



# **Photovoltaic Power Applications in France National Survey Report 2011**

**Prepared for**

**INTERNATIONAL ENERGY AGENCY  
COOPERATIVE PROGRAMME ON PHOTOVOLTAIC POWER SYSTEMS**

**by**

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## FOREWORD

The department SRER of French Agency for Environment and Energy management (ADEME) prepared this document. It constitutes the annual French Photovoltaic National Survey Report as requested by Task 1 of the IEA PVPS programme. Information from this document will be used as input to the annual "Trends in photovoltaic applications – Survey report of selected IEA countries between 1992 and 2011".

The French Agency for Environment and Energy management (ADEME) is a public agency under the joint authority of the Ministry for Ecology, Sustainable Development and Energy and the Ministry for Higher Education and Research.

The agency's mission is to encourage, supervise, coordinate, facilitate and undertake operations with the aim of protecting the environment and managing energy.

The focus areas are energy (including renewables), air, noise, transport, waste, polluted soil and sites, and environmental management.

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) that carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The 22 participating countries are Australia (AUS), Austria (AUT), Canada (CAN), China (CHN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association, the US Solar Electric Power Association and the US Solar Energy Industries Association are also members.

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of photovoltaic power systems. An important deliverable of Task 1 is the annual Trends in photovoltaic applications report. In parallel, each Task 1 participant produces National Survey Reports annually.

The IEA PVPS website [www.iea-pvps.org](http://www.iea-pvps.org) plays an important role in disseminating information arising from the programme, including national information.

## INTRODUCTION

This report provides an update on photovoltaic activity in France in 2011. It covers the implementation of photovoltaic systems at national level, the industry status and R&D projects and, the framework for deployment.

The report follows the guidelines proposed by the IEA/PVPS/Task 1.

The main sources of information used are as follows:

ADEME reports and studies, French observation and statistics office (SOeS, data collected from ERDF, RTE, SEI and main local distribution companies), Syndicat des énergies renouvelables (SER/SOLER), ENERPLAN association, "Systèmes solaires" publications including Le Journal des énergies renouvelables, Le Journal du Photovoltaïque and Observ'ER (Atlas of the Observatory of Renewable Energies), magazines Photon and Plein Soleil, websites (photovoltaïque.info, outils-solaires.com, etc.), data from equipment suppliers, company publications and press releases, Internet searches, event brochures, contacts with professionals in the sector.

Sources of valuable information are:

- Tableau de bord éolien-photovoltaïque, published by Service de l'observation et des statistiques (SOeS) du Commissariat général au développement durable, No. 293, 2012-02;
- Marchés et emplois des activités liées aux énergies renouvelables, In Numeri study for ADEME, to be published 2012;
- Annuaire de la recherche et de l'industrie photovoltaïque française 2011 (Directory of French research and industry), SER/SOLER, 2011-06;
- Journal du Photovoltaïque, hors-série No. 6, 2011-10. 'Atlas of photovoltaic installations (> 250 kW)', hors-série No. 7, 2012-04;
- Le Journal des énergies renouvelables, No. 205, 2011-10 ; No. 206, 2011-12.

## 1 EXECUTIVE SUMMARY

### Installed photovoltaic power

According to the French observation and statistics office (SOeS, 2012-02), the grid-connected installed photovoltaic (PV) power in France during 2011 was 1 634 MW compared with 817 MW in 2010. The installed grid-connected PV power doubled but the total number of systems decreased by 26 %.

The 100 % annual power increase comes mainly from medium power systems (36 kW to 250 kW) contributing to 36 % and large power systems (> 250 kW) representing 46 % of annual installed power. Ground-mounted centralised systems connected to the electricity grid during 2011 are estimated at 402 MW and distributed systems (mainly building applications) reached 1 232 MW.

Grid-connected cumulative PV power capacity at the end of 2011 was 2 802 MW (242 295 systems), compared with the 1 168 MW (163 004 systems) at the end of 2010. Building integrated residential systems of less than 3 kW represented 89 % of the total number of installations and 20 % of total cumulative power while systems of power greater than 36 kW represented 3 % of the number of installations and 69 % of total cumulative power capacity.

By a decree dated 4 March 2011, a new support system was proposed with a target of 500 MW per year of new projects over the next few years. The government's policy confirmed its priority to focus on building-integrated photovoltaic applications.

The new support system introduces two separate mechanisms, based on the power of the installations. Under the first mechanism, for installations on buildings of less than 100 kW, feed-in tariffs are adjusted each quarter based on the total volume of projects submitted during the previous quarter. The second support mechanism involves a bidding system for large roof installations and photovoltaic ground-mounted power plants greater than 100 kW.

### Market incentives and budget

There are three kinds of market incentive: enhanced feed-in tariffs, income tax credits and direct financial subsidies from local authorities. The cost of promotion through the feed-in tariffs financed by customers of electricity companies through their CSPE contribution is estimated at 800 MEUR for 2011. The cost of tax credit is evaluated at 670 MEUR (2010).

### R&D

Main R&D programmes are funded by public agencies ADEME, ANR and OSEO. Under the auspices of the Ministry of Ecology and within the National future investment programme (PIA), ADEME was given responsibility for launching a call for expressions of interest in solar RD&D (AMI PV and AMI solaire). Eight projects were selected within the AMI PV initiative.

The ANR launched the three-year PROGELEC research programme (renewable electricity production and management) in early 2011. The "Photovoltaic electricity production" theme selected five research projects. The new 3 to 5-year R&D projects will receive support from ADEME and ANR (refundable advances and subsidies) amounting to around 80 MEUR.

### System prices

The turnkey price of building integrated rooftop systems was around 3,9 EUR/W by end of 2011 compared with 5,9 EUR/W 12 months ago (source SER), a 35 % decrease. Large roof of commercial/industrial buildings between 250 kW and 500 kW were 53 % less expensive at 2,6 EUR/W and turnkey prices of ground-mounted centralised systems were around 2,0 EUR/W (56 % decrease during the year).

Reduction is principally due to price reduction of modules and, to a lesser extent, other components such as inverters. During 2011, the drop in the price of photovoltaic modules and systems induced a significant increase in the internal profitability rate of the projects and led to a rapid expansion in medium- and high-power systems.

### **PV industry**

There are about 210 players active in the photovoltaic field (not including installers). In 2011, the multicrystalline silicon ingot production capacity was 1 360 tonnes, crystalline silicon cell production capacity was around 100 MW and photovoltaic module production capacity was estimated at 470 MW. During 2011, some projects to develop new production facilities or to expand annual production capacity of silicon ingots, cells and modules were suspended.

### **Employment and business value**

In 2011, there were 27 400 jobs in the sector of photovoltaic business (not including R&D). A 13 % decrease compared with 2010. Value of PV business in 2011 was estimated at 2,5 billion euros. A decrease of 30 % compared to 2010.

### **Conclusion**

The 100 % photovoltaic installation growth in 2011 is mainly due to projects of medium and large power placed on the waiting list for grid-connection before the government's decision to suspend the feed-in tariff policy for three months by end 2010. In March 2011, the Government decided to control the development and financial impact on the CSPE tax (public electricity service contribution) by setting up a system of feed-in tariffs adjustable each quarter for projects of power up to 100 kW and a tendering system for installations of higher power.

