

Task 1

**Exchange and dissemination of information on PV
power systems**

**National Survey Report of
PV Power Applications in France
2010**

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1 Summary

1.1 Overview of the sector

The cumulative photovoltaic power installed in France (mainland and overseas territories) was 180 MW at the end of 2008, and was in excess of 1 000 MW at the end of 2010; in other words, it has grown by a factor of 5 in 2 years.

The procedures for the acceptance of requests for connection to the national grid have been simplified and the waiting times have been reduced. Thus, nearly 150 000 facilities have been connected to the national grid over the course of the year. However, at the end of December 2010, approximately 75 000 systems were awaiting connection over the entire country (metropolitan France and overseas territories) adding up to a total power of 4 150 MW.

This increase marks an advance on the Grenelle Environment Forum targets defined at the end of 2007 (1 100 MW installed by the end of 2012 and 5 400 MW by 2020).

In order to avoid windfall profits, the Government has, following gains in productivity and reduction in the costs of modules in the market, proceeded over the course of the year to revise the feed-in tariffs of photovoltaic electricity in order to adapt the support measures to the explosive growth in the number of facilities.

Furthermore, a decree was promulgated on 9 December suspending the obligation to purchase photovoltaic electricity for three months. This suspension affects photovoltaic systems with a power of greater than 3 kW, where the producer has not notified the grid operator of their acceptance of the technical and financial proposal (PTF) for connection to the grid before 2 December 2010.

By means of this moratorium, the government wished to start a forum to discuss the lowering of feed-in tariffs and the implementation of a system of quotas. Discussions brought together players in the photovoltaic segment, elected representatives, and representatives of consumer groups and environmental associations, who started the talks on 20 December in order to come up with a new regulatory framework during March 2011, thus ensuring visibility for the players in the field.

On an industrial level, new operators in the industry are being set up, and the value chain of this segment is being filled out. The production capacity for modules in France amounted to around 525 MW by the end of the year.

According to a report published by the Syndicat des Energies Renouvelables in December 2010, the sector as a whole is the source of approximately 23 000 jobs, from the “upstream” activities (manufacture of the equipment necessary for the production of the products and manufacture of materials and products) to the “downstream” activities of the integration, assembly, and operation of electricity generating installations from photovoltaic sources.

The ADEME (the French Agency for the Environment and Energy Management) www.ademe.fr together with the ANR (the National Research Agency in France - www.agence-nationale-recherche.fr), the OSEO (French Government body funding creation, innovation, and development in SMEs) - www.oseo.fr), and local government bodies (Regional Councils, General Councils, Communes) continue to support research and investment in the field of photovoltaics.

1.2 Installed capacity

Over the course of the year 2010, approximately 720 MW have been installed. According to the operator, ERDF, the cumulative capacity connected to the grid has reached 973 MW, of which 808 MW is in metropolitan France and 165 MW in the overseas territories and in Corsica. The annual energy production of the entire French system is estimated at 1 000 GWh.

In metropolitan France, 91% of the photovoltaic systems in service are facilities of less than 3 kW. These systems represent 42% of the installed capacity. The 3 kW -250 kW segment represents 9% of all systems and 39% of the installed capacity.

The development of large photovoltaic ground installations initiated over the course of the two previous years has continued with many completions in 2010: 78 ground mounted systems of over 500 kW were connected to the grid in metropolitan France, of which 16 plants were over 5 MW.

The market for “off-grid” installations, the historic basis of the PV market in France has shrunk considerably. According to the “Barometer of renewable electrical energy in France” (*Observ'ER*), the total installed capacity in autonomous facilities is estimated at 30 MW (including metropolitan and overseas territories) as of the end of 2010.

1.3 Price levels

On the basis of interviews with manufacturers and installers, price levels of the different types of facility connected to the grid stand as shown in Table 1.

Table 1: Pre-tax price levels of photovoltaic systems (connected to the grid) installed in 2010

Installation examples	Example of installed capacity (kW)	Pre-tax price of installed system (EUR/kW)
Residential roof-tops	approx. 3	4,3 to 5,9 (*)
		5,8 to 6,7 (**)
Building roof-tops	approx. 10 to 100	5,4 to 6,5 (***)
		>11 (****)
Large industrial building roof-tops	~250 to 500	5 to 6
Ground-level plants	~1 000	3,5 to 5,5 (*****)

(*) for added-on roof systems

(**) for BIPV systems integrated with a SOLRIF-type integration procedure

(***) for BIPV systems

(****) for systems integrated into glass envelopes

(*****) heavily dependent on the size of the plant and the infrastructure of the site

1.4 Module production capacity

Production capacity in France for crystalline silicon modules amounts to approximately 525 MW.

Projects are being developed using the CIGS and CdTe thin-film technologies.

The price of modules in the French market varies from 1,2 EUR/W to 1,5 EUR/W net of tax for products made in China and 1,7 EUR/W to 3,5 EUR/W for products from Europe, the USA, or Japan.

For solar tiles (sourced in Europe), the retail price is of the order of 3,5 – 4,0 EUR/W net of tax.

1.5 Funding of photovoltaics

Public initiatives structure and support the expansion of the market: these take the form of a feed-in tariff, with a highly specific orientation towards building integration, together with a range of tax incentives supporting private individuals and companies.

A supply contract is underwritten for a period of 20 years between each electricity producer and the distribution company (essentially ERDF).

Other measures are in place to complete these incentives:

- Income tax credit of 25% of the amount of the investment in photovoltaic system goods (this was 50% until 29 September 2010), up to a cap of 8 000 EUR per taxpayer (16 000 for a couple);
- For off-grid systems, the ADEME-FACE contracts.
- Regional and Local aid (variable as a function of regions)

In the field of research, the National Research Agency (ANR) provides financial support for photovoltaic projects (10 to 12 each year), for the development of emerging PV segments and promoting public/private partnerships.

ADEME is also providing support for R&D projects oriented towards solutions for integrating the photovoltaic modules into the structure of buildings (the RESSOURCES programme), and is supporting demonstrator programmes. It also continues to give its support for developers of PV projects (PHOTON and PHOTON RÉSEAU training courses). Internationally, ADEME continues to work with its partners on cost-shared projects within the International Energy Agency (AIE/IEA), particularly in working groups nos. 1, 2, 9, 10, 11, 12, and 13. Similarly, it has funded an operating agent for the animation of standardisation activities undertaken by the International Electrotechnical Commission (CEI/IEC) on rural electrification using renewable energy sources. (IEC 62257 specifications series).

Just as in previous years, French regional councils are active in providing their support for photovoltaic installations through targeted tenders in which energy efficiency and solar energy must be linked.

2 Implementation of photovoltaic systems

2.1 Applications

In the French market, applications may be classified in the following manner:

- **Off grid applications** (the historic basis of the photovoltaic market in France)
 - Domestic applications
 - Professional applications
- **Applications connected to the grid**
 - **Distributed:**
 - Applications for individual dwellings (≤ 3 kW): this segment represents 91% of the total number of installations and 42% of the installed capacity
 - Applications in apartment blocks (from 3 kW to 120 kW, approximately 8% of all installations in number and 18% of the installed capacity)
 - Applications on tertiary and industrial buildings (from 120 kW to 250 kW) which represents 0,5% of the number of facilities, but 20% of the installed capacity
 - **Centralised**
 - Solar power plants on the ground (≥ 250 kW), for 19% of the installed capacity

2.2 Installed capacity

Table 2: Installed capacity in 2010

Applications	off grid (domestic)	off grid (business)	grid- connected (distributed)	grid- connected (centralised)	TOTAL
Installed capacity in 2010 (kW)	146		582 390	133 610	719 146

Source: Systèmes solaires-April 2011

**Table 3: Share of the photovoltaic segment in the electrical energy system in France
(year 2010)**

Share of the total capacity of all installed PV facilities in total electricity production capacity in France 2010	Share of the capacity of all installed PV facilities in total investment in electricity production in the year 2010	Share of PV production in electricity consumption for the year 2010
Total capacity: 123,5 GW (*) PV Capacity: ~1 GW, or < 1%	Increase in electricity production capacity: ~3 100 MW (**) Increase in PV capacity: ~720 MW	Gross domestic consumption: 513,3 TWh PV Production 2010: 0,6 TWh, or ~0,1% (capacity at end 2010: ~1 TWh)

(*) Source: Centre d'information du réseau électrique français –January 2011

(**) Source: Les Echos-January 2011

Table 4: Cumulative capacity installed in France, by application

Application	31 Dec. 2003 kW	31 Dec. 2004 kW	31 Dec. 2005 kW	31 Dec. 2006 kW	31 Dec. 2007 kW	31 Dec. 2008 kW	31 Dec. 2009 kW	31 Dec. 2010 kW
off grid (domestic sector)	11 924	13 024	13 844	15 015	15 881	22 947	29 200	29 346
off grid (business sector)	5 332	5 932	6 232	6 539	6 666			
grid-connected (distributed production)	3 817	7 067	12 967	22 379	52 685	140 785	247 860	830 250
grid-connected (centralised production)	0	0	0	0	0	16 000	58 140	194 250
TOTAL	21 072	26 023	33 043	43 933	75 232	179 732	335 200	1 054 346

Sourced from: preceding NSR 2003-2008 reports; Observ'ER for 2009 and 2010 – April 2011

Figure 1 illustrates the growth of installed capacity from 2003 to 2010.

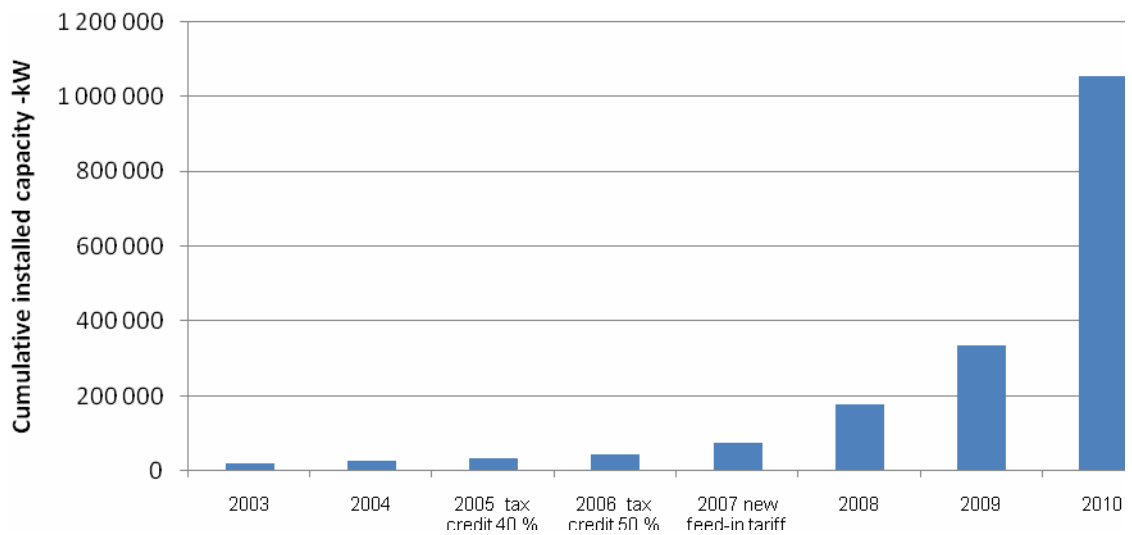


Figure 1: Cumulative installed capacity from 2003 to 2010

“Off grid” type applications, which represented 50% of the market in 2005, and which contributed considerably to the development of the know-how in studies and engineering in France are today in a completely marginal situation, as is illustrated by Figure 2 which shows the growth of the applications as a percentage of the total number of facilities in France from 2003 to 2010.

