IEA INTERNATIONAL ENERGY AGENCY

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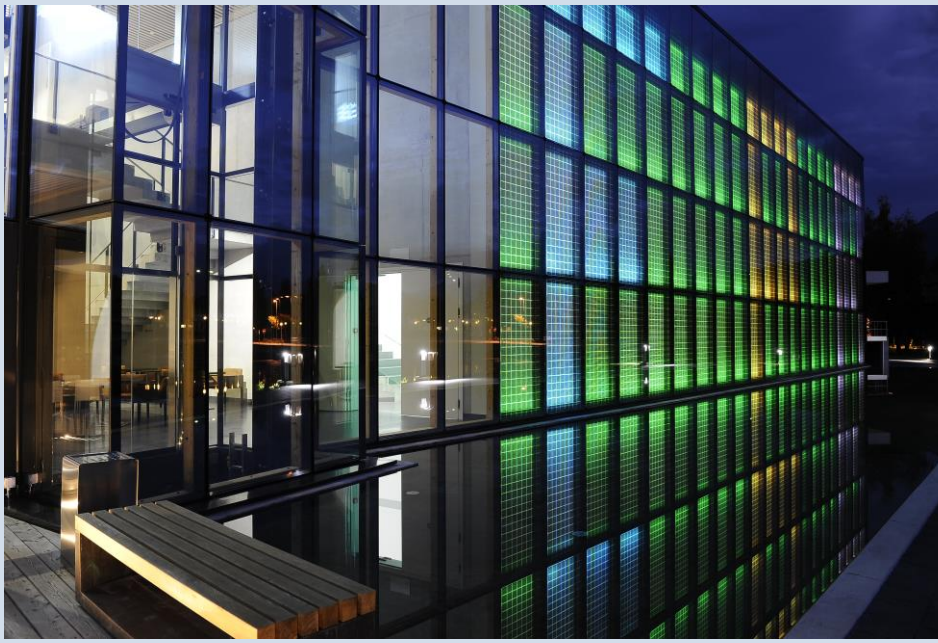
IEA-PVPS

# National Survey Report of PV Power Applications in Austria 2015



PVPS

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

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## Foreword

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) which carries out a comprehensive programme of energy co-operation among its member countries

The IEA Photovoltaic Power Systems Technology Collaboration 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 participating countries and organisations can be found on the www.iea-pvps.org website.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org

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## Introduction

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "*Trends in photovoltaic applications*" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2015. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

# 1 INSTALLATION DATA

The PV power system market is defined as the market of all nationally installed (terrestrial) PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, **PV installations are included in the 2015 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2015, although commissioning may have taken place at a later date**.

## 1.1 Applications for Photovoltaics

Grid-connected plants with a total capacity of 151,806 kWp were installed. Thereof 1973 kWp are roof-integrated and 910 kWp façade integrated. As during the previous years, the off-grid sector plays a minor role in the Austrian PV market (off-grid PV-capacity installed in 2015: 46 kWp). Data about market segments (residential, commercial) is not available.

## 1.2 Total photovoltaic power installed

After the absolute highest market diffusion of photovoltaic (PV) systems in Austria in 2013, the PV market has stabilized in 2014 and 2015. In 2015, off-grid and grid connected PV systems with a total PV power of 151,851 kWp have been installed, which represents a 5.39 % decrease of the domestic market compared to the year before. This led to a cumulated total installed capacity of 937.1 MWp at the end of 2015. On a 10 years basis, an average market growth of 44.25 % per year for all PV installations can be reported. As a consequence the estimated renewable electricity produced by PV amounted to 937.1 GWh in 2015 (~ 1.6 % of the total electricity consumption in Austria) and lead to a reduction in $CO_2$ emissions by 787,126 tons (emission coefficient 2015: 840.0 g$CO_2$-equ/kWh).