The development will be more modest in the future since the installed power will be capped at 500 MW per year over the next few years with a strong emphasis on building integration. The government target of 5 400 MW installed by 2020 is maintained though 7 000 to 8 000 MW are envisaged. The industry associations advocate a new approach and target 20 GW by 2020 and 40 GW by 2030.

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## 2 IMPLEMENTATION OF PV SYSTEMS

### 2.1 Photovoltaic applications in France

Photovoltaic (PV) power systems consist of PV modules, inverters, storage batteries (if any) and all installation and control components. For the purpose of this report, photovoltaic installations are included in the 2011 statistics if the PV systems were installed between 1 January and 31 December 2011.

Four categories of photovoltaic power systems are considered:

- 1) grid-connected distributed PV power system: application providing electricity to a grid-connected customer or directly to the grid. Systems installed on dwellings, tertiary, commercial and industrial buildings, or in the built environment;
- 2) grid-connected centralised PV power system: application performing the function of a centralised power station. Typically ground-mounted PV system supplying bulk power and functioning independently of any nearby development;
- 3) off-grid domestic PV power system: application to provide power mainly to a household or village not connected to the electricity grid. System with electricity storage and/or another source of power;
- 4) off-grid non-domestic PV power system: industrial and agricultural applications such as water pumping supply, remote telecommunication relays, safety and protection devices, etc. Usually with a means of electricity storage and/or another source of power.

The off-grid categories are the historic basis of the PV market in France<sup>1</sup>. At end 2006, 50 % of installed photovoltaic systems were applied to off-grid rural electrification. Today 99 % of photovoltaic applications in France concern installations connected to the electricity grid.

The government's decision to promote the development of photovoltaic energy in France led to the publication of a decree in 2006 ruling on the compulsory purchase of photovoltaic electrical energy at an attractive price for the producer. Government policy is to privilege the use of photovoltaic systems in buildings. The systems installed on buildings represent 80 % of the total cumulative power and the ground-mounted centralised PV plants represent 18 %.

### 2.2 Total photovoltaic power installed

Data concerning grid-connected installations are extracted from a publication by the French observation and statistics office (SOeS) of the *Commissariat Général au Développement Durable* (the French General Commission for Sustainable Development) (No. 293, February 2012). The SOeS relies on the files managed by the various transport and distribution network operators: ERDF, RTE, SEI and main local distribution companies. PV systems considered are installed *and* connected to the grid.

Table 1 shows the power installed (systems physically grid-connected) during 2011, Table 2 gives the cumulative power according to four market sectors and Table 2a gives grid-connected cumulative power according to the power categories as defined in the SOeS statistics.

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<sup>1</sup>France, member state of the European Union, includes metropolitan France and Overseas departments (Guadeloupe, Guyane, Martinique and Réunion).

**Table 1 – Photovoltaic power installed during 2011 (MW)**

Applications	Off-grid domestic	Off-grid non-domestic	Grid-connected distributed	Grid-connected centralised	Total (MW)
PV power installed in 2011	0,1		1 232	402	1 634,1

Sources: SOeS, Le Journal du Photovoltaïque (HS n 6), FACE, SER and ADEME.

**Table 2 – Cumulative installed PV power as at end of 2011 (MW)**

Applications	Off-grid domestic	Off-grid Non-domestic	Grid-connected distributed	Grid-connected centralised	Total (MW)
Cumulative installed power as at end of 2011	29,4		2 289	513	2 831,4
<i>Revised cumulative power as at end of 2010*</i>	29,3		1 057	111	1 197,3

\*Figures from IEA NSR 2010 were reviewed to take into account adjustments from SOeS data.

**Table 2a – Grid-connected cumulative installed capacity as at end of 2011**

Power range	Installation number	Power (MW)
0 – 3 kW	215 768 (89,1 %)	570 (20,3 %)
3 kW – 9 kW	8 759 (3,6 %)	44 (1,6 %)
9 kW – 36 kW	10 087 (4,2 %)	250 (8,9 %)
36 kW – 100 kW	3 501 (1,4 %)	241 (8,6 %)
100 kW – 250 kW	3 593 (1,5 %)	616 (22,0 %)
> 250 kW	587 (0,2 %)	1 081 (38,6 %)
Total	242 295 (100 %)	2 802 (100 %)

Source: French observation and statistics office (SOeS).

Table 2b positions photovoltaic power in the general context of the national energy market in 2011.

**Table 2b – Photovoltaic power and the broader national energy market**

Total national PV power capacity as % of total national electricity generation capacity	New (2011) PV power capacity as % of new (2011) electricity generation capacity	Total PV electricity production as % of total electricity consumption
2,2 %	57 %	0,4 %

Table 3 lists the total powers on 31 December of each year since 2004 according to the four market sectors. Since 2008 both off-grid categories were added to each other because it was difficult to get accurate data. The data collected by SOeS concern only installed/grid-connected PV systems. The PV systems installed but not yet connected to the grid in 2011 are not counted.

**Table 3 – Cumulative installed PV power by application as at 31 December (MW)**

Application	2004	2005	2006	2007	2008	2009	2010	2011
Off-grid domestic	13,0	13,8	15,0	15,8				
Off-grid non-domestic	5,9	6,2	6,5	6,7	22,9	29,2	29,3	29,4
Grid-connected distributed	7,1	13,0	22,4	52,7	140,8	314,0	1 057,0	2 289,0
Grid-connected centralised	0	0	0	0	16,0	37,0	111,0	513,0
<b>TOTAL (MW)</b>	<b>26,0</b>	<b>33,0</b>	<b>43,9</b>	<b>75,2</b>	<b>179,7</b>	<b>380,2</b>	<b>1 197,3</b>	<b>2 831,4</b>

Sources: preceding IEA PVPS NSRs France, reviewed grid-connected data for 2009 and 2010. For 2011 see Table 1.

The SOeS statistics do not classify the data by market sector as defined by the IEA PVPS for this report (distributed applications and centralised ground-mounted plants). The Atlas of photovoltaic installations (> 250 kW) published in October 2011 by *Le Journal du Photovoltaïque* is a source of information. It was sometimes necessary to guess whether the reported installation belonged to a 'centralised' ground-mounted PV plant (power generally greater than 1 MW) or a 'distributed' application (the largest BIPV in France is 8,8 MW) because the data provided were incomplete. The volume of grid-connected installations considered as 'distributed' is obtained by subtracting 'centralised' from the total volume given by SOeS. This breakdown will be adjusted in the future when additional data will be issued. Table 1, Table 2 and Table 3 (including revised grid-connected data for 2009 and 2010) show the results of this exercise.

The data concerning off-grid domestic applications are collected from the FACE (fund subsidising rural electrification). Off-grid non domestic is an estimate of the author, both applications amounting to 100 kW in 2011.

For 2011, we observe a substantial increase in the number of applications connected to the grid. The annual grid-connected volume of 1 634 MW is double that of the previous year. This increase is due to the medium-power systems (36 kW to 250 kW) with 589 MW and the high-power systems (> 250 kW) at 752 MW with an estimated value of 'centralised' ground-mounted plants of 402 MW. In 2011, power installations of less than or equal to 3 kW (residential roofs) represent 12 % of the installed power but 87 % of the number of systems installed that year (total 79 291). High-power systems (> 250 kW) represent 46 % of the power and 0,5 % of the total number of installations.