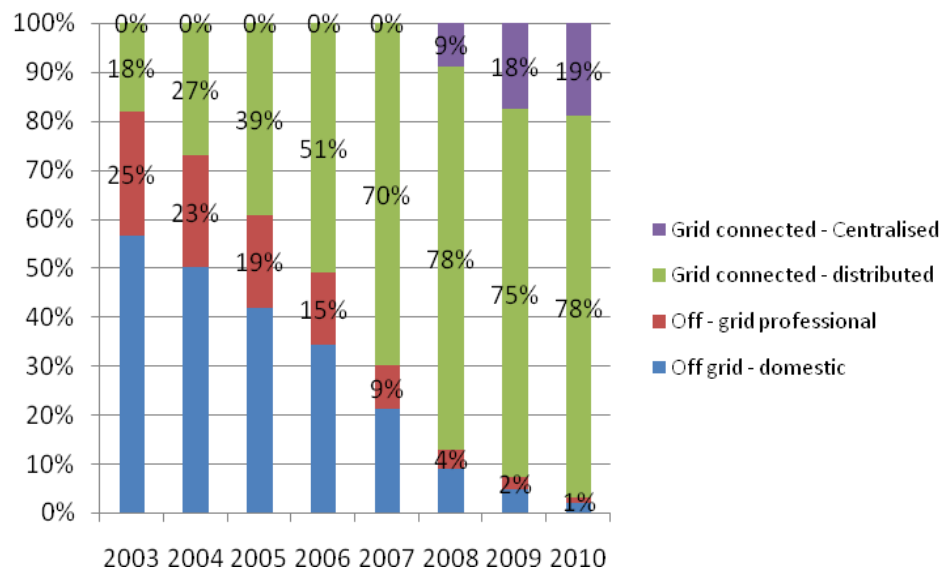


Figure 2: Trend of applications in installations between 2003 and 2010

The geographical location of the grid-connected installations at the end of 2010 (~ 973 MW), is illustrated in Figure 3:

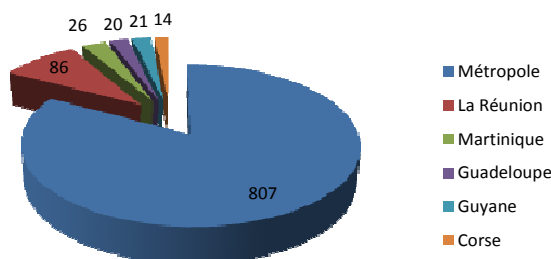


Figure 3: Geographical distribution of the power of the grid-connected segment (MW)
 The evolution of the grid-connected segment over the last four years is also differentiated by area, as is illustrated in Figure 4.

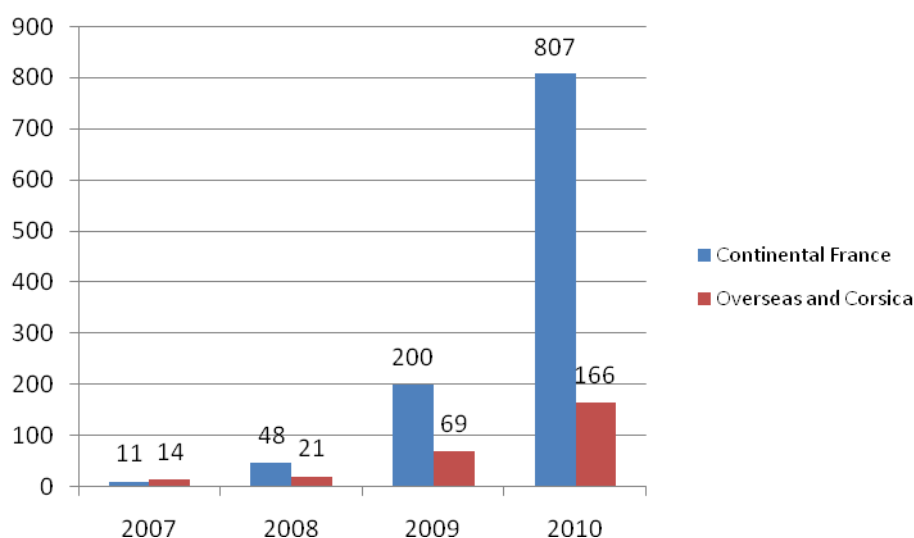
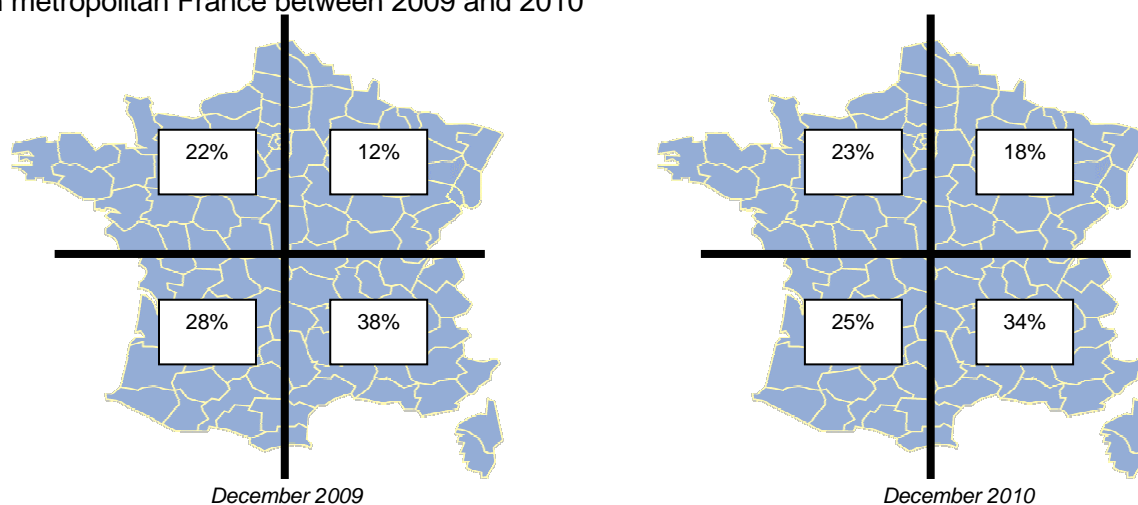


Figure 4: Evolution of grid-connected power over the entire country (MW)

Figure 5, below, illustrates the change in the geographical distribution of the grid-connected segment in metropolitan France between 2009 and 2010



Source: SER 2009 and 2010

Figure 5: Geographical distribution of grid-connected power in metropolitan France (December 2009 and December 2010)

Change can also be seen on a technological level.

Based on an inventory of installations with a power of greater than 100 kW, in service or rolled-out but awaiting grid connection as of end September 2010 (~700 installations), the nature of the technologies employed in the construction of such power plants has changed since 2007, as is shown in Figure 6.

Source: *Systèmes solaires*

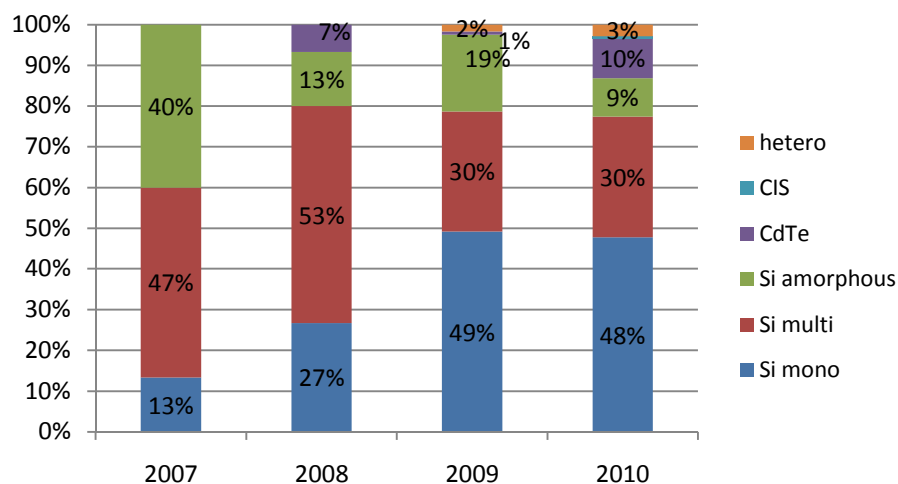


Figure 6: Changing technologies employed in the construction of plants with installed capacity > 100 kW

2.3 Key features of the roll-out of the PV segment

2.3.1 The growth of the grid-connected segment

The number of facilities connected to the grid has increased considerably over the last four years (cf. Figure 7).

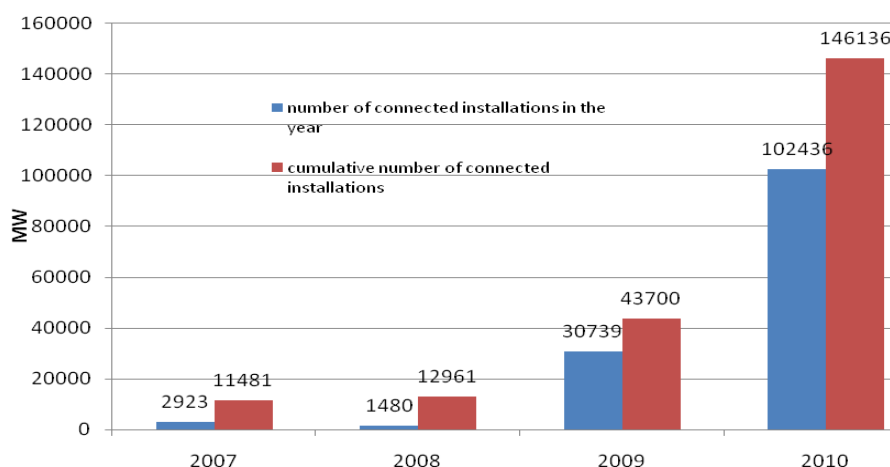


Figure 7: Growth in the number of facilities connected to the grid from 2007 to 2010

Source: *SER, after ERDF*

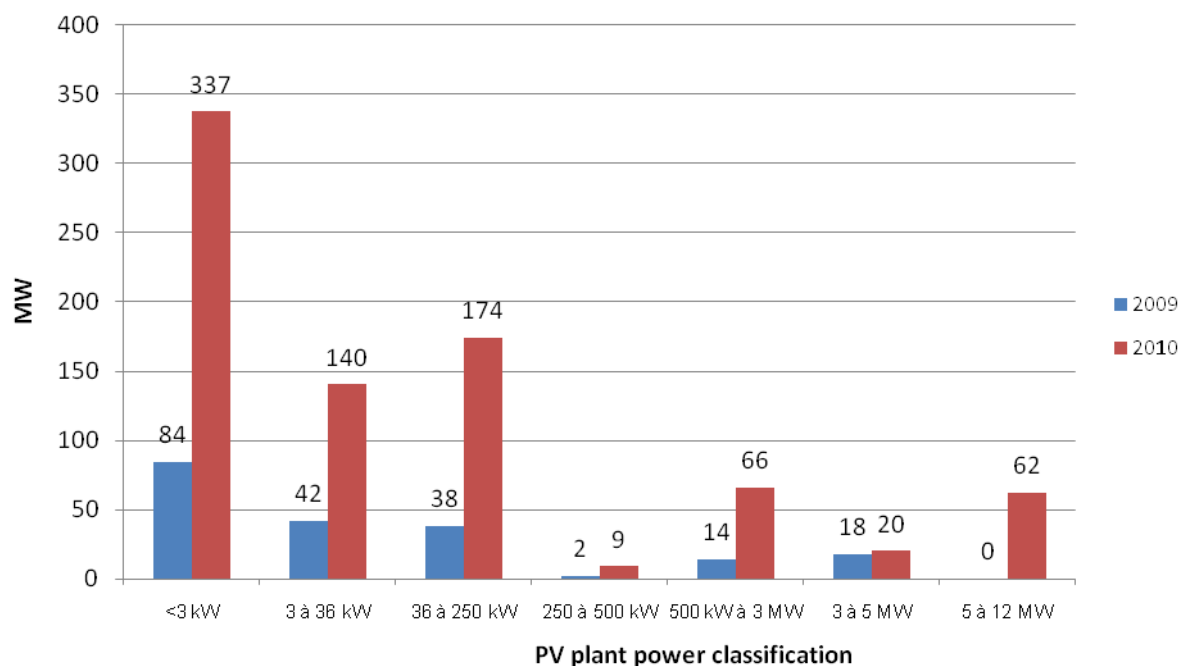
Measures have been put in place to improve waiting times for registration, specifically with the reduction in the steps required from five to two.