**Table 1: PV power installed during calendar year 2015**

| **DC** | | | **MW installed in 2015 (mandatory)** | **MW installed in 2015 (optional but HIGHLY NEEDED)** | **AC or DC** |
|---|---|---|---|---|---|
| **Grid-connected** | BAPV | Residential | 130.09 | | DC |
| | | Commercial | | | |
| | | Industrial | | | |
| | BIPV (if a specific legislation exists) | Residential | 2.88 | | DC |
| | | Commercial | | | |
| | | Industrial | | | |
| | Ground-mounted | cSi and TF | 18.82 | | DC |
| | | CPV | | | |
| **Off-grid** | | Residential | | | |
| | | Other | 0.046 | | DC |
| | | Hybrid systems | | | |
| | | **Total** | **151** | | DC |

**Table 2: Data collection process:**

| | |
|---|---|
| If data are reported in AC, please mention a conversion coefficient to estimate DC installations. | DC Data |
| Is the collection process done by an official body or a private company/Association? | Institute of Renewable Energy<br>University of Applied Sciences Technikum Wien |
| Link to official statistics (if this exists) | PV Market Study 2015:<br>http://www.nachhaltigwirtschaften.at/nw_pdf/201606_marktentwicklung_2015.pdf |
| | Data provided by federal (Austrian Climate and Energy Fund, OeMAG Abwicklungsstelle für Ökostrom AG) and regional funding bodies |

**Table 3: PV power and the broader national energy market.**

| *MW-GW for capacities and GWh-TWh for energy* | 2015 numbers | 2014 numbers |
|---|---|---|
| Total power generation capacities (all technologies) | Not yet available | 24.224 GW[1] |
| Total power generation capacities (renewables including hydropower) | Not yet available | 16.265 GW[2] |
| Total electricity demand (= consumption) | ~ 58 TWh / 60 TWh (including grid losses and own requirements) [3] | ~ 56 TWh / ~ 60 TWh (including grid losses and own requirements) [4] |
| New power generation capacities installed during the year (all technologies) | Not available | Not available |
| New power generation capacities installed during the year (renewables including hydropower) | 152 MW PV<br>323 MW Wind | 159 MW PV<br>411 MW Wind |
| Total PV electricity production in GWh-TWh | ~937 GWh | ~785 GWh |
| Total PV electricity production as a % of total electricity consumption | ~ 1.6 % | ~ 1.4 % |

[1] http://oesterreichsenergie.at/daten-fakten/statistik/stromerzeugung.html

[2] http://oesterreichsenergie.at/daten-fakten/statistik/stromerzeugung.html

[3] https://www.e-control.at/statistik/strom/betriebsstatistik/betriebsstatistik2015

[4] https://www.e-control.at/statistik/strom/betriebsstatistik/betriebsstatistik2014

**Table 4: Other informations**

| | **2015 Numbers** |
|---|---|
| Number of PV systems in operation in your country (a split per market segment is interesting) | < 5kWp: 19,354 PV systems ( 60.531 MWp)<br>> 5kWp: 1,676 PV systems (86.901 MWp)<br>For the rest ( 4.374 MWp) no information is available. |
| Capacity of decommissioned PV systems during the year in MW | No reports about decommissioned systems |
| Total capacity connected to the low voltage distribution grid in MW | No data available |
| Total capacity connected to the medium voltage distribution grid in MW | No data available |
| Total capacity connected to the high voltage transmission grid in MW | No data available |

**Table 5: The cumulative installed PV power in 4 sub-markets.**

| **Sub-market** | Stand-alone domestic | Stand-alone non-domestic | Grid-connected distributed | Grid-connected centralized | **TOTAL (MW)** |
|---|---|---|---|---|---|
| Until 2004 | 2.645 | | 17.262 | 1.153 | **21.060** |
| 2005 | 2.895 | | 19.973 | 1.153 | **24.021** |
| 2006 | 3.169 | | 21.263 | 1,153 | **25.585** |
| 2007 | 3.224 | | 23.721 | 1.756 | **27.701** |
| 2008 | 3.357 | | 27.274 | 1.756 | **32.387** |
| 2009 | 3.605 | | 48.991 | N/A | **52.596** |
| 2010 | 3.812 | | 91.686 | N/A | **95.498** |
| 2011 | 4.502 | | 182.670 | N/A | **187.172** |
| 2012 | 4.722 | | 258.163 | N/A | **362.885** |
| 2013 | 5.190 | | 620.784 | N/A | **625.974** |
| 2014 | 5.498 | | 779.757 | N/A | **785.250** |
| 2015 | 5.535 | | 931.563 | N/A | **937.098** |

## 2 COMPETITIVENESS OF PV ELECTRICITY

### 2.1 Module prices

Table 6 indicates the typical module prices for the year 2015 as quoted by the Austrian manufacturers and installation companies. Compared to the previous years, module sales price of Austrian manufacturers dropped again in 2015. The average wholesale price of Austrian manufacturers in 2015 was 0.60 EUR/W. The average wholesale-price of Austrian planners was 0.56 EUR/W in the year 2015 (2014: 0.60 EUR/W).