According to the Atlas of *Journal du Photovoltaïque* (October 2011) there were at time of publication 13 ground-mounted centralised PV power plants larger than 10 MW (maximum-reported 60 MW, CdTe technology). Apart from ground-mounted PV plants, the photovoltaic systems are building-integrated. Photovoltaic modules added on top of roofs (not integrated) are found mainly in Reunion Island. The largest building-integrated system has a power of 8,8 MW (c-Si PV tiles). Photovoltaic canopies over vehicle parks (commercial centres, motorways) are starting to develop (largest solar canopy reported is 4,5 MW, c-Si). The examples given here were grid-connected in 2011 and benefit from the feed-in tariffs set up before the new decree of March 2011.

Concerning PV technology of modules used in installations greater than 250 kW, crystalline silicon occupies around 80 %, thin film cadmium telluride technology 17 % and thin film amorphous silicon 2 %.

The majority of French photovoltaic installations are located in regions where there is the most sunshine. The most active regions include Provence – Alpes – Côte d'Azur (13 % of the total cumulative power), Midi-Pyrénées (10 %), Aquitaine (10 %), Languedoc-Roussillon (9 %), Pays de la Loire (7 %) and Rhône-Alpes (7 %). Reunion Island accounts for 50 % of the installed power in the overseas departments (DOM) and 5 % of the total national photovoltaic power. We observe a reduction in the number of requests to connect photovoltaic installations in the overseas departments (DOM) and in Corsica due to the 30 % threshold of intermittent energies allowed.

### **2.3 Implementation highlights, main projects**

The French action plan in favour of renewable energy intends to increase the share of renewable energies in energy consumption to 23 % by 2020. The photovoltaic development objective is to have 5 400 MW connected by 2020. To reach this objective, already well underway with more than 2 800 MW installed in 2011, the Government decided to control the development and financial impact on the CSPE tax (public electricity service contribution financed by electricity consumers on their bill) by setting up a system of feed-in tariffs

adjustable each quarter for projects of power up to 100 kW and a tendering system for installations of higher power. The annual target is 500 MW for installations wanting to benefit from the support schemes: 100 MW for building-integrated residential installations up to 36 kW, 100 MW for installations between 36 to 100 kW, 120 MW for installations between 100 and 250 kW and 180 MW for installations of more than 250 kW. The target could be reconsidered and increased to 800 MW, after revision of the multi-year national investment programme for electricity production (PPI-électricité).

The first phase of the 120 MW invitation to tender concerning the construction of photovoltaic installations on buildings of 100 kW to 250 kW was launched on 17 July 2011. The *Commission de régulation de l'énergie* (CRE - French Energy Regulation Commission) received applications for 345 projects (68 MW) and, in March 2012, selected 218 projects (45 MW) proposing an average feed-in tariff of EUR 0,229 per kWh. Concerning this invitation to tender, the professional associations were disappointed that the complexity of the specifications formed a significant obstacle preventing more players from replying to the consultation, which explains why the total power proposed was almost half the target of 120 MW. The associations also wanted the public authorities to revise the current mechanism of a quarterly reduction in the tariffs on the segment from 0 to 100 kW to take account of the feed-in tariff offer proposed by the projects selected in the invitation to tender, which were on average over 0,016 EUR per kWh greater than the official feed-in tariff on the segment from 36 kW to 100 kW.

The CRE launched a second type of invitation to tender on 15 September 2011. It concerns power applications of more than 250 kW. The deadline for submitting bids was 8 February 2012. In addition, stricter environmental and industrial quality requirements have been placed on the projects, with in particular mandatory recycling at end of life and dismantling and the need to supply a life cycle analysis as of 1 January 2012.

The decree of 4 March 2011 set up a new framework for the feed-in tariffs with precise technical rules. The *Comité d'évaluation des produits photovoltaïques intégrés au bâti* (CEIAB - the French building-integrated photovoltaic product assessment committee) determines whether the photovoltaic integration systems it receives comply with the technical criteria governing 'building-integrated photovoltaic systems' (IAB) or 'simplified building-integrated photovoltaic systems' (ISB). The photovoltaic array field must be parallel to the roof and must be water- and air-tight to the roof. For 'building-integrated photovoltaic systems' (IAB), the gap between the roofline and the upper limit of the PV array field must be less than 2 cm. Where the PV array field rest on top of another water- and air-tight element, however, they belong to a different category, known as 'simplified building-integrated photovoltaic systems' (ISB) (see also section 4.5.3).

The reduction in feed-in tariffs every 3 months depends on the number of grid-connection requests made during the previous quarter. For building-integrated installations up to 3 kW, the tariff dropped from 0,580 EUR/kWh at the start of 2011 to 0,388 EUR/kWh at the start of 2012. For ground-mounted plants, the tariff dropped from about 0,300 EUR/kWh at the start of 2011 to 0,110 EUR/kWh one year later (Table 4).

In France, PV energy purchase contracts are managed financially by the EDF Compulsory Purchase Agency (EDF OA) and other local distribution subsidiaries. ERDF is responsible for the national grid and provides connection and access contracts for the public distribution and operation network (photovoltaic systems < 36 kVA). Note that the tariff granted when signing the contract is guaranteed for a period of 20 years.

**Table 4 – Applicable feed-in tariffs up to 31-12-2011 and 31-03-2012**

Title	Building usage	Installed PV power (W)	Price (EUR/kWh) 31-12-2011	Price (EUR/kWh) 31-03-2012
IAB (Building-integrated photovoltaic system)	Residential use	P < 9 kW 9 kW < P < 36 kW	0,4063 0,3555	0,3880 0,3395
IAB	Building for education or health activities	P < 36 kW	0,3325	0,3009
IAB	Other type of building	P < 9 kW	0,2882	0,2609
ISB (Simplified building-integrated system)	Residential use, building for education or health activities, other type of building	P < 36 kW 36 kW < P < 100 kW	0,2485 0,2361	0,2249 0,2137
Other installations	Other installations	0 MW < P < 12 MW	0,1138	0,1108

IAB: Building-integrated photovoltaic system, ISB: Simplified building-integrated system

## 2.4 R&D programmes

The Ministry of Ecology implements its policy through a number of subsidiary agencies such as ADEME (French Environment and Energy Management Agency), ANR (French National Research Agency) and OSEO (organisation providing financial support to French companies for start-up, innovation and development projects).

End 2009, the government launched a major programme of investments for the future (PIA). Solar technology was identified as a key target, with ADEME given responsibility for launching two calls for expressions of interest (AMI PV for photovoltaics and AMI Solaire for solar thermal and concentrated solar power technology). The deadline for this process was in May 2011. The aim of the AMI solar programmes is to improve the economic and environmental performance of solar solutions. ADEME received about 60 projects and selected 14 pre-industrial demonstration projects (AMI PV: 8 projects and AMI Solaire: 6 projects). Selected AMI PV projects are ISOPEM (Photosil Industries/Ferropem) and PV800Export (ECM technologies), photovoltaic solar grade silicon by metallurgical route; DEMOS (SolarForce), crystalline silicon ribbon process; PVCIS (Nexcis), CIGS thin film modules; S3 (Solsia), a-Si thin film modules; GUEPARD (Soitec), cell for high-concentration; HCPV1024Soleils (Heliotrop), concentrator photovoltaic (CPV) modules; ISOCEL (Arkema), encapsulation processes based on polymers.

Funding by ADEME (subsidies and refundable advances) for AMI PV is around 75 MEUR for 3 to 5 years, starting 2012.