According to Enerplan, a professional association, taking the total of grid-connected installations as of the end of 2010 as the basis, if all applications for connection had become actual installations, the photovoltaic capacity would be 5,12 GW. It would then have appeared that the fulfilment of the objectives of the Grenelle Environment Forum (a capacity of 5,4 GW and 1% of annual electricity consumption sourced from the photovoltaic segment) was realized.

Other than the renewed enthusiasm of the general public for installing systems on roof-tops, the year 2010 was marked by the development of large capacity PV power station projects (ground installations and large roof-top installations).

Figure 8 shows the growth of grid-connected facilities between 2009 and 2010 by installed capacity.

The figure shows the growing share taken by large-sized PV systems.



Source: SER

Figure 8: Change in the distribution of power of grid-connected installations between 2009 and 2010

The heavy demand from private individuals and investors has run up against the capacity of the national operator (ERDF) to absorb all of the applications for connection to the national grid. As at 31 December 2010, about 75 000 systems were awaiting connection throughout France (metropolitan and the overseas territories), with a potential of an additional 4 150 MW installed capacity.

2.3.2 Changes to the feed-in tariff

But the most significant feature of 2010 was the position taken by the government in their support policy for the sector: the government began to fear that abusive practices would appear around the existing feed-in tariffs, and at the end of the year 2009 announced a revision of the feed-in tariffs for the beginning of the following year.

This announcement led to a race to submit projects by developers who wished to benefit from the old rates before they were modified. The new feed-in tariffs came into force in March 2010, with retroactive effect for installations coming on line after 15 January 2010. A further downwards revision of the feed-in tariffs occurred in the month of August 2010, effective from 1st September 2010. A drop of an average of 12% in the feed-in tariffs was put into effect, justified by the sharp fall in the prices of photovoltaic equipment.

Table 5 traces the change in tariffs occurring over the course of the year 2010

Table 5: Changes to the feed-in tariff between 2009 and 2010 (EUR cents/kWh)

Type of facility		Location	2009	2010		
				2010-1 (*)	2010-2 (**)	2010-3 (***)
Not integrated		Mainland	32,823	31,502	31,502	
		Corsica and overseas territories	43,764	42,002	42,002	
Integrated into the building	Households <3 kW	Mainland	60,176	57,753	57,753	58,000
		Corsica and overseas territories				44,000
	Households > 3 kW	Mainland, Corsica and overseas territories			50,000	51,000
	Educational establishments					
	Healthcare institutions					
Others	44,000					
Simplified integration into buildings	all buildings	Mainland Corsica and overseas territories			42,000	37,000
Ground-level plants		Mainland (North)			37,680	33,120
		Mainland (South)			31,400	27,600
		Corsica and overseas territories			40,000	35,200

(*): from 01/01/10 to 15/01/10

(**): from 16/01/10 to 02/09/10

(***): from 02/09/10

Source 1: from "Le baromètre Observ'ER 2010 des énergies renouvelables électriques en France"

Source 2: after www.photovoltaique.info –January 2011

Furthermore, a reduction in the tax credit for private individuals from 50% to 25% took place in September, and was applicable as from 1st October 2010, (this rate will be reduced to 23% in 2011)

2.3.3 Moratorium on the obligation to purchase

A decree was promulgated on 9 December 2010 to suspend the obligation to purchase photovoltaic electricity for a period of three months. This suspension affects photovoltaic facilities with a power greater than 3 kW, where the producer has not notified the grid operator of their acceptance of the technical and financial proposal (PTF) for connection to the grid before 2 December 2010.

By means of this moratorium, the government wished to start a forum to debate the lowering of feed-in tariffs or the implementation of a quotas system. Discussions brought together players in the photovoltaic industry, elected representatives, and representatives of consumer groups and environmental associations, who started talks on 20 December in order to come up with a new regulatory framework during March 2011 ensuring visibility for the players in the field.

An analysis carried out by the grid operators, ERDF and RTE, revealed the projects impacted by the decree of 9 December. According to this data, 7 389 projects were impacted by the moratorium, with a potential installed capacity of 2 053 MW.

Pending a new regulatory framework for the construction of ground-level solar power plants, EDF Energies Nouvelles suspended their planned strategic alliance with First Solar for the implementation of a factory of 130 to 150 MW using CdTe modules close to Bordeaux. Under the provisionally suspended partnership it was planned that First Solar would undertake to construct the factory, while EDF Energies Nouvelles would in turn undertake to purchase the entire production for a period of ten years.

Furthermore, the call for tenders launched by the government in 2008, for the construction of a total of 300 MW distributed over 27 regional power plants between then and 2011 was declared void.

2.4 Research and development

2.4.1 Public sector partners

The Agence de l'Environnement et de la Maîtrise de l'Énergie (the French Agency for the Environment and Energy Management) is the organisation which has historically funded development and promotional activities in photovoltaic power in France. Since 2005, both national and regional initiatives have been launched, to strengthen ADEME' actions. The creation of the National Research Agency (ANR) and the OSEO Agency has made it possible to scale up R&D activity.

The ADEME has two role in R&D support namely:

- It plays a coordinating and funding role for R&D through its demonstrator and technology platform programme, the objective of which is to carry out operations on a virtually life-size scale and demonstrate their technological effectiveness. The fund is managed by a committee on which the Ministry of Ecology and Sustainable Development, the Ministry of the Economy, and the Ministry of Education and Research all sit, through road maps which call for demonstrations of interest.
- Furthermore, the ADEME supports the emergence of start-ups, in particular in the field of thin films (SOLSIA, and NEXCIS in the CIS). The ADEME also continues to provide support for the training of fitters working on projects (PHOTON and PHOTON NETWORK training programmes).

ADEME has a strategy for supporting the development of the French market which is structured around five different areas:

- Encouraging the design of photovoltaic construction materials as part of the PREBAT programme (a research and design programme set up under the 2004 Climate Plan aimed at developing synergies between the efforts put into various different programmes such as Bâtiment 2010, Foundation for Energy Building Research, the European technology platform, and the 6th and 7th PCRD - Framework Programme on Research and Development);
- Participating in the funding of high-profile model operations such as grouped operations with a high architectural and educational added-value;
- Developing a method to permit factoring photovoltaic energy into the economics of buildings;
- Reinforcing quality and performance control of installations;
- Monitoring closely how photovoltaic power is included in the development of thermal regulations;
- Studying the implementation of financial tools designed to accelerate the growth of the market (low-interest loans, bridging loans, etc.).

The Agency acts at several different levels in its mode of operation:

- Cooperation between funding partners;
- Training and the dissemination of information;
- International action.

The task-sharing between ADEME and ANR means that ANR deals with upstream research and development, on a pre-manufacturing level, while ADEME is entrusted with the role of supporting technological development in industry targeted at placing new commercial products on the market.

In 2008, the ANR launched a new 3-year research programme. They decided to merge research work on construction and photovoltaics under a single programme known as HABISOL in order to highlight the importance of integrating photovoltaic systems into buildings (see paragraph 2.4.2)

In parallel with the action of the ANR, a major industrial project caught the attention of the public authorities in 2008: The Solar Nano Crystal R&D programme (2008-2012). The OSEO and the ADEME pooled their funding in order to get this ambitious project under way (see Table).

The regional councils in France are also playing a very active role in providing support for photovoltaic installation projects through targeted invitations to tender, which involve energy efficiency and solar power. It is important to note that competitiveness clusters - regional initiative clusters bringing together manufacturing business and public sector bodies - are also involved in research activities.

2.4.2 Technological research and development

Research in the photovoltaic sector is principally led by the French National Solar Energy Research Institute (Institut National de l'Énergie Solaire - INES) with 250 researchers in 2010, which was created in 2006, and the Photovoltaic Energy Research and Development Institute (Institut de Recherche et Développement sur l'Énergie Photovoltaïque - IRDEP) with 45 researchers in 2010, which was created in 2005; to these we must add twenty or so teams from the National Scientific Research Centre (Centre National de la Recherche Scientifique - CNRS), which are based throughout the country.

A proposal is under consideration to regroup IRDEP with other R&D establishments by creating a Solar Institute which would use IRDEP to focus:

- The Interface and thin film physical laboratory (CNRS-École Polytechnique)
- The R&D teams from Total
- A Master's degree from the École Polytechnique and Paristech,

all of which currently represent a staff of 150 people, with the purpose of setting up a structure of between 200 and 250 people, including the recruitment of foreign researchers, all brought together on a common site in the region of Paris.

The Ministry of Research is thinking along the same lines, with a proposal for a scheme to guide R&D in the photovoltaic field, based specifically on:

- Clarification of the positioning of the various different centres (upstream research/technology and integration research)
- Harmonised management of these two classes of research centres
- Enhanced partnerships with manufacturers

Recommendations have been prepared by the Mission in respect of the regulation and the development of the photovoltaic sector in France, so that a debate may be conducted in the same direction on the link between the funding organisations (ADEME, ANR, OSEO) and the implementation of a global R&D strategy in the sector.

The INES research programme in the photovoltaic field bears on cells, modules, systems, and storage.

The INES is working on two lines of innovation under the umbrella of the PV Alliance programme:

- the improvement of the performance of multicrystalline silicon-based cells produced by Photowatt, in a "Labfab" pilot unit of 25 MW.
- The development of high-performance heterojunction cells on their own site, in association with the Korean equipment maker Jusung, with the target of being able to set up a "Labfab2" of 25 MW within two years.

The work of IRDEP, based in the thin-film field, principally covers the reduction of the manufacturing costs of PV modules, the improvement of photovoltaic conversion ratios, and thin films deposition process.

The fields of research are currently under way:

- CIS thin-film technology
- very high performance cells (multi-junction cells)
- Research into new structures (hybrid nanostructure cells, transparent oxide conductors)

The HABISOL programme, funded by the ANR (the National Research Agency) for the period 2008 - 2010 has the objective of mobilising the scientific community and manufacturers in the sector to respond to the very ambitious challenge of energy savings in buildings. Three complementary approaches are being developed within the programme:

- The method of energy management in the home;
- Energy efficiency and development of the use of renewable energies in buildings;
- Development of photovoltaic systems in order to standardise its use in buildings.

11 new R&D projects were selected in 2010 to round off the 24 projects supported since 2008.

OSEO supports important programmes devoted to different technologies: homojunction silicon, heterojunction silicon, thin film, organic cells, as shown in Table 6.