**Table 6: Typical module prices for a number of years**

| Year | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| Standard module crystalline silicon price(s): Typical | 1.45<br>1.40 | 0.94<br>0.85 | 0.75<br>0.64 | 0.67<br>0.60 | 0.60<br>0.56 |
| Lowest prices | 0.95 | 0.63 | 0.54 | 0.52 | 0.57 |
| Highest prices | 3.6 | 1.25 | 0.90 | 1,05 | 0.70 |

### 2.2 System prices

A summary of typical system prices is provided in the following tables.

**Table 7**: **Turnkey Prices of Typical Applications – local currency**

| Category/Size | Typical applications and brief details | Current prices per W |
|---|---|---|
| OFF-GRID Up to 1 kW | Prices for off-grid systems vary widely (from 3 to 6.5 EUR/W) depending on the application (DC appliances or AC island grid) and the mounting-site. | ~ 5 EUR |
| OFF-GRID >1 kW | | |
| Grid-connected Rooftop up to 10 kW (residential) | For a 5 kWp System on buildings per kWp | 1,658 EUR |
| Grid-connected Rooftop from 10 to 250 kW (commercial) | For a system > 10 kWp per kWp | < 1,274 EUR |
| Grid-connected Rooftop above 250kW (industrial) | No exact data available (no support for systems > 200kWp)<br>Some larger systems are composed out of many systems < 200kWp | 1000 EUR (est.) |
| Grid-connected Ground-mounted above 1 MW | No systems of this size installed | |
| Other category (hybrid diesel-PV, hybrid with battery…) | No data available | |

**Table 8: National trends in system prices (current) for different applications – local currency**

| Price/Wp | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|
| Residential PV systems < 10 KW | 5.140 | 4.370 | 3.680 | 2.970 | 2.216 | 1.934 | 1.752 | 1.658 |
| Commercial and industrial | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ground-mounted | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

## 2.3 Cost breakdown of PV installations

### *2.3.1 Residential PV System < 10 kW*

**Table 9: Cost breakdown for a residential PV system – local currency**

| Cost category | Average (local currency/W) | Low (local currency/W) | High (local currency/W) |
|---|---|---|---|
| Hardware | | | |
| Module | 0.719 EUR/W | | |
| Inverter | 0.232 EUR/W | | |
| Other (racking, wiring…) | 0.430 EUR/W | | |
| Soft costs | | | |
| Installation | 0.277 EUR/W | | |
| Customer Acquisition | N/A | | |
| Profit | N/A | | |
| Other (permitting, contracting, financing…) | N/A | | |
| **Subtotal Hardware** | 1.381 | | |
| **Subtotal Soft costs** | 0.277 | | |
| **Total** | 1.658 EUR/W | 1350 EUR/W | 2.100 EUR/W |

### *2.3.2 Utility-scale PV systems > 1 MW (N/A)*

**Table 10: Cost breakdown for an utility-scale PV system – local currency**

| Cost Category | Average (local currency/W) | Low (local currency/W) | High (local currency/W) |
|---|---|---|---|
| **Hardware** | | | |
| Module | - | | |
| Inverter | - | | |
| Other (racking, wiring, etc.) | - | | |
| **Soft cost** | | | |
| Installation Labor | - | | |

| | | | |
|---|---|---|---|
| Customer acquisition | - | | |
| Profit | - | | |
| Other (contracting, permitting, financing etc.) | - | | |
| ***Subtotal Hardware*** | | | |
| ***Subtotal - Soft cost*** | | | |
| **Total Installed Cost** | N/A | N/A | N/A |

## 2.4 Financial Parameters and specific financing programs

In 2012 Wien Energie, one of Austria's biggest electric supply companies, started a public participation model for PV in Vienna and Lower Austria, which became very popular especially in urban areas – called "Citizen Solarpower plant"- "BürgerInnensolarkraftwerke".