These projects complement those aimed at developing the photovoltaic industry, previously funded through the ADEME, ANR and OSEO programmes.

ANR (French National Research Agency) launched the PROGELEC (renewable electricity production and management) research programme in early 2011. The 'Photovoltaic electricity production' sub-programme (2011-2013) selected five photovoltaic projects: Bifacial (CEA-INES), Menhirs (INL), Multisolosi (LGEP), Picks (Simap) and Tandori (CEA-INES). Subsidies amount to 5 MEUR for 3 years.

French PV research covers a wide spectrum of studies. There are around 30 companies and practically all component manufacturers involved in R&D, usually in partnerships with public research organisations such as CEA, CNRS and the universities. Around 36 public research teams are listed in the SER Directory.

These activities range from fundamental research well upstream from the value chain to finalised projects and industrial prototypes. Research concerns firstly the first generation crystalline silicon sector, largest in production terms, in order to improve the manufacturing processes and the cost/efficiency ratios. French research also focuses on the second and third generation technologies: thin film deposition on various substrates, especially

heterojunction cells, a-Si, Cu-In-Ga-Se, etc. Other laboratories are developing new organic or hybrid organic/inorganic photovoltaic cells, as well as very high-efficiency concepts.

The *Institut national de l'énergie solaire* (INES - French national solar energy institute) is currently undergoing rapid growth and is involved in a range of different public-private partnership projects. The *Institut Photovoltaïque d'Île-de-France* (IPVF - Greater Paris photovoltaic institute) has been formed, drawing together several public-private research centres specialising in thin films materials and high efficiency concepts.

## 2.5 R&D budget and market stimulation

### 2.5.1 R&D budgets

In 2011, the public agencies ADEME and ANR launched new photovoltaic R&D support programmes (see section 2.4). The agencies act as risk buffers. Refundable advances represent a privileged financing method (in case of failure, the advances do not have to be entirely reimbursed, unlike bank loans). Subsidies are the second financing method. In 2011, the ADEME and ANR budgets (subsidies and refundable advances) allocated amounted to 80 MEUR for 3 to 5 years. The financing as such will take place in 2012.

Some industrial projects have benefited from the fund for innovation in industry (f2i).

### 2.5.2 Market stimulation

The various market stimulation measures are listed below:

#### **Electricity feed-in tariffs**

The cost of the promotion policy through the feed-in tariffs (see section 2.3) is not included in a public budget. Customers of electricity companies, help finance the promotional tariffs through the CSPE tax. The cost is estimated at approximately 800 MEUR for 2011.

#### **CRE invitations to tender**

The decree of 4 March 2011 set up the new government strategy by launching invitations to tender for installations greater than 100 kW. These measures are detailed in section 2.3.

#### **Tax credit, tax exemption on sale and VAT**

For private individuals, an income tax credit is granted to owners of installations less than or equal to 3 kW. The credit covers 11 % of the cost of the materials shown on the estimate. The threshold of eligible expenses is 3 200 EUR incl. VAT per kilowatt installed. Private individuals are not taxed on the sale of photovoltaic electricity. The rate of VAT on the cost of equipment and installation is 7 % (instead of 19,6 %). The cost of these measures is evaluated at 670 MEUR (2010).

#### **Grants from local authorities**

Local authorities play an important role in the development of this market. The regional councils, general councils (departments) and communes award grants in various forms. The financial level varies. The ENERPLAN ([enerplan.asso.fr](http://enerplan.asso.fr)) association provides the list of grants available.

The Languedoc-Roussillon regional council, for example, launched an investment fund for photovoltaic amounting to 400 MEUR (credits from the EIB and regional banks).

#### **Export grants**

In October 2011, the government launched a call for projects to support the development of companies in the solar sector abroad and in particular in the southern emerging countries. Up to 100 MEUR of low cost loans and 5 MEUR of donations can be allocated. The aim is to promote the concentrated solar power technology and the concentrator photovoltaic sectors, which can be exported under the Mediterranean Solar Plan (MSP).

### 3 INDUSTRIAL ACTIVITY

There are around 180 industrial companies involved in PV (SER Directory) of which 30 are involved in R&D activities, not counting the installers. All professions forming the photovoltaic value chain are represented. The upstream part extends from original equipment manufacturing to producing the raw materials in order to manufacture the photovoltaic cells and modules, which are adapted by some companies for building integration. Balance of system components (BOS) such as inverters, cables, control instruments, supporting structures, solar trackers, etc. are included. The downstream part of the value chain concerns all implementation activities: studies, integration of components, execution, operation, maintenance, recycling of materials, etc.

In 2011, the global overproduction, a significant drop in module prices and the squeeze of the French residential market have had a serious impact on company results and some projects to increase the production capacity of cells and modules have been put on hold. Some companies have gone bankrupt, some changed hands.

#### 3.1 Manufacture of materials, silicon ingots and wafers

In France, the multicrystalline silicon (large grain material) sector has historically been the strategic choice supported by the public authorities. Ingots are made by directional solidification (Photowatt) with annual capacity of 1 000 t or continuous casting in electromagnetic crucible (Emix) with annual capacity of 360 t. In industry, wire saws are used to cut the silicon ingots into thin wafers. Photowatt in cooperation with a Swiss mechanic pioneered the development of this technique, now widely used. Annual capacity of wafering by Photowatt is equivalent to 70 MW.

Two industrial projects offer an alternative to slicing the ingots: manufacture of a silicon ribbon by company SolarForce (RST process) and, proposed by company S'tile, manufacture of silicon wafers by sintering silicon powder.

Studies on the preparation of feedstock silicon concern the metallurgical method. Ferropem, Apollon Solar and the INES (French National Solar Energy Research Institute) are jointly developing a pilot plant (capacity 200 t) which includes the manufacture of multicrystalline silicon ingots after purification of metallurgical grade silicon.

#### 3.2 Photovoltaic cells and modules

##### 3.2.1 Crystalline silicon photovoltaic cells

Photowatt International is the historical manufacturer of multicrystalline silicon photovoltaic cells (annual capacity 70 MW). Photowatt partnered with EDF ENR and the CEA in the PV Alliance consortium, which uses an industrial pilot plant to test new techniques for the manufacture of silicon cells (capacity 25 MW). In 2010, company MPO Energy engaged in an industrial project (funds for reindustrialisation) for the manufacture of crystalline silicon cells using a process developed in cooperation with company Irysolar. Plans are underway for an industrial line of 140 MW. The Irysolar cell fabrication laboratory (subsidiary of Semco Engineering) has an annual capacity of 10 MW.

At end 2011, the industrial annual production capacity of silicon photovoltaic cells in France amounted to 70 MW. Pilot lines for manufacturing silicon cells have an annual capacity of 35 MW.

##### 3.2.2 Photovoltaic modules

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. There are two types of photovoltaic module, depending on the component materials. The first technique uses cells made from crystalline silicon wafers, the second implements thin films of materials such as amorphous silicon,

copper indium gallium diselenide or cadmium telluride. These materials are deposited on a foreign substrate (glass, steel, etc.).

#### 3.2.2.1 *Crystalline silicon PV modules*

Historic manufacturers of crystalline silicon modules are Photowatt International and Tenesol. In 2011, Photowatt, which initially manufactured modules with its own cells, decided to subcontract its module activity.