Table 6: Main Programmes supported by OSEO in the Photovoltaic Sector

Programme	Period	Objective	Partners
Solar Nano Crystal	2008-2012	Reduce the costs of basic materials by producing photovoltaic quality silicon directly. Develop high performance technologies by the use of nanotechnologies in the thin film silicon segment	PV Alliance (Photowatt International, EDF Energies Nouvelles, CEA-Valorisation), Emix, Photosil, Apollon Solar, INES (*)
PV20	2010-2012	Rethink the whole crystalline silicon module production chain such as to obtain a module 100% made in France at a competitive price	MPO , Emix, Semco, Tenesol, INES
SOLCIS	2010-2012	Set up a manufacturing segment based upon the CIS technology, with: <ul style="list-style-type: none"> • as first generation of glass-glass modules based upon a mixed procedure of electro-deposition couples with annealing at atmospheric pressure • a second generation of CIS with a reduced production cost and with an innovative encapsulation procedure, intended for light-weight roof products 	Nexcis , Semco, Impika, Amlitude systèmes, Komax, Solems, Rescoll, CNRS, Armines, Enthone, Arkema, with non-financial support from IBM and ST Microelectronics
OSCAR	2010-2013	Produce organic photovoltaic films (OPV) from active materials and innovative substrates, making use of industrial printing techniques	Armor , INES, LCPO, Plasto, Alca Packaging

(*) Created in September 2007, PV Alliance is a joint subsidiary of EDF ENR, Photowatt International, and CEA, the mission of which is to develop and then produce high-performance cells. In order to attain their goals, PV Alliance is partner and leader of a 5-year research programme: Solar Nano Crystal This project enjoys the support of local community councils and the national government, and includes 7 partners. It is expected that this project will result in the construction of sites for the production of two types of cell: high-performance silicon cells based upon metallurgically purified silicon, and very high-performance cells using heterojunctions, by implementing nanotechnologies.

PV Alliance will initially operate a pilot unit (25 MW) the purpose of which is to qualify and validate the technological innovations emerging from the laboratories in particular the INES, using representative equipment of the industry and significant quantities.

Another major R&D programme is the POLYSIL project, which is funded by the ADEME, the Rhone-Alpes Region through the EFRD (the European Fund), and the General Directorate for Competitivity, Industry, and Services (DGCIS) via the French inter-ministerial fund for innovation (FUI), which was launched in December 2009. The POLYSIL Project is focused upon the industrial development of a thin-film photovoltaic technology, and has the goal of providing France with a cutting-edge industry of global importance in the thin-film photovoltaic market. A young start-up, SOLSIA, is coordinating the work programme set up between the laboratories and the companies. This project is based upon the joint use of polymorphous and micromorphous silicon.

The following projects should also be noted:

- The research carried out by APOLLON SOLAR and INES in the development of a new design of modules which do not require the cells to be encapsulated, and simplify the production of contacts. (NICE Procedure). Modules produced on the INES pilot line have passed their IEC 61215 and IEC 61730 certification tests successfully.
- The SOLAR JET project (Ardeje, CEA-INES, Hutchinson) for the development of printed cells (for very low-cost energy)

- The SOLION project, for the development of photovoltaic systems incorporating a storage function.
- In the area of the recycling of modules, the VOLTAREC project, led by the RECUPYL company. VOLTAREC includes 2 major businesses, one regional agency, and 2 laboratories.

2.5 Funding for R&D, for demonstration programmes, for market stimulation activity

Table 7: Public funding

	R&D	Demonstration programmes	Market stimulation
At the national level	Approx. 43,5 MEUR		see text
At the regional level			see text

2.5.1 National market stimulation activity

Financial incentives

Since 2006, the development of the French market has been marked by the increase in the feed-in tariff of photovoltaic electricity, initiated in 2002. It was this “feed-in tariff” signal which suddenly placed France among the top ten markets for photovoltaic electricity in the world.

An incentive measure reinforced by the sustainable development tax credit instituted in 2005 to the advantage of households, and regulations favouring investment in SMEs. (25% of the value of the real investment as from September 2010).

The government has confirmed a feed-in tariff for electricity from photovoltaic sources which is shown here in Table 8.

This tariff has been set up following the typologies of installations defined at the beginning of 2010 by the Ministry of Ecology, Energy, Sustainable Development and the Sea:

- Building-integrated: the modules replace all or part of the roof of the building on which they are installed
- Simplified integration: the modules are placed on/fixed to the roof
- Ground mounted systems: the modules are placed on structures on the ground

Source: Certisolis press notice of 18 November 2010

Table 8: Tariffs for the purchase of photovoltaic electricity as from 1 September 2010 (EUR/kWh)

Type of integration	Location		Application		
			Housing	Educational and healthcare buildings	Other types of buildings
Building-integrated (installations < 250 kW)	Mainland		New and existing: • P < 3 kW : 0,58 • P > 3 kW : 0,51	Existing for less than 2 years : 0,51	Existing for less than 2 years : 0,44
Simplified building-integration	Mainland / Corsica and overseas territories		As from 2011, for P < 3 kW : 0,37	0,37	
Not integrated (including ground-level plants)	Mainland	France (North)	0,3312		
		France (South)	0,276		
	Corsica and overseas territories		0,352		

Source: Enerplan

The major difficulty produced by the tariff for building-integration lies in the delimitation of the equipment which can enter this category.

A committee has been charged with examining the acceptability of the technical solutions classed as “building-integrated” on the basis of the definition of the rules for eligibility for the premium for building-integration, and for the premium for simplified building-integration enacted by the Ministry for Ecology, Energy, Sustainable Development, and the Sea, which is responsible for green technologies and climate negotiations.

This Committee for the Evaluation of Building-Integration (CEIAB) is examining the procedures for the incorporation of photovoltaic systems submitted to them, in order to determine whether or not they satisfy the criteria for integration or simplified integration into the construction, in the meaning of the new Ministerial Order on tariffs of 31 August 2010. It maintains an updated list of procedures which satisfy the technical criteria for incorporation and simplified incorporation into the construction which is freely accessible.

The following administrative obligations (see Table 9) which were set up at the end of 2009 came into effect in 2010.

Table 9: Formalities to be observed for the implementation of systems

Characteristics of the system	Formalities				
	No formalities	Prior declaration	Construction permit	Impact study	Public enquiry
Outside protected conservation areas					
P < 3 kW + H ≤ 1.80 m	X				
Inside protected conservation areas					
P < 3 kW + H ≤ 1.80 m		X			
All areas					
P < 3 kW + H > 1.80 m or 3 kW < P < 250 kW		X			
P > 250 kW			X	X	X

Technical incentives

In its calls for declarations of interest intended to promote R&D projects, the Government was looking for research demonstrators, pre-manufacturing demonstrators, and technological platform demonstrators to emerge, so as to support the achievement of the following objectives:

- “Factory door” costs of photovoltaic modules less than 0,50 EUR/W
- The costs of residential roof-top systems installed at the client less than 2,00 EUR/W.
- The costs of installed ground-mounted systems less than 1,50 EUR/W
- A supply of electricity to the final client observing the constraints of security and continuity of supply, where the cost is lower than 150 EUR/MWh in an average sunny area.

2.5.2 Regional and local initiatives

As the ENERPLAN Association points out, the role played by the regions and local community councils in the development of this market is important. Indeed, being close to the ground, these councils are in a position to verify what types of initiatives or support are truly effective. They also benefit from the development of this sector, both from the increased local industrial fabric and from the financial aspect, and even from the enhancement of the image of being good eco-citizens.

By way of example, we may point out the installation of 1 MW of shading at a car park in Montpellier, designed by HELIOWATT, a design and engineering office 48% owned by AEROWATT in partnership with the Alès College of Mines, and thanks to the support of Innov’up, of the Languedoc Roussillon Region, and OSEO.

For its part, the Rhone-Alpes Region has launched an call for projects intended to support grid-connected facilities projects *“clearly presenting their nature as demonstrators and a genuine interest in the development of the sector”*. This appeal is of interest to the tenants of social housing, councils with less than 50 000 inhabitants, energy distribution consortia acting on behalf of communities, regional parks, SMEs, and associations.

As from 2006, “permanent” regional and local aid has taken a range of different forms, as is shown in Table 10, based upon the inventory drawn up by the ENERPLAN Association (www.enerplan.asso.fr).

Table 10: Summary of the forms of regional and local aid to the funding of photovoltaic systems

Aid distinguished by:	Examples
• The population or the type of project which is the beneficiary	private projects, collective facilities, off-grid sites, grid-connected electricity generation
• The framework for processing the application for aid	on request from the beneficiary, only by tender, on the initiative of a purchasing group
• The parameters employed to define the amount of the aid	installation cost, labour cost, cost of the installed W, % of the installation cost, % of the installation labour, forecast energy produced per year, forecast energy produced in the first year
• Conditions for award of aid	principal residence, building-integration,
• Data for defining a potential ceiling to the aid	resource conditions, amount of investment, installed capacity, amount per W
• Ranges of value	example of a private individual, by the form of aid, by region: <ul style="list-style-type: none"> • from 700 to 1 000 EUR on the total cost of the investment • from 300 to 1 300 EUR on the installation labour • 10% to 30% of the installation cost • 1 EUR/W to 2 EUR/W • 0,10 EUR/kWh per year to 0,20 EUR/kWh per year

Source: after ENERPLAN

2.5.3 Other support for the photovoltaic sector

Centres of competitiveness

Three of the 66 centres of competitiveness set up in 2005/2006 are developing photovoltaic initiatives:

- Tenerrdis in the Rhône-Alpes Region
- Derbi (“Development of Renewable Energies in Buildings and Industry”) in the Languedoc-Roussillon Region
- Capenergie in the Provence – Alpes – Côte d’Azur region

Each centre receives funding from OSEO/AII, ANR, ADEME, and the local councils depending on the interest carried by the projects submitted.

Professional bodies /associations

Companies involved in consulting, market studies, training, technical studies, project management are supporting the development of the segment. Associations and professional organisations such as ASDER, CLER, ENERPLAN, SER, HESPUL are very active in promoting photovoltaic systems, and in organising links with the market and the public authorities.

Events

Several major events are held over the course of the year for the purpose of promoting photovoltaic technology and applications.

After a “Solar Event Family” organised in June and orientated towards the general public, “SOLAR MEETINGS” conferences for professionals are held in Savoie in the month of November; intended for researchers, promoters, architects, companies in the sector, etc., these meetings, organised by the regional players in Rhône Alpes, have had the goal of providing an update on the situation of the market, presenting problems and advances in the research in the field, and promoting business opportunities.

The 4th edition of the ENERGAIA show welcomed 30,000 visitors to Montpellier from 8 to 11 December. This international event brought together 400 international exhibitors and offered a vast programme of conferences, colloquia, forums in employment, and business link organisations.

PV Legal, a European project begun in July 2009, has the purpose of reducing administrative barriers to the photovoltaic market, so as to reduce the connection time of a PV facility to the electricity grid. In this respect, on 25 November, the SER-SOLER professional association and the Association ENERPLAN organised a conference on the topic of the "Perspectives and barriers to the deployment of photovoltaic systems in France and in Europe". Nearly 150 players in the photovoltaic field took part in this working conference.

Furthermore, associations which promote the renewable energy sector (CLER, ENERPLAN) once again organised “open-doors” days, allowing thousands of people to visit photovoltaic facilities and meet the professionals. The enthusiasm of the general public is real, drawn by these opportunities to learn more about the field and seduced by measures from the national government and the regional incentives.

European solar days, held in May and organised by Enerplan with the support of the ADEME, Qualit’EnR, EPIA, and ESTIF, put the closeness, the commitment, and the initiative of the local authorities in favour of solar solutions in the limelight.

ENERPLAN has also set up a prospective plan, open to all, called “France Solaire 2.0”, intended to analyse the 2020 horizon for solar energy in France on the technological and socio-economic levels, and employment, urban planning, etc.

Training initiatives

A company, Blue Green Energy, has chosen to develop photovoltaic plants with a heavy pedagogical dimension. Attracted by this initiative, the Crédit Coopératif provided support for the company in funding its first installation in France on the roof of a school, close to Limoges. This

initiative is meant to result in the establishment of a permanent system of citizen finance for photovoltaic plants.

3 Industrial activities

All of the business activities which make up the crystalline photovoltaic value chain are continuing to become established.

Two sections can be distinguished in the PV sector:

- An “upstream” section: from the manufacture of the photovoltaic material to the production of the photovoltaic modules
- A “downstream” section: this involves the integration of modules into systems (design and production), the integration of the systems on the ground, and their operation.