Private persons have the possibility to buy single PV modules (950 EUR / module) of a solar power plant. After selling all modules successfully, the solar power plant is built and operated by Wien Energie and the private investors will get a 2.25 % revenue every year for leasing their modules to Wien Energie. The minimum contract term is 5 years. At the end of the lifespan of the solar power plant Wien Energie will rebuy the PV modules and the complete amount of the investment will be refunded to the private investors. So far, Wien Energie has built 19 solar power plants, with a capacity between 80kWp and 2,7 MWp each.

A similar public participation model is offered by Energie AG Oberösterreich Fair Energy GmbH in Upper Austria. Private investors will receive an annual remuneration of 3.3 % of their investment. So far, the Energie AG built 23 solar power plants with a total power of 4,5 MWp.

Similar activities (Citizen Solar power plants- BürgerInnensolarkraftwerke) are initiated by many municipalities, mainly in lower Austria.

**Table 11: PV financing scheme**

| | |
|---|---|
| Average rate of loans – residential installations | 2.25 % - 3.3 % |
| Average rate of loans – commercial installations | 2.25 % - 3.3 % |
| Average cost of capital – industrial and ground-mounted installations | _ |

## 2.5 Specific investments programs (see comment above)

| | |
|---|---|
| Third Party Ownership (no investment) | - |
| Renting | - |
| Leasing | - |
| Financing through utilities | - |

| | |
|---|---|
| Investment in PV plants against free electricity | - |
| Crowdfunding (investment in PV plants) | - |
| Other (please specify) | - |

## 2.6 Additional Country information

**Table 12: Country information**

| | |
|---|---|
| Retail Electricity Prices for an household (range) | 0.201 EUR (2015)[5] |
| Retail Electricity Prices for a commercial company (range) | 0.125 EUR (2015) |
| Retail Electricity Prices for an industrial company (range) | 0.125 EUR (2015) |
| Population at the end of 2014 (or latest known) | 8.7 Mill (1.1.2016)[6] |
| Country size ($km^2$) | 83,879 |
| Average PV yield (according to the current PV development in the country) in kWh/kWp | 950 kWh/kWp to 1.100 kWh/kWp [7] |
| Name and market share of major electric utilities. | More than 70 electricity provider, the largest is Energie-Allianz with 3,32 Mio. Customers; this is a composition from 3 energy providers, Wien Enegrie, EVN and Energie Burgenland) |

[5] Österreichs Energie, Eurostat (choosen countries), data status 1. halfyear 2015

[6] http://www.statistik.at/web_de/statistiken/menschen_und_gesellschaft/bevoelkerung/bevoelkerungsstand_und_veraenderung/bevoelkerung_zu_jahres-_quartalsanfang/index.html

[7] Authors estimation

# 3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing or simplifying or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

## 3.1 Direct support policies for PV installations

### *3.1.1 New, existing or phased out measures in 2015*

#### *Description of support measures excluding BIPV, and rural electrification*

In general self-consumption of PV electricity is allowed in Austria, except for PV systems which receive a Feed-In tariff by the national GEA. Until 2013 self-consumption was not charged with a tax, but in March 2014 the Ministry of Finance announced, that self-consumption of PV electricity over 5,000 kWh per year will be charged with 1.5 Cent/kWh in the future. In July 2014 the yearly exemption limit was increased from 5,000 kWh to 25,000 kWh. This tax is not new, but exists since 1996.

*3.1.1.1 BIPV development measures*

Building integrated PV systems up to 5 kWp are supported by the Austrian Climate and Energy Fund, which provides an additional investment subsidy of 100 EUR/kWp (375 EUR/kWp for BIPV instead of 275 EUR/kWp). Some provinces offer higher subsidies from the "Wohnbauförderung" (subsidized housing scheme) if a PV system is installed.

*3.1.1.2 Rural electrification measures*

The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management supports renewable energy systems (e.g. PV, wind power, storages, etc.) in areas not connected to the grid with an investment subsidy up to a maximum of 35 % of the eligible costs.

*3.1.1.3 Support for electricity storage and demand response measures*

Since January 2014 decentralized electricity storages in combination with PV systems are supported in the some province. Styria has a subsidy of 200 to 500 EUR/kWh depending of the storage technology for storage up to 7.5 kWh. Upper Austria supported again the decentralized electricity storages in the second half year of 2015. Since June 2015 in Vienna a limited incentive of