Over the last few years, a dozen companies have started to manufacture PV modules and part of the production is devoted to building integrated products for roofs and façades. In 2011 main actors are Auversun, EliFrance, Fonroche Energie, Francewatts, KDG Energy, Luxol (tiles), Sillia Energie, Snasolar, Solarezo, Systovi, Tenesol, and Voltec Solar. Most of them use cells imported from abroad. The global module production capacity in 2011 is estimated at 470 MW per year.

New entrants 2012: Bosch Solar Energy will start manufacturing crystalline silicon PV modules in France in 2012 after converting part of its Vénissieux site near Lyon to photovoltaics. Two lines will be operational in 2012. Tournaire Solaire Energie is another module manufacturer starting production in 2012. Production capacity added by these new entrants will be about 170 MW per year.

#### 3.2.2.2 *Thin film modules*

Modules composed of amorphous silicon on glass substrate are manufactured by Free Energy with an annual capacity of 1 MW and Solems specialised in small low-power modules.

Company Solsia, in partnership with Solems and the public laboratory PICM/CNRS, develops the film deposition processes that combine amorphous silicon and its variants for large area modules. The pilot plant is under construction.

Company Nexcis is planning the industrialisation of a copper indium gallium diselenide compound prepared by an electro-deposition process, initially studied by the mixed institute IRDEP (EDF and CNRS).

#### 3.2.2.3 *Concentrator photovoltaic (CPV) cells and modules*

This technique is based on specific PV cells using group III-V materials, such as GaAs, InP, etc. and concentrator PV modules mounted on solar trackers.

Company Soitec develops multijunction photovoltaic cells for the concentration using proprietary technologies. Soitec purchased the German CPV company Concentrix Solar.

Heliotrop develops and commercialises a concentrator module (1024-suns) under Fresnel lens (5 kW systems are installed in France, Portugal and Morocco). The company works in cooperation with the solar tracker manufacturer Exosun (ground-mounted system of 2 MW operational in southwest France).

### 3.2.3 **Product recycling**

The association CERES (*Centre européen pour le recyclage de l'énergie solaire* - European centre for the recycling of solar energy) was created in 2011. Since then, some 50 member companies have endorsed its principles. Independent from the photovoltaic industry, CERES launched a voluntary programme promoting the collection and recycling of photovoltaic modules and production waste. With its innovating business model, the collection and recycling costs are funded by partner industrial recyclers. CERES is also working in order to preserve its system's compliance with all the requirements of the new WEEE European directive, which now includes photovoltaic modules.

Companies Arena Technologies and Recupyl propose solutions to recycle materials from the photovoltaic industry.

### **3.2.4 Changes of ownership in 2011**

#### **3.2.4.1 Photowatt International**

Created in 1978, Photowatt International is the historical French manufacturer of multicrystalline silicon ingots, photovoltaic cells and modules. At the start of November 2011, the Canadian parent company ATS announced that Photowatt had filed for bankruptcy. A judicial recovery process was initiated. In March 2012, the assets were assigned to EDF ENR. EDF ENR also acquired 100 % of the PV Alliance consortium that develops the silicon high conversion efficiency technology on its industrial pilot site.

#### **3.2.4.2 Tenesol**

Tenesol is the second historical company specialised in photovoltaic systems. It manufactures crystalline silicon photovoltaic modules. The company was equally owned by Total and EDF and became a 100 % subsidiary of Total in 2011. In May 2011, Total took control of SunPower Corp., a California-based manufacturer of high-efficiency photovoltaic cells and modules. More recently, SunPower bought Tenesol.

### **3.3 Manufacturers of equipment and materials for PV industry**

Around twenty companies produce equipment and machinery for the production of silicon ingots, wafers, cells and modules (Aet, Alcatel, Apollon solar, Ecm, Efd, Eolite, Semco ...). Materials for the PV industry (gas, glasses, polymers ...) come from some twenty actors (Air Liquide, Arkema, Mersen, Saint-Gobain Solar ...). Some of them occupy leading positions worldwide.

### **3.4 Manufacturers and suppliers of other components**

#### **3.4.1 Electrical and electronic equipment**

Essential components of photovoltaic systems, the electrical/electronic devices are used to connect, convert and measure the electrical energy produced by the modules. There are around 45 companies active in this field (SER Directory).

For residential photovoltaic systems, inverters are included in the kits sold by the turnkey operators. Several French companies commercialise inverters (Ainelec, Leroy-Somer, Schneider Electric, Socomec) on the home and export markets, while some module producers, integrators and installers develop their own brands. Numerous leading French companies propose all the hardware and electrical equipment required to connect, check and monitor the photovoltaic systems. The SER estimates that 22 % of the electrical equipment is manufactured in France.

#### **3.4.2 Structural components**

There are about 60 companies (SER Directory) specialised in the production of structural components (building roof and facade components, ground structures, concentrator, etc.). Most of these companies are either turnkey operators or design offices, however. There are about a dozen manufacturers of clay tile and metal roof coverings, aluminium profiles, underlays and supports, some of them being leaders in their activity. The SER estimates that 48 % of the structural components are manufactured in France.

#### **3.4.3 Installers**

Numerous companies install systems. The sector is extremely heterogeneous and it is estimated that about 80 % of the installers (small businesses) install only one or two systems a year, whereas about a thousand install about 10 or 20. One third, corresponding

to an average of more than 200 systems each, would be installed by a maximum of a few dozen large companies.

The number of installers having obtained the QualiPV label, launched in October 2007, has increased considerably over the last two years: from 1 200 in June 2008, the figure had reached 5 260 by the end of 2009. According to the SER, the number had dropped to 4 500 at end 2010 and 3 600 at end 2011 (down 20 %). More than half of the labelled companies have a headcount of one or two.

#### 3.4.4 Energy producers

In view of the profitability guaranteed by the feed-in tariffs, the main energy producers are increasing their number of projects. Alongside the generalist companies EDF (EDF EN, EDF ENR) and GDF Suez (Ineo), often installers, one observe the presence of numerous companies such as Solairedirect, Eco Delta Développement, Voltalia, Séchilienne Sidec, etc. which, in some cases, develop projects for later resale. Solairedirect proposes photovoltaic electricity production agreements in partnership with the regions (for example Poitou-Charentes).

#### 3.4.5 Building-integrated products

The financial support offered to systems implementing building-integrated photovoltaic components encourages companies to develop this type of component to meet the demand. Numerous companies manufacture building-integrated or simplified building-integrated products, for roof, roof-terrace and façades. The *Journal du Photovoltaïque* (No 6, Oct. 2011) describes in detail around 70 products for building integration.

Building-integrated photovoltaic products and processes may benefit from a Technical Assessment (or a Pass'Innovation Vert) from the CSTB and be eligible for feed-in tariffs as defined by the CEIAB (see section 4.5.3).

### 3.5 Module prices

The drop in the price of photovoltaic modules (Table 5) and systems (Tables 6 and 7) led to a rapid expansion in medium- and high-power systems (see section 2.2) (source SER).

**Table 5 – Typical crystalline silicon module prices (EUR/W)**

2006	2007	2008	2009	2010	2011
5,10	4,80	3,17	2,00	1,66	0,80

Source: IEA NSR France 2010 up to 2010 and SER 2011.