Table 11 illustrates the distribution of the activities carried out by the French players in the field (certain players are present at several stages).

Table 11: The value chain of the French PV sector in 2010

Numbers of companies present in the various different stages of the value chain:

“Upstream” section of the value chain				“Downstream” section of the value chain			
Production of ingots	Production of wafers	Production of cells	Production of modules (mc-Si and a-Si)	Assemblers	Engineering and Design Offices	Installation	Operation
		1		~22	~32	~6 000	> 20
1	1		9				

Source: Observ'ER- Baromètre 2010

3.1 Technology segments

3.1.1 The crystalline silicon segment

Production of silicon

A segment is being developed with the PHOTOSIL project, in which FERROPEM (FERRO ATLANTICA, the world number one in metallurgical grade silicon), INES (the French National Solar Power Institute), and equipment manufacturers are in cooperation. A pilot workshop (with a capacity of 200 Tn per year) has been built in Bourget du Lac, close to the premises of INES (National Institute for Solar Power)

The procedure consists of removing certain impurities, in particular boron, using a plasma torch developed by the CNRS. The aim is to be able to commercialise solar quality silicon at a price in the order of 25 EUR/kg.

The results obtained to date in obtaining solar quality silicon make it possible to obtain cell performance of greater than 16%. The pre-production manufacturing stage in the Rhone-Alpes region is scheduled for 2011.

Production of ingots and wafers

In

Table 12 the industrial players for the manufacture of ingots are listed with the characteristics of their production.

Table 12: Production and production capacity for ingots and wafers - France 2010

Producer	Technology	Production	Installed capacity	Destination of the products
PHOTOWATT	mc-Si ingots	600 tonnes	1 000 tonnes	Own requirements for the production of wafers and then cells
EMIX	mc-Si ingots	80 tonnes	360 tonnes	France and export
PHOTOWATT	mc-Si wafers	equivalent to 70 MW	equivalent to 70 MW	own requirements

mc-Si: multicrystalline silicon

PHOTOWATT

Photowatt International S.A.S. is a subsidiary of the Canadian group ATS, based in Bourgoin-Jallieu, close to Lyon.

Photowatt was launched in 1978, and its business covers all stages in the photovoltaic sector, extending from the production of silicon in ingots to the design of systems and the supply of turn-key solutions “grid-connected systems, residential roof-top systems, and industrial and agricultural building, and turn-key solar plants). Photowatt employs all of the ingots it produces to manufacture the equivalent of 70 MW of wafers.

Photowatt is a partner and a shareholder in PV Alliance, which includes EDF ENR and the CEA, for research and development of new photovoltaic cells.

EMIX

EMIX, is a company which employs 30 people in the production and sale of silicon ingots, located at St Maurice-La Souterraine, Creuse.

The principle of the procedure which has been used by EMIX since 2004 is the continuous drawing of silicon from a cold electromagnetic crucible. Using this procedure it is possible to produce silicon ingots with a multicrystalline structure. It is differentiated from conventional procedures in that it is a continuous process with high productivity which is easy to operate and very highly automated.

The principle advantages of this technology are as follows: the homogeneous quality of the ingots, a yield of material of up to 50 wafers per kg, a process suitable for UMF silicon, a concentration of metallic impurities 100 times reduced, no degradation of the crucible (reduced consumable costs, no pollution of the silicon, low energy consumption (10 kW per kg), a process which is kind to the environment (with no liquid or gaseous wastes).

Investments made over recent years have permitted the company to increase their annual production capacity to 360 Tonnes per year, which corresponds to approximately 60 MW per year.

The orientation of the company's R&D is focussed on the purification of metallurgical silicon (manufacturing pilot schemes), increased productivity (50 kg/hr), and increased ingot sections (400 mm x 400 mm).

The production of modules

Table 13 lists the main manufacturers which produce modules and the characteristics of their production capacity.

Table 13: Si-c module production capacity - principal manufacturers - France 2010

Producer	Technology	Installed capacity (MW)	Year started
PHOTOWATT	Multicrystalline	70	1984
TENESOL	Mono and Multicrystalline	85	2005
AUVERSUN	Mono and Multicrystalline	22	2009
SUNLAND 21	Monocrystalline	35	2009
SILLIA	Mono and Multicrystalline	50	2009 + 2010
FONROCHE	Mono and Multicrystalline	90	2009
SYSTOVI	Monocrystalline	26 (beginning 2011)	2009
SOLAREZO	Monocrystalline	60	2009
VOLTEC SOLAR	Mono and Multicrystalline	25	2010
FRANCE WATTS	Mono and Multicrystalline	5	2010
ELIFRANCE	Mono and Multicrystalline	20 (beginning 2011)	2010
KDG ENERGY	Mono and Multicrystalline	25	2010
TOTAL		approx. 525	
<i>forecast capacity</i>			<i>developments in progress</i>
• <i>Projet PV20</i>		80	
• <i>LabFab</i>		25	

Source: Photovoltaic manufacturers' year book and press articles

The LabFab pilot unit of the PV Alliance consortium (Photowatt-CEA-LITEN, EDF Energies Réparties) has been set up with transfers of technology from research to industry, to achieve a final result of developing an installed production capacity of 2 units of 100 MW, one for the production of cells based on purified metallurgical silicon, and the other for the production of very high yield cells (>20%) using the "heterojunction" technology which combines crystalline silicon with nanotechnologies.

Elsewhere, a production unit to have a capacity of 78 MW in 2012 is being installed, as part of the PV20 Project (an OSEO programme) led by MPO-ENERGIE, in which the manufacturers TENESOL and SEMCO Engineering (diffusion ovens, turnkey production lines) are participating. The objective is to reach a point of setting up a production process for modules which are 100% made in France, at a reduced cost.

The considerable progress in manufacturing capacity for the production of modules is illustrated in a striking manner in Figure 9, below.

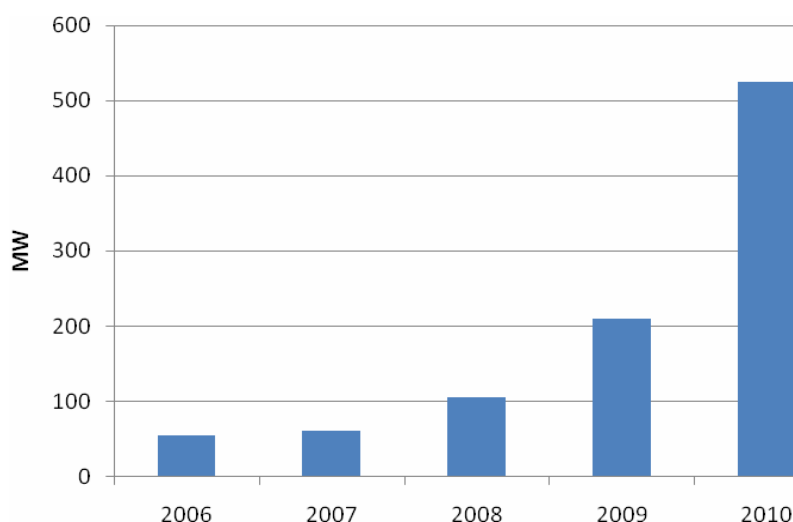


Figure 9: Evolution of capacity for the production of Si-c modules in France (2006-2010)

PHOTOWATT INTERNATIONAL

Using silicon produced in their own factory, PHOTOWATT is producing cells and then modules (with an annual capacity of 70 MW).

In the framework of the PV development policy followed in France, part of the production is devoted to BIPV (products to be incorporated into roofs or façades), in development partnerships with other companies (incorporating PV into tiles by IMERYS, using the SOLRIF framework).

TENESOL

With close to 1 000 employees, TENESOL is strongly represented in metropolitan France and has several installations throughout Europe, Africa, the Middle East, and America.

This year, the Group increased its production capacity in the two manufacturing sites located in France in Toulouse, and in the Cape in South Africa. The overall annual capacity will be taken up to 170 MW.

In addition, TENESOL and AGC Glass Europe, the glass manufacturer, got together to produce crystalline silicon BIPV modules.

AUVERSUN

AUVERSUN is a company which manufactures monocrystalline and multicrystalline silicon modules at its plant in Clermont Ferrand using cells sourced in Europe (an annual production capacity of 22 MW) AUVERSUN designs and manufactures made-to-measure solutions using their own product (kits for private individuals, agricultural and industrial buildings, car park shades, autonomous lighting columns). Auversun has signed an agreement with Agréole Développement, a services company, for the supply of 4 MW of photovoltaic equipment for agricultural buildings.

SUNLAND 21

designs multifunctional components for building envelopes in the form of large dimension self-supporting metal panels onto which high-yield cells are superimposed by means of a flexible automated process. The annual installed capacity at their site in Anse (France 69) is 35 MW.

SILLIA ENERGIE

SILLIA is a company which originally specialised in the manufacture of printed circuits. In June 2009 it launched the production of multicrystalline silicon modules at its factory in Lannion, Côte d'Armor, which are well suited to building-integration (20 MW initially, then increased to a capacity of approximately 50 MW).

FONROCHE ENERGIE

This is a partnership between FONROCHE and the Spanish company, PEVAFERSA, for the design, manufacture, and turn-key installation of photovoltaic systems produced in their factory at Roquefort, in Lot et Garonne, and modules with an annual capacity of 25 MW.

SYSTOVI

Founded in 2008, SYSTOVI SAS carries on the production of modules and integration systems at its site in St Herblain, in Loire Atlantique. With its new manufacturing site fitted out in October 2009, the annual production capacity rose to 26 MW as at the beginning of 2011.

SOLAREZO

One year after taking possession of the former SONY site in Pontonx (France 40), the company invested in a second production line for modules at the end of the year, which is going to make it possible to multiply the capacity of their Les Landes factory by 6, from 10 MW to 60 MW.

VOLTEC SOLAR

Incorporated in November 2009, VOLTEC Solar is based in Alsace and launched its production on 1 March 2010 with an installed capacity of 25 MW. The company offers a complete range of high-yield modules, in addition to complete 3 kW kits.

FRANCE WATTS

Designs and manufactures its modules at its site in Barentin, Seine Maritime (20 MW). The products are specifically devoted to integration in roofs. The products are distributed in the form of kits, with inverters, control panels, cables, and wiring.

ELIFRANCE

This company forms a part of the Flextronics group, and has set up production of photovoltaic modules near St Étienne (France 42), with the goal of claiming from 5 to 10% of a strongly growing French market, through annual production which allows the generation of 30 MW of electricity, that is the equivalent of the annual production of 85 000 square metres of solar panels.

KDG ENERGY

With more than 25 years' worth of industrial experience in the design, development, and manufacture of high-tech electronic and optical products, KDG ENERGY has set up a production unit for photovoltaic modules, with a capacity of 25 MW.

3.1.2 The amorphous silicon segment**FREE ENERGY**

The FREE ENERGY production unit is located close to Lens, in the Pas de Calais (capacity of 1 MW). Initially orientated towards the design of products devoted to the electrification of off-grid sites, the business expanded to the development of grid-connected systems, and more specifically building-integrated systems.

The company plans to launch a photovoltaic system using micromorphous technology for large roofs incorporated into buildings (an association of amorphous and microcrystalline silicon) (a production capacity of 9 MW).

3.1.3 Ribbon technology

Attention should be drawn to the production of high-quality silicon wafers using the ribbon manufacturing technology (the RST process) from SOLAR FORCE, a start-up which has developed a process which makes it possible to cut the quantity of silicon used in manufacturing cells by a factor of 4 (ribbon technology).

3.1.4 Other segments

In the field of thin film (CIS, CIGS), the technology is still not developed to a manufacturing level. Nevertheless, the start-up company, NEXCIS, which commenced its installation in March, has the ambition of producing 50 MW of CIGS technology modules between now and 2014, based upon the R&D work carried out at the IRDEP.