### 3.6 System prices

The turnkey price of photovoltaic systems has dropped significantly over the last few years. For building-integrated residential installations, prices have dropped from 8,6 EUR/W in 2006 to 8,3 EUR/W in 2008 and to 5,9 EUR/W in 2010. The price was in the region of 3,9 EUR/W in 2011 (source SER). A 35 % decrease in one year. Large roof of commercial/industrial buildings between 250 kW and 500 kW were 53 % less expensive at 2,6 EUR/W and turnkey prices of ground-mounted centralised systems were around 2,0 EUR/W (56 % decrease during the year).

During 2011, the drop in prices induced a significant increase in the internal profitability rate of the projects and led to a rapid expansion in medium- and high-power systems.

**Table 6 – Turnkey prices of typical applications in 2011 (EUR/W)**

Category/Size	Typical applications	Current prices
Grid-connected residential less than 3 kW	Residential building- integrated system (system recognized by CEIAB and CSTB)	3,9 EUR/W
Grid-connected 100 kW to 250 kW	Industrial, commercial agricultural large roof integrated	2,6 EUR/W
Grid-connected ground-mounted >1 MW	Centralised production, utility scale plant	2,0 EUR/W

Source: SER

**Table 7 – Trends in system prices for three types of applications (EUR/W)**

Application	2006	2007	2008	2009	2010	2011
Residential building-integrated	8,6	8,4	8,2	6,9	5,9	3,9
Large roof integrated	7,6	7,8	7,6	6,4	5,5	2,6
Centralised production	6,3	6,3	6,2	5,2	4,5	2,0

Source: IEA-PVPS NSR France 2010 up to 2010 and SER 2011.

### 3.7 Employment and training

#### 3.7.1 Labour places

The number of jobs linked to the fabrication of components, installation and studies was estimated at 27 400 in 2011 (down 13 % compared with 2010). System installation represents 82 % of jobs (source: In-Numeri study for ADEME, to be published 2012).

The reduction in the number of jobs mainly concerns the installation sector (22 600 in 2011 against 26 200 in 2010) and can be explained firstly by the higher productivity and secondly by the reduction in the number of residential installations.

Employment due to the sales of energy was estimated at 1 270 persons in 2011 compared with 522 in 2010. Research represents around 900 people (source SER).

#### 3.7.2 Training

Training is a key factor in the development of renewable energies and ecoconstruction. *Le Journal des énergies renouvelables* (March 2012) listed 586 training courses in this field (30 % more than the previous year). Building companies have understood the need to change, especially to comply with the new Thermal regulations for buildings. The photovoltaic sector is firmly established and about 30 courses are proposed for short continuous training alone.

The design offices Transénergie and Metrol are active through their specialised technical forums held at Lyon (three forums organised in 2011). Companies also organise training cycles specific to their products.

### 3.8 Business value

The estimate of the value of photovoltaic business is carried out through the Gross domestic product (GDP) approach. Value of PV business in 2011 is estimated at 2,5 billion euros (Table 8). A decrease of 30 % compared to 2010 (source: In Numeri for ADEME).

**Table 8 – Value of photovoltaic business in France (MEUR)**

Value	2007	2008	2009	2010	2011
Sales value	301	794	1 785	5 851	3 839
Export of PV products	117	91	33	62	43
Import of PV products	169	216	566	2 311	1 414
Business value	248	669	1 252	3 602	2 469

(Source: In Numeri study for ADEME, to be published, 2012)

## 4 FRAMEWORK FOR DEPLOYMENT

### 4.1 Support measures

Certain aspects of the national policy which were not detailed in the previous sections are presented below:

#### Feed-in tariffs

(see also section 2.3)

Under the terms of the renewable energy support scheme set up by the law, the EDF OA (*EDF Agence obligation d'achat*) and the local distribution companies (ELD) must purchase the electricity produced from renewable energies at a feed-in tariff higher than the market price so that the renewable energies can follow their learning curve while offering investors normal profitability. The feed-in tariff is set by a decree or results from an invitation to tender.

The high growth in the photovoltaic market exceeded all expectations (the figure rose from 46 MW in 2007 to 1 168 MW in 2010 then 2 802 MW in 2011. In 2010, all installations benefiting from high tariffs represented an average CSPE contribution of 537 EUR/MWh paid by electricity consumers on their bills.

- Key dates of the feed-in tariff policy:
  - 10 July 2006: decree introducing attractive feed-in tariffs for photovoltaic electricity and creation of a 50 % tax credit for households on the price of equipment;
  - 10 December 2010: three-month suspension of the compulsory purchase of photovoltaic electricity and connection of photovoltaic installations. The political advisers Mr Charpin and Mr Trink organised rounds of talks with the profession and produced a detailed update on the photovoltaic sector<sup>2</sup>. The conclusions led to publication of the decree of 4 March 2011;
  - 4 March 2011: publication of the decree indicating the new applicable feed-in tariffs. Introduction of a quarterly adjustment for installations on buildings up to 100 kW and creation of a bidding system for installations over 100 kW and ground-mounted photovoltaic plants. From 2012, a cap of 500 MW per year will be set for new projects on the waiting list of authorisations to connect to the grid.
- CSPE contribution:

Introduced by a French law in 2003, the *Contribution au service public de l'électricité* (CSPE, public electricity service contribution) is a tax fixed by the government. It applies to the quantity of electricity consumed by domestic and industrial consumers (the figure doubled in 2011 to reach 9 EUR/MWh). It is designed to compensate electricity operators for the higher costs incurred for the expenses related to public utility. For example, the higher costs related to the principle of providing electricity for all French citizens at the same price or reduced rates for low-income households. Lastly, the higher costs resulting from support

<sup>2</sup> Rapport de la concertation avec les acteurs concernés par le développement de la filière photovoltaïque, 2012-02.

policies for cogeneration and renewable energies. The *Commission de régulation de l'énergie* (CRE - French Energy Regulation Commission) estimates that the total cost reached 54 MEUR in 2009 and was to reach 800 MEUR in 2011, representing 26 % of the CSPE public service charge, and according to its own scenario to 2 300 MEUR in 2020 for about 7 GW installed.

**Income tax credit (CIDD)**

(See section 2.5.2).

**Direct financial subsidies** from local authorities

(see sections 2.5.2 and 4.4).

**Other aspects**

Ten-year guarantee:

The ten-year guarantee is mandatory for all building trades. The guarantee subscribed by the photovoltaic installer covers the repair of the roof in case of leak. The 'equipment' guarantee applies to the photovoltaic equipment.

Financial guarantee:

The obligation of a financial guarantee for large power installations required by the decree of 4 March 2011 is formalised in two types of document: certificate indicating that the producer has a capital of 0,6 EUR/W or certificate of a loan offer from one or more banks or financial organisations to cover the financing required for the installation.

The profession has reported no difficulties in obtaining these documents and even sees them as a way of preventing unfeasible projects from congesting the grid connection request waiting lists and thereby artificially reaching the quotas and consequently the feed-in tariffs.

Administrative formalities:

It is estimated that it takes about 18 weeks, including 12 for administrative formalities, between the first contact of a private individual with an installer and the date the installation is actually commissioned. It costs about 1 000 EUR to connect the PV installation to the grid and 150 EUR to obtain the certificate of electrical conformity issued by the Consuel (French committee for the safety of electricity users).

#### **4.1.1 Other support for the photovoltaic sector**

**Competitiveness clusters.** Three competitiveness clusters are active in the photovoltaic sector: Tenerrdis in the Rhône-Alpes region, Derbi ("development of renewable energies in building and industries") in the Languedoc-Roussillon region and Capenergie in the Provence – Alpes – Côte d'Azur region. Each cluster receives financing from ADEME, ANR and OSEO the local authorities, depending on the interest for the projects submitted.

**Professional organisations and associations.** Companies involved in consulting, market studies, technical studies, training and project management are supporting the development of photovoltaics. Associations and professional organisations such as ASDER, CLER, ENERPLAN, SER, Hespul, are very active in promoting the PV technology and in organising links with the market and the public authorities.

**Events.** Several important events were held during the year to promote photovoltaic technology and applications. For example, the 2011 renewable energy exhibition at Lyon from 15 to 18 February 2011 and the 5<sup>th</sup> edition of the ENERGAIA exhibition at Montpellier from 7 to 9 December 2011. These events offered a programme of conferences, symposia, organisation of business meetings. The fourth European Solar Days organised in 9-15 May by Enerplan allowed general public to attend one thousand local demonstration events throughout France.

## 4.2 Indirect policy issues

Operators such as the *Agence Française de Développement* (AFD - French development agency), Ubifrance and the Ministry of economy, finance and industry treasury department, with tied aid tools such as the FASEP (Private Sector Study and Support Fund) and the RPE (Emerging Country Fund) provide support to French solar companies to develop abroad. Through a call for projects launched October 2011, the state is ready to raise up to 100 MEUR of low-cost loans to fund the best projects in the field of CPV and CSP.

In 2011, the equipment manufacturers ECM Technologies, Semco Engineering, Vesuvius, BEA and Thermocompact with the contribution of the CEA/INES supplied the equipment required to manufacture crystalline silicon materials for an integrated photovoltaic manufacturing plant in Kazakhstan.

The Mediterranean Solar Plan (MSP) of the Union for the Mediterranean is a major project in which French companies will participate.

## 4.3 Interest of electricity companies

In France, the two main energy companies EDF, with its subsidiaries, and GDF Suez are involved in the development of photovoltaics.

EDF EN (EDF Énergies Nouvelles), an EDF subsidiary created in 1990, develops, builds and operates renewable energy power plants in Europe and North America (capacity at end 2011: 4,12 GW including 85 % wind power). At the end of 2011, the company owned 414 MW of photovoltaic plants throughout the world. The main installations in France are ground-mounted PV power plants: at the start of October 2011 EDF announced that the largest French power plant of 67,2 MW PV had been commissioned at Gabardan (Aquitaine). It consists of 65,2 MW of cadmium telluride thin film modules and 2 MW of crystalline silicon modules mounted on solar trackers.

EDF ENR (EDF Énergies Nouvelles Réparties), an EDF subsidiary created in 2007, proposes turnkey systems for domestic consumers, agricultural, industrial and community buildings with after-sales services (about 300 installations at end 2011). EDF ENR participates in several R&D public-private consortia. More recently, in March 2012, EDF ENR took over the assets of Photowatt International and its subsidiary PV Alliance (cell fabrication laboratory).

GDF Suez. The group was created in 2008 following the merger of Gaz de France and Suez. The company (through its subsidiary Ineo) operates as system integrator, turnkey project developer for private individuals and institutional investors, or power plant developer and operator. A 26 MW power plant has been commissioned at Curbans. Company EuroFideme was created with financial partners to build and operate the plant.

## 4.4 Interest of municipalities and local authorities

Installation of photovoltaic modules on communal building roofs is carried out frequently, often fully financed by loans without involving subsidies. Installation of ground-mounted photovoltaic power plants on unused areas such as waste burial areas is commendable applications. In 2011, the national federation of licensor and direct control local authorities (FNCCR - *Fédération nationale des collectivités concédantes et régies* - fnccr.asso.fr) included nearly 70 energy associations regularly conducting actions on renewable energies, resulting in 13 MW of photovoltaic projects. However, the Federation observes that the new decree of March 2011 is not favourable to local authorities since the invitations to tender encourage high-power, centralised projects, which exceed the investment capacities of the authorities and are only accessible to the large industrial groups. As a result, the local fabric of SMEs and SMIs is also penalised. The local authorities and the photovoltaic professional associations have drawn the attention of the public authorities to this type of difficulty.

## 4.5 Quality policy, standards and directives

### 4.5.1 Photovoltaic standards

France does not develop its own photovoltaic standards but adopts those prepared either by the international organisation IEC or by the European organisation CENELEC. French AFNOR is responsible for the mandatory translation of these standards into French. For example, a well-known standard such as IEC 61215 for photovoltaic modules has been transposed to the French version standard NF EN 61215. Bidding documents may refer to either IEC or NF EN standards. The UTE French photovoltaic commission UF82 is the national equivalent of committees IEC/TC82 and CENELEC/TC82. This Commission, with its 25 experts, takes part in writing comments and voting on draft standards.

International standards translated into French and published in 2011 were the following: NF EN 62509, NF EN 62253, NF EN 60904-5 Ed. 2.0, NF EN 62548 Ed. 1.0, NF EN 62116 Ed. 1.0, NF EN 61683 Ed. 1.0 and NF EN 50548.

Note that technical specifications (TS) do not have to be translated into French. Nevertheless, considering the importance of the series IEC TS 62257 Recommendations for small renewable energy and hybrid systems for rural electrification, Part 1 "General introduction to rural electrification" is being translated.

### 4.5.2 Certificate of conformity

All electricity production installations of power less than 250 kVA and external electrical installations connected to the public grid require a certificate signed by the Consuel (French committee for the safety of electricity users), testifying that they comply with security recommendations.

A survey conducted on small residential photovoltaic installations in 2010 showed that 15 % of the installations presented a significant risk. To increase the checks carried out by the installers themselves, since September 2011 the certificate of conformity requests must be accompanied by a new technical file (SC 134-2 or SC 132-3).

Since 1 January 2011, low-voltage photovoltaic systems must refer to the recommendations of the UTE C 15-712-1 practical guide "Photovoltaic systems connected to the public electricity grid". This document replaces UTE C 15-712 and complements the general standard NF C 15-100 concerning low-voltage electrical systems.

### 4.5.3 Technical Assessments

In 2008, the CSTB (*Centre scientifique et technique du bâtiment* - French scientific and technical centre for building) set up an evaluation procedure to ensure that the photovoltaic products and processes used on a building will minimise the risks of accident and will be covered by the basic contracts of the insurance companies. Photovoltaic technical approvals are renewable, modifiable and public. They are valid for a period up to 5 years. It takes about eight months to obtain a Technical Assessment if the file is complete (delays are often due to missing documents).

The Pass'Innovation Vert from the CSTB is an optional step before starting the Technical Assessment procedure. It consists of a simplified evaluation obtained within a period of time of about 9 months. It is valid for a maximum period of 2 years, allowing time to collect the necessary documents and acquire sufficient feedback to issue a Technical Assessment. In 2011, five processes obtained the Technical Assessment (cumulative total 25) and 12 processes obtained the Pass'Innovation Vert (cumulative total 102).