SOLSIA was founded in 2008 in order to design, produce, and market modules suitable for roof-top and ground-level plant applications (modules of 1,4 m²). The technology is based on that developed by SOLEMS (Si in thin films). The objective is to produce photovoltaic modules at a pilot site from 2011, and then in a LabFab of 50 to 100 MW over the horizon of 2012.

S'TILE, a start-up of 10 people based in Poitiers, is working on a new manufacturing concept for silicon substrates by sintering silicon powders. The technology being developed offers the advantage of avoiding the need for the stages of melting the ingots and cutting the sheets.

3.1.5 Concentration systems

SOITEC is a company which offers high performance CPV systems, projects and services which comprise aid to development and to project finance, in addition to operation and maintenance. The company offers fully integrated CPV plants on an industrial scale, optimised for hot dry climates.

Elsewhere, HELIOTROP, a start-up company, has been testing its concentration photovoltaic technology (CPV) since the summer of 2010, by means of the installation of a pilot unit (7 kW) on the CEA site in Cadarache. The technology is the fruit of cooperation with the teams at CEA-Liten and the National Solar Energy Institute (INES). This technology uses Fresnel lenses to concentrate the energy from the sun by a factor of 900 times on high-performance III-IV triple junction cells.

3.1.6 Other industrial development projects in progress

In 2008, EDF ENR and Imerys founded a joint company (Captelia) to specialise in the production of construction-integrated photovoltaic systems (installation of an R&D and manufacturing site in Rhône Alpes). Imerys-Toiture is the French market leader in clay tiles in Germany. Their product catalogue includes photovoltaic tiles (based upon mc-Si cells developed with Photowatt since 2002 under the European "PV Starlet" project) which are installed instead of traditional tiles and just like them.

An initial project by Total planned to make an investment of 70 MEUR for the establishment of a unit on a site for revitalising the former mining basin of Vernejoul, in Lorraine, for manufacturing silicon wafers for solar panels for Photovoltech, their joint subsidiary with GDF Suez. The investment for the PV module assembly factory, to be in operation during 2011 with a first assembly line of 25 MW, should be significantly less costly.

EASY SOLAR, a design and engineering office and installer of turn-key systems, is developing a production line for modules.

ENERGIZ SA has acquired licenses for SOLARSTYL (from ARCELOR MITTAL) and NICE TECHNOLOGY (from APOLLON SOLAR) to manufacture these new processes in 2010. The first production unit for modules should have an annual capacity of 20 MW, and can be extended to 40 MW.

POUJOLAT, a specialist manufacturer of chimney liners and metal roof outlets for chimneys, with production sites located in Poitou Charentes and Rhône Alpes, has developed a photovoltaic solar system to be integrated into roofs (low- and medium- power).

Continuing with their policy of development in the solar energy sector, Saint-Gobain has bought out the Shell holding in AVANCIS, a company which they owned jointly. Avancis produces CIS technology modules in their factory in Targau, in Germany, which has a capacity of 20 MW. Saint-Gobain is also looking to develop a new coated glass for photovoltaic cells in the pyrolysis workshop in their factory in Aniche.

It is worth noting also the launch of activities in the field of the end-of-life treatment of photovoltaic materials and recycling of modules through the VOLTAREC project.

3.1.7 Related industrial activities:

Following the developments achieved by INES, APOLLON SOLAR, and the equipment manufacturer VINCENT INDUSTRIES under the umbrella of the NICE Project, automatic encapsulation chains designed on the model of the prototype set up at INES have been sold abroad.

In the field of production equipment, other manufacturers are already in place: ECM Technologies (manufacturer of crystallisation ovens), VESUVIUS (the number 1 manufacturer of crucibles for photovoltaics in the world), CARBONE LORRAINE (leader in the supply of graphite for PV).

BLUESTAR SILICONES is launching a new range of products which make it possible to increase the efficiency and the durability of modules while extending their weather resistance, the performance of which should be maintained at constant levels for at least twenty-five years.

Elsewhere, manufacturers in the electrical field have been diversifying, by adapting or designing components to satisfy the specific requirements of photovoltaics. Manufacturing activities related to PV are therefore being developed: cables (NEXANS, OGIER, etc.), transformers and inverters (SCHNEIDER ELECTRIC, AINELEC, IES Synergie), batteries (SAFT, PROLION), wiring and connectors (RADIALL), trackers (HELIOTROP, EXOSUN), and monitoring systems (GREENERCOS, EHW, MULTICONTACT).

Other manufacturing businesses are contributing to the development of equipment for the photovoltaic industry (AIR LIQUIDE, SAINT-GOBAIN) or marketing new products for construction integration. (IMERYS TOITURE, LAFARGE COUVERTURE, KAWNEER EUROPE, ARCELOR, SOPREMA, etc.).

3.2 Systems

3.2.1 Set-up of projects

With respect to systems, a large number of players are in the market to design and develop projects (SOLAIS, TRANSENERGIE, SUNVIE, CLARTENE, ENEVIA, TCE SOLAR, TENESOL), produce and install systems, in particular for the supply of turn-key installations in the market for private individuals (TENESOL, EVASOL, SUNNCO, PHOTON, SPIE, CEGELEC, etc.).

To meet their own requirements, the mass distribution group Casino has created their own subsidiary, Green Yellow, to develop systems intended for fitting out the roofs of their supermarkets. The construction of eight generating plants has been launched, with a total of 4,1 MW.

3.2.2 Design and implementation of systems

APEX BP SOLAR

APEX is a company which has become a historic player in France since 1991, specialising in turn-key operations for off-grid sites, and since it became a part of the BP Group it has been developing grid-connection applications. In 2009, they put kits for private individuals and for the construction trade on the market.

In 2010, the American management of the group opted for a change of strategy by aligning the development of solar power with the sale of modules and ground-level solar plants. Consequently, the off-grid site project business of APEX BP Solar has been transferred to another company, Phaesun GmbH.

The new French subsidiary of Phaesun GmbH, created on 24 September 2010, focuses on solar potable water supply systems, telecommunications, and the petroleum and gas sectors in Africa and the Middle East. The R&D and the development and production of photovoltaic systems have been brought together close to Montpellier. The range of components, until now produced and used by APEX BP Solar for their own systems, is now the responsibility of Phaesun France SAS.

TENESOL

In association with the telecommunications group, Orange, Tenesol took the prize for the best innovation in wireless network infrastructure in the "Global Telecoms Business Innovation Awards 2010" (900 base stations supplied with electricity by solar power, manufactured, supplied, and installed by Tenesol in 13 countries).

PHOTON TECHNOLOGIES

Photon Technologies, the installer of roof-top photovoltaic systems, and since May a subsidiary of EDF Energies Nouvelles Réparties (EDF ENR), has changed its name and became EDF ENR Solaire on 1 July 2010. Created at the end of 2006, the company markets and installs electricity production solutions using solar panels for residential clients, companies, and local authorities. The threshold of 10 000 installations should be passed this year.

Many other companies, such as PHOTOWATT, CONERGY, SUNWATT, SOLARCOM, etc., are also in the market as assemblers and suppliers of turn-key systems.

EDF EN

The EDF group has 223 MW and 572 MW worth of projects for which access to the tariff has not been suspended in the waiting lists of ERDF and RTE, respectively.

3.2.3 Installation capacities

Different types of company are able to meet the different demands of the market:

- Craft companies with fewer than 10 employees
- More structured companies with more than 10 employees
- Large companies, which often play the role of project developers and installers

Table 14: Typology of systems installers

Type of enterprise	Craft companies	More structured companies	Large companies
Services provided	Installation only	Installation and services (public authority processes, maintenance, etc.)	Installation and services (solutions for funding, insurance, etc.)
Proportion of installers (%) by number	80 - 85%	15 - 20%	<<1%

Source: Etude PCW and Observ'ER

The growth in demand has led to the arrival on the market of installers coming from various directions, and which have diversified in line with their original trade (electrician, roofer, etc.) drawn by the promising prospects of the photovoltaic market.

Figure 10 illustrates the geographical distribution of these installers over the area of metropolitan France in 2009 and 2010, which highlights a trend which has been seen towards the more southerly parts of the country.

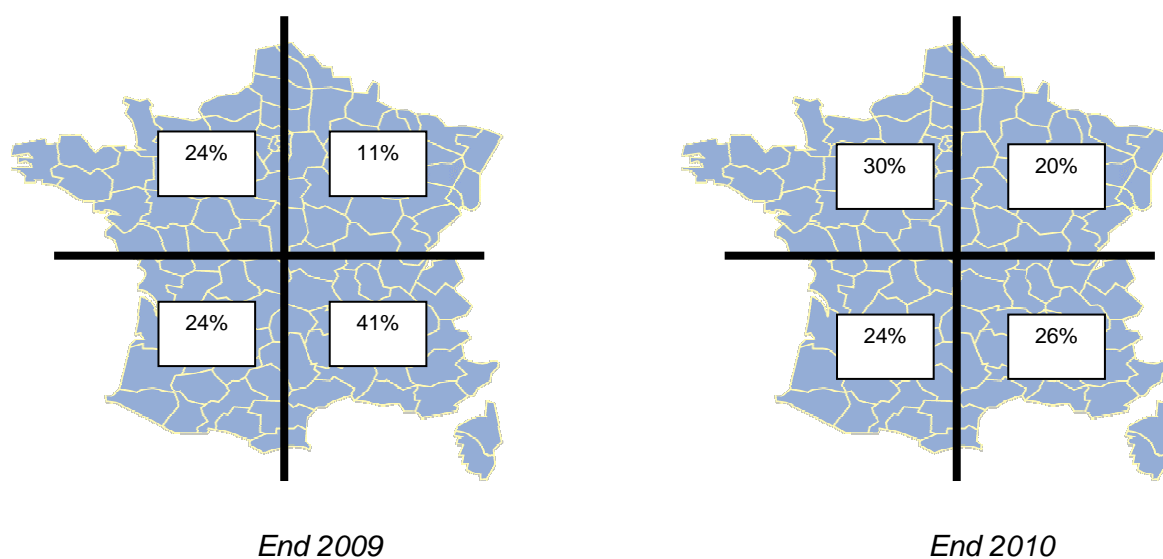


Figure 10: Geographical spread of installation companies in 2009 and 2010

Source: Quali PV on a database of 3,500 certified installers in mid-2009 and 6,300 certified installers at end 2010

3.2.4 System operation

At the end of the value chain, companies have been developing with the objective of developing, constructing, financing, and operating photovoltaic energy production installations, in particular solar power plants, throughout the country and abroad.

The total gross capacity (service and construction throughout the country) of EDF Energies Nouvelles at mid-2010 was 163 MW

Source: EDF EN –Half-Yearly business report_June 2010

POWEO is already operating 3 MW and their plant in Toreilles (France 64) with a capacity of 12 MW is in the process of completing the installation phase; production should start at the beginning of 2011.

With its power plants at Verdon and des Mées (France 04) SOLAIRE DIRECT has completed a solar plant programme in 2010 with an accumulated power of 25 MW. The company has a total of 600 MW of plants under development.

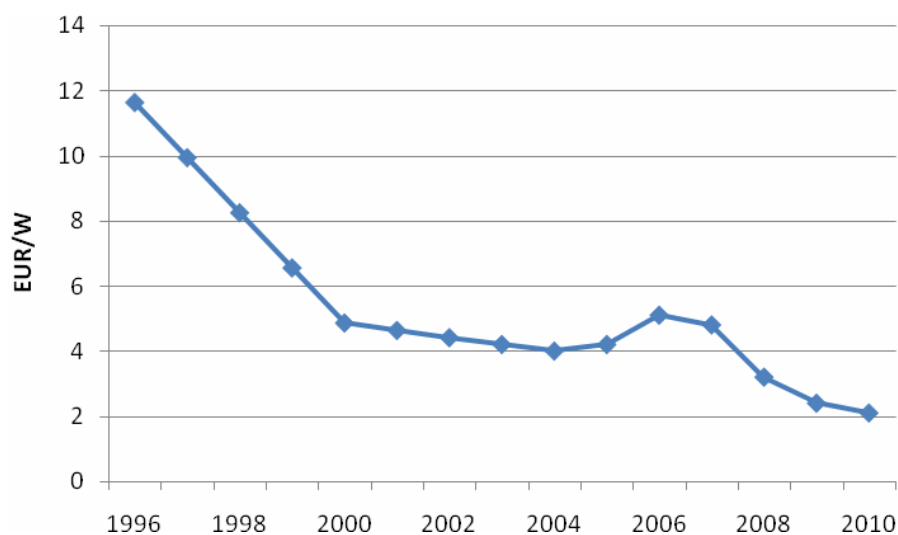
Other companies, such as SAMSOLAR, SECHILIENNE SIDEC, and SUN R are also carrying out very large-sized installations on roofs or on the ground.

3.2.5 Prices of modules and turn-key systems

Source: preceding ADEME reports and commercial sources

Figure 11 shows the trend in the prices of modules in the French market over the last 10 years (for quantities of the order of 10 kW).

PHOTOWATT, a company which has been the historic manufacturer in the sector in France, confirms that they are confronted by competition which has led them to lower the sale prices of their modules by 45% since 2008.



Source: preceding ADEME reports and commercial sources

Figure 11: evolution of the average sale price net of tax of crystalline Si modules

Table 15 shows the average turn-key prices for typical applications.

Table 15: Prices of turn-key systems (net of tax) (2010)

Application		EUR/W (net of tax)	
Off- grid systems (< 1 kW)	solar kit including battery, without inverter (100 W)	9 to 10	To be installed as a kit
	solar kit including battery, without inverter (750 W)	6 to 7	
grid-connected systems (3 kW)	laid on roof	4,8 to 5,2	
	integrated in roof	5,9	
grid-connected systems (centralised production)	ground-level plant	3,5 to 5,5 greatly dependent upon the size of the plant and the infrastructure of the site	

Source: suppliers and distributors + Outils solaires

According to the results of a survey conducted among 265 professionals in September 2010, the cost of 3 kW installations with the modules integrated in the roof fell by close to 30% between 2006 and 2010, as shown in Table 16.

Table 16: evolution of average prices of roof-integrated 3 kW systems (2006 - 2010)

	2006	2008	2010	variation 2010/2006
Supplies (EUR)	22 014	21 643	15 510	-30 %
Installation, including public authority formalities (EUR)	3 669	3 397	2 270	-38 %
Total EUR	25 683	25 040	17 780	-31 %
EUR/W	8,56	8,35	5,93	

Source: Outils solaires

3.3 Production of components and systems

TENESOL, as part of its business as a systems provider, has set up an inverter production line (1 to 5 kW) and has developed monitoring systems.

For connecting photovoltaic panels together, or for connecting them to an inverter, PRYSMIAM, an Italian company with a base in Isère, is now producing and marketing several ranges of cables and connectors.

The SCHNEIDER ELECTRIC group is continuing to develop in the sector, with the establishment of production sites devoted to monitoring systems, concrete house sub-stations specifically designed for photovoltaic systems, inverters, protection devices, control panels and connection boxes, in addition to providing training aimed at members of the trade. Cooperation is planned with companies in the field of concentration photovoltaics.

Other manufacturing groups such as FERRAZ SHAWNUT (Carbone Lorraine), SOCOMEC, AINELEC, COMECA (low tension equipment) are producing components for PV systems at their French sites.

EHW Research, a company based in Toulon, has developed a component for the grid-connection of modules individually and not in series, so that weakened elements do not penalise the entire installation; 80% of the production losses due to shadows and damage can thus be recovered.

POLYRISE is developing varnishes designed for anti-reflection surface treatment, particularly for photovoltaic cells.

ADIXEN (ALCATEL group) is continuing with its investments in the manufacture of vacuum pumps for the manufacture of silicon cells.

The strong tariff support for systems using construction-integrated photovoltaic components is encouraging manufacturers to develop this type of component in order to meet the demand.

These products which integrate the functions of the production of electricity + watertight roofing / façades, are, in particular, roof tiles and slates, modules with an integrated waterproofing function, sheet materials (steel, zinc, aluminium, fibre-cement), flexible membranes, and glass envelope materials.

For example, EDF Energies Nouvelles has funded a production line with a daily capacity of 600 m² of modules in aluminium and zinc, factory-fitted with a UNISOLAR fine flexible amorphous silicon membrane. A first agricultural building has been equipped (38 kW) with these 288 kW modules installed by PHOTON TECHNOLOGIES.

The new regulations issued for making these products eligible for the integration premium were drafted by the Committee for the Evaluation of Building Integration (CEIAB).

It is important to note that the analysis of the CEIAB in respect of the eligibility of a photovoltaic construction system for the building integration tariff or the simplified building integration tariff and registration in one of the national lists, is under no circumstances a substitute for expert advice as to the quality of the system (stability, water-tightness, security, etc.). In no way does it constitute a waiver from obtaining a Pass'Innovation, a Technical Experiment Appreciation, a Technical Advice, or any other evaluation and certification procedure carried out by a third party organisation (see paragraph 3.7).

Many manufacturers contribute to this range of construction-integration products or simplified construction integration products for the roof or roof-terrace:

ALEO SOLAR, AUVERSUN, CAPTELIA, CENTROSOLAR, CLIPSOL, CMS, DUPONT DE DEMOURS, ETERNIT, FIRST HYBRID ENERGY, FONROCHE ENERGY, GEHLLICHER SOLAR, IMRERYS TC, JMA SOL, LE TRIANGLE, MECOSUN, MIDI SOLAIRE, MITJAVILA, PHOTOWATT, RENU SOL, ROTO FRANCK, SCHOTT France, SCHUCO, SERRES MARCHEGAY, SOLAIRE DIRECT, SOLAIRES ENERGIES, SOLAR CENTURY, SOLARQUEST, SOLARWORLD France, SOLAR COMPOSITES, SOLEOS SOLAR, SUN'ISO, SYSTOVI, YANDALUX, 3T France, DERBIGUM France, MEPLÉ, SMAC, SOLARDIS, and HIOLLE INDUSTRIES

In this field of building integration, other types of activity are taking shape: ECOTEMIS, for example, is a company which works with the project initiator very much upstream on each architectural project in order to develop customised photovoltaic solutions responding to the various different challenges of the building (and the cost); customisation then gives rise to the different dimensions, forms, and colours offered to the architects.

3.4 Manufacturing activity outside France

This paragraph gives a number of examples of the activities of French manufacturing companies in the PV sector established abroad:

SAINT-GOBAIN AND THE CIS

The SAINT-GOBAIN group, which has 20% of the world market in photovoltaic glass, is looking to speed up its development in photovoltaics. Saint-Gobain Solar is manufacturing photovoltaic tiles in Luxembourg.

The company has stated that it is going to construct a new factory for the production of photovoltaic modules for the roofs of residential, industrial, and commercial buildings, and also for solar power plants through its subsidiary AVANCIS, which it has acquired from the SHELL group. The factory in Torgau, in Germany, will have an annual production capacity of 100 MW of CIS photovoltaic modules.

Source: Saint Gobain

TOTAL PHOTOVOLTECH

Photovolttech, a subsidiary of TOTAL and GDF Suez which produces multicrystalline silicon photovoltaic cells, was formed in December 2001. As a spin-off from IMEC (Institut de Micro Electronique et Composants, a research centre which is a European leader in the field of micro electronics), Photovolttech holds innovative technologies (including MWT - Metallization Wrap Through). The production line inaugurated in August will increase annual capacity from 150 to 160 MW.

Source: Photovolttech

CARBONE LORRAINE

At the beginning of the year, CARBONE LORRAINE took full control of the Scottish company CALCARB, the world's second largest manufacturer of rigid graphite felt used as insulation in very high temperature kilns, particularly in ovens for producing solar silicon.

Source: Carbone Lorraine

AIR LIQUIDE

The Air Liquide Group is an innovator in the fast-growing photovoltaic industry, offering turn-key solutions including the supply of gases (carrier gases, doping and special gases, nitrogen, hydrogen, and silane).

Since 2009, Air Liquide has signed several long-term contracts, to become the principal supplier of the three largest photovoltaic production sites in the world: in Germany, in Thalheim, home to the largest "Solar Valley" in Europe; in the eastern region of China, where the Group is providing a turn-key solution for the supply of gas uses in the production of thin-film solar cells; and in the Philippines, where Air Liquide has extended its partnership with SUNPOWER for the manufacture of high-yield cells.

The Group is now partnering the world's three largest manufacturers of crystalline silicon technology solar cells.

Source: Air Liquide

RHODIA

The chemicals company Rhodia has taken a holding in the British company, Eight19, beside the Carbon Trust and The Technology Partnership. The long-term goal is to offer a range of photographic type films (light-weight and flexible) for new markets such as BIPV modules (building-integrated), intelligent textiles or electrical equipment and mobile electronics.

Source: Systèmes solaires –Dec 2010

3.5 Examples of developments by foreign companies in the French market

SOLARIG is continuing its international expansion in the French market by launching the construction of a roof-top power plant of 1 MW in the Hautes Alpes district over the last quarter of 2010.

NEOEN is commencing the construction of a car park shade system of 3,3 MW in Pau, in the Pyrénées Atlantiques district.

The Spanish energy group T-Solar has signed an agreement with the French group Eco Power to install 120 MW in France over the next few years.

3.6 Employment

Employment

According to a survey carried out by the ADEME (Markets and jobs and the energy challenge related to renewable energies - October 2010) there was a very significant increase in the number of direct jobs in the photovoltaic sector over the year 2010.

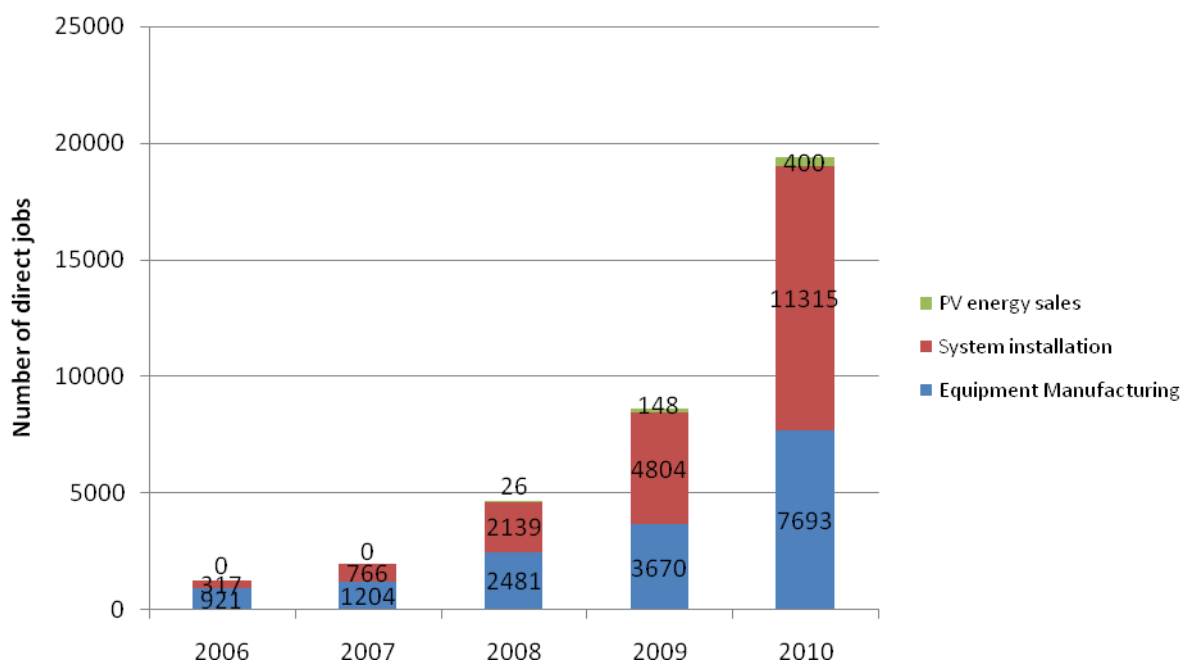
Table 17: Evaluation of the number and type of jobs in the photovoltaic sector in 2010

Research and Development (public sector)	~500 (INES+IRDEP+CNRS)
Manufacturing business	~23 000
Product distribution	
Systems installation	
Electricity companies investing in PV	~500 (ERDF, EDF ENR, EDF SEI, etc.)