The PV Technical Assessments from the CSTB do not indicate whether the process complies with the building integration criteria as proposed in the feed-in tariff decree of 4 March 2011. The French building-integrated photovoltaic product assessment committee (CEIAB)

determines whether or not the photovoltaic integration processes comply with the 'building-integrated photovoltaic systems' (IAB) or 'simplified building-integrated systems' (ISB). The committee is composed of experts from public organisations (DGEC, CSTB, ADEME, and DREAL). In 2011, about 110 products were IAB-eligible and around 45 products were ISB-eligible. The feed-in tariffs assigned to these categories are listed in Table 4. The ADEME recommends project initiators to check that an IAB-eligible or ISB-eligible process has also obtained a photovoltaic Technical Assessment of CSTB (or at least a Pass'Innovation Vert).

#### **4.5.4 Qualification and quality label**

CERTISOLIS TC, a subsidiary of LNE and the CSTB, is the photovoltaic product performance testing and certification laboratory. The CERTISOLIS MODULES PHOTOVOLTAÏQUES label affixed on the modules tested is a guarantee of their compliance with applicable standards and the quality of their design and manufacture.

The quality label QualiPV certifies that the installers have received training and apply a quality charter (3 600 installers in 2011). The QualiPV Élec label is for electricians and the QualiPV Bât label is for roofers. Since 2011, these quality labels have obtained the official mention "*Reconnu Grenelle environnement*" (recognised by Grenelle Environment) allocated by the State and the ADEME.

The aim of the ADEME is to provide guidance to private consumers to help them identify the various quality labels applicable to companies and products. Jointly with the Ministry of Sustainable Development and its partners (FFB, CAPEB, Qualibat, Quali'ENR, Qualifelec), a commitment charter signed in November 2011 defines the requirements to be respected. The qualifications or quality labels concerned will therefore bear the mention "*Reconnu Grenelle environnement*" (recognised by Grenelle Environment). Consumers will therefore find it easier to identify companies offering the professionalism required to perform work on energy savings and renewable energies.

## **5 CONCLUSION AND OUTLOOK**

The French public authorities decided six years ago to develop building-integrated photovoltaics, laying down a more attractive feed-in tariff for these solutions. Revised in March 2011, feed-in tariffs are now indexed every quarter based on the number of projects submitted during the preceding quarter. The tariffs also depend on the degree of integration of the photovoltaic modules, the installation power and the types of building equipped. Above 100 kW, the support scheme involves a tendering procedure.

The year 2011 is paradoxical. It holds the record of installed power and at the same time, small French companies that had started up in this field had to reduce their headcount or went bankrupt. The historical player Photowatt International was no exception, but its assets were taken over by EDF ENR in March 2012. Several factors account for this situation: the global economic crisis, which also struck this sector, the government that imposed a moratorium on feed-in tariffs, which had cast doubt on the private investors and the future of the technology in France and, lastly, the arrival on the market of cheap photovoltaic modules competing with national and European productions.

The grid-connected power (1 634 MW) doubled compared with the previous year due to the medium- and high-power projects launched before compulsory purchase was suspended in December 2010. The total number of installations dropped by 26 % and business value decreased by 30 %. During the year, the number of direct jobs related to the investments reached 27 400 in full time equivalent, with 82 % in installation of systems.

### **Outlook**

The objective of the national action plan is to have 5 400 MW grid-connected by 2020, a figure which, at the current development level, will probably be exceeded.

The new framework for development of photovoltaics targets an annual installed power of 500 MW. The DGEC administration indicated that between 7 000 and 8 000 MW of PV power could be installed at end 2020.

The objectives set by the public authorities concern only installations benefiting from the support scheme and in particular compulsory electricity purchase. In practice, the level of power installed in 2020 will depend mainly on the date at which 'grid parity' is obtained. From 2016, parity could be reached with the retail electricity price. Several systems have already been developed outside the compulsory purchase system.

Beyond 2020, and possibly from 2018 for some buildings, implementation of the Thermal regulation on buildings RT 2020 (BEPOS positive-energy buildings), should lead to generalisation of photovoltaic solutions in new buildings.

The industry associations advocate new approaches and target 20 GW by 2020 and 40 GW by 2030.

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## ANNEX A COUNTRY INFORMATION

This informative annex gives the reader some background about the French national environment in which photovoltaics is deployed. The readers should do their own research if they require data that are more detailed.

### 1) retail electricity prices

Average price for consumer 0,129 EUR/kWh (VAT included), industry 0,081 EUR/kWh.

### 2) typical household electricity consumption

3 000 kWh (not including heating) per year.

NOTE - In France, the building sector represents an energy consumption of 70 Mtep, or 42 % of final consumption and nearly 25 % of CO<sub>2</sub>. The average annual consumption of primary energy in the building sector is close to 400 kWh/m<sup>2</sup> per year. To meet its commitments "Factor 4" and as part of the Grenelle Environment, Parliament has set two objectives for this sector:

- 2012 (RT 2012, BBC) new buildings meet the standards Effinergie low consumption, that is to say they should not consume more than 50 kWh/m<sup>2</sup> of primary energy per year.
- from 2020 (RT 2020, BEPOS) new buildings, said BEPOS, must be "positive energy" that is to say they will produce more energy than they consume. These two objectives can be achieved with the use of renewable energy especially solar building integrated which will play a major role.

### 3) Typical metering arrangements and tariff structures for electricity customers

The electricity bill paid by the consumer is the sum of: a) cost of producing electricity (40 %), b) costs of delivering electricity through transmission and distribution (calculated by CRE, 33 %), c) local taxes (TLE, 7 %), and routing (CTA, 2 %), d) public electricity service contribution (CSPE, 4 %) and e) VAT (14 %). The regulated tariffs (TRV) are proposed to CRE by ministry of Energy. The TRV offer different categories, tariff options or versions. Category (price Blue, Yellow or Green) depends on the subscribed power. Residential customers choose a contract power (from 3 to 36 kVA) and an option. The tariff option allows consumers to optimize their electricity bills based on its ability to shift some consumption away from peak hours. In consideration for this virtuous behavior, the consumer benefits from lower bills adapted to this behavior. Option 'base', option 'off-peak-peak hours' and options 'EJP' and 'Tempo'.

### 4) typical household income

Paying income tax: 31 898 EUR per year; not paying income tax: 8 946 EUR per year; all households: 21 504 EUR per year (source: france-inflation.com)

### 5) typical mortgage interest rate

Fixed mortgage rate by end 2011: loan for 10 years: 3,4 % to 4,3 %, loan for 20 years: 3,9 % to 4,8%.

### 6) voltage (household, typical electricity distribution network)

230 V, 50 Hz

### 7) electricity industry structure and ownership

The electricity market in France is organised around four major areas: a) production: three main players, EDF, Endesa France and CNR. They provide more than 95 % of electricity production in France, 90 % being provided by EDF mainly nuclear (85 % of EDF's output is nuclear). This segment of the electric sector is fully open to competition; b) transportation: RTE is the public organisation in charge of transport infrastructure (management, construction, maintenance); c) distribution: actors are EDF and local distribution companies (ELD). The Energy Regulation Commission (CRE) regulates both the transportation and distribution; d) marketing: financial activities such brokerage and trading on the OTC market or on the power exchange (Pownext).

### 8) Price of diesel fuel: 1,40 EUR per litre (motor vehicles).

### 9) Typical values of kWh/kW for PV systems in parts of France

A PV system delivers an average electrical energy of 800 to 1 000 kWh/kW in Alsace Region, 1 200 to 1 400 kWh/kW in Provence – Alpes – Côte d'Azur Region and an average of 1 450 kWh/kW per year in Overseas departments (DOM).

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