Source: ADEME survey and data from R&D organisations

These values are to be considered as a minimum: according to the solar branch of the renewable energies trade association, SER-SOLER, 24 300 jobs were counted in the photovoltaic sector following a survey of 265 members.

Figure 12 shows the dynamics of the sector since 2006, with a significant doubling of jobs between 2009 and 2010



Source: ADEME Survey (Markets and jobs and the energy challenge related to renewable energies - October 2010)

Figure 12: Evolution in the number of direct jobs in the photovoltaic sector (production - installation) (2006-2010)

Training

As part of its development in the South-West, SUNNCO is planning to create in this region the first training centre devoted entirely to the photovoltaic installation trade in partnership with the regional council of Aquitaine and Pôle Emploi.

TRANSENERGIE is a design and engineering office which specialises in renewable energies and energy management and provides training for installers, technicians, and engineers in thermal and photovoltaic solar energy. Technical workshops are also organised on topics such as grid-connection inverters, a UTE C15-712 installation guide, and photovoltaic technical forums.

3.7 The economic aspect of the photovoltaic sector

In their survey on the renewable energy markets published in October 2010, the ADEME summarises the position of the photovoltaic market for the years 2006 - 2009 and gives a forecast for 2010.

Table 18: Change in the value of the photovoltaic markets 2006-2010 (MEUR)

(market values in million Euros)

	2006	2007	2008	2009	2010 (est.)
Equipment					
production	204	278	515	596	1 188
imports	24	95	176	443	1 166
Installation	19	45	122	259	613
Energy sales	~2	~5	~22	~89	~268
Total markets	249	423	835	1 387	3 235

(est.): estimated

3.8 Quality policy - standards and directives

Certificate of Compliance

In March 2010, the <French> government published a decree which extends the obligation to hold an initial certificate of compliance for new residential electrical installations to include photovoltaic electricity systems. All electricity generating facilities with a power of less than 250 kVA and exterior grid-connected electricity installations are required to hold a certificate of compliance with the security regulations in force, approved by the Consuel.

Trade Association

The association of photovoltaic trades (GMPV) has been in operation since the month of September. Its missions are to achieve greater visibility for the know-how of the companies by means of setting up specialist qualifications and certifications, clarifying the responsibilities of the various different players, and adapting appropriate insurance.

Quali PV

The installation of systems on off-grid or grid-connected sites is required to comply with the guidelines, practices, and recommendations issued by the UTE (the electrical standards authority), EDF, and the ADEME. The electricity trade association SER plays a major role in the preparation of these technical guides.

Heavily supported by the trade and the public authorities, a number of quality assurance strategies have been implemented. The "Quali PV" label (www.qualit-enr.org/qualipv) was introduced in 2007. For a company to be awarded the "Quali PV" label, it has to undertake to comply with the ten points of the Quali PV charter drawn up by the trade bodies. To be a part of this quality assurance strategy, companies have to provide evidence of their expertise by following generic "Quali PV" training modules imparted throughout the country.

Since 2009, the "Quali PV" qualification requires 3 days' of training for the "Elec" module and 2 days for the "Building" module.

As of the end of 2007, no installation companies had embarked upon the Quality PV certification process. By the end of 2010, more than 6 300 installation companies had become “Quali PV” certified (against 2 500 as of the end of 2008), with 80% of them employing less than 10 people.

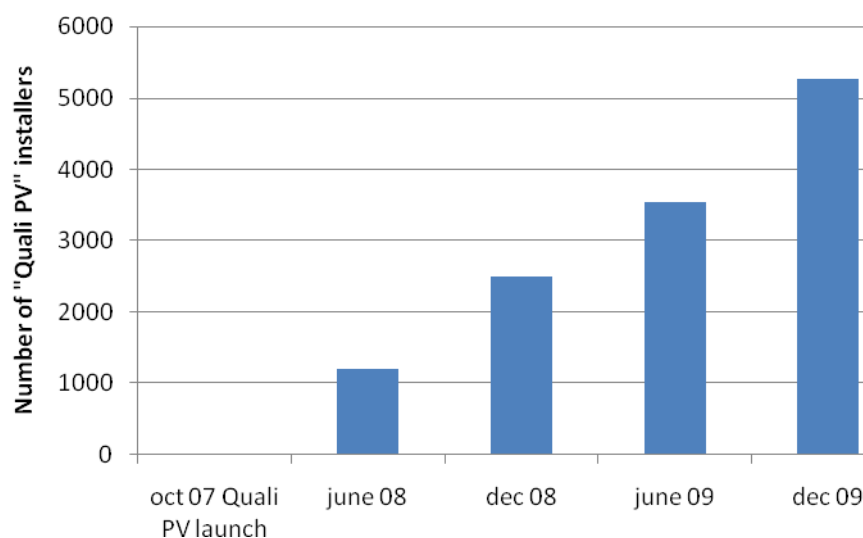


Figure 13: Trend in the number of companies joining the QualiPV charter since its creation

Technical Evaluation and Pass’Innovation

In order to encourage the development of photovoltaics in buildings, new procedures have been developed by the CSTB (the Scientific and Technical Building Centre) which is tasked with certifying innovations in the construction industry as being in compliance with current regulations.

In France, the implementation of traditional building procedures is governed by standards referred to as DTUs (standard technical documents). Compliance with these standards guarantees the quality of construction over time in order to minimise the risk of accidents during construction. Furthermore, these standards most often also serve as a reference basis that insurance companies use to deal with construction-related accidents in accordance with the terms of cover provided by their basic contracts.

However, procedures associated with the use of photovoltaics are not yet considered to be traditional, and so do not fall within the scope covered by the DTU standards. The question therefore arises as to how to ensure that the procedures used for photovoltaic systems in buildings keep risk to a minimum and are properly covered by the insurance companies’ basic contracts.

The Scientific and Technical Building Centre (CSTB) provides a number of voluntary initiatives which can help to answer this question. www.cstb.fr

In particular, the Pass’Innovation is a voluntary scheme which provides companies, technical auditors, and insurance companies with a preliminary technical assessment of products or procedures within a short time (3 months). It provides the guarantees which are required before a product is put on the market, before the Technical Evaluation Certificate is applied for, and serves as an optional step towards this.

The Pass’Innovation scheme has three stages: the definition of the procedure, the analysis of its suitability, the final report. The report ends with:

- Green light: the risk is very limited and may be managed by recommendations for implementation and/or supervision;
- Orange light: there is a “qualified” risk; it is recommended that the suitability of the product or procedure should be verified on a pilot project;
- Red light: the risk is not adequately managed and the techniques have not been properly developed as they stand.

These Pass’Innovation assessments are chiefly aimed at three product families:

- Products already widely implemented in other countries but as yet untested in France because of climatic differences and different techniques
- Products deriving from existing ranges
- Products which are totally new.

54 "Pass'Innovation" certificates had been issued for photovoltaic procedures by the end of December 2010.

Source: CSTB

Performance certification

At the request of a number of module manufacturers, the CSTB, the LNE, and the CEA, with the support of the ADEME, decided to set up a photovoltaic module energy performance certification platform, the CERTISOLIS laboratory, on the INES site. The CERTISOLIS mark applied to tested modules has the purpose of guaranteeing the following:

- Compliance with the IEC 61215:2005, IEC 61646:2008, and IEC 61730-2:2007 standards.
- Design and manufacturing quality (annual audits covering the quality system and the manufacturing process)
- Compliance with additional specifications covering both enhanced mechanical and climatic performance and clearly displayed environmental specifications.

Points 1 and 2 constitute the basic certifications. Only achieving the two together gives the right to use the CERTISOLIS MODULES PHOTOVOLTAÏQUES mark.

Construction regulations for solar power plants

In view of the growth in the number of solar power plant projects, in February the ADEME published a statement recommending that all solar power plant projects *"in the interests of high environmental quality and compliance with the regulations on the use of land, should encourage the implementation of exemplary worksites, incorporation into the landscape, the preservation of the natural heritage and the landscape, and the absence of conflict of use of the land"*.

4 Conclusions and outlook

In the 2010 edition of its "Annual Survey of the French population and renewable energies", the ADEME confirms that 97% of French people state that they are in favour of the development of these forms of energy. 44% of those surveyed are considering the possibility of producing electricity in the home using renewable energy sources.

France has set the target of having 5 400 MW of photovoltaic systems installed by 2020 in order to meet their undertaking to Europe to achieve 23% of final energy consumption being from renewable sources.

With the growing involvement of the major manufacturing and energy groups, the French photovoltaic sector is becoming stronger.

The year 2010 was marked principally by the considerable development of medium and high power generating plants, the appearance of new players in the photovoltaic manufacturing sector, and the adjustment of tariff and fiscal regulations.

Incentive measures in place since 2006 have continued to produce their effects and have given great stimulus to investment by private individuals and members of the trade. The boom in demand which began in 2009 has led to the creation of a waiting list for contracts reaching a level of 4,1 GW by the end of 2010, which leaves the achievement of the target of 5,4 GW set by the Grenelle Environment Forum for 2020 very close indeed.

A new tariff scheme was set up in January 2010. In order to avoid the formation of a speculative bubble, an inventory of the situation of the photovoltaic sector in France was undertaken.

At the end of its analysis of the pertinence of the measures taken by the government for developing photovoltaics in France, the "Mission on the regulation and development of the photovoltaic sector in France" made the following recommendations:

- Progressively reduce the purchase tariff for photovoltaic sourced electricity and the tax incentives for investment from September 2010,

- Set up a permanent regulatory system which is clear for the sector,
- Maintain resources in R&D,
- Mobilise the major manufacturers who are capable of taking a position in photovoltaics and organise the grid-connection players on a national scale.

Private individuals, small and medium enterprises, manufacturing groups, local authorities involved in the funding and construction of facilities, and trade associations, which make up a very active network in support of the photovoltaic sector, would like the measures for the support and development of the sector to stabilise quickly.

The committed cooperation between the public authorities and the players in the field has to give rise to acceptable conditions for continuing the harmonious development of a field of manufacturing which now constitutes a significant sector with more than 20 000 jobs.

The strategy adopted is to do better than merely support the growth of the domestic market, by means of targeted investment in break-through technologies such as thin-film and high-yield silicon.

Appendix: Working method

The events related in respect of manufacturing life and research activities were collected in real time over the course of the year 2010 and the first quarter of 2011.

The principal sources of information are as follows:

Observatoire des énergies renouvelables, Syndicat des énergies renouvelables <SER Trade association>, ENERPLAN press releases, Observ'ER publications, "Systèmes solaires" publications, EDF EN and EDF SEI statistics, ERDF quarterly updates, ADEME reports and studies, Outils solaires report, data from equipment suppliers, publications and press releases from manufacturers, contacts with members of the trade, Internet research, event brochures.

Note: the ISO ruling has been observed in designating units of power (W) although the usage in the field of photovoltaics is to use W_c . The case is the same for the monetary unit, the Euro, where the symbol EUR is used instead of €.

□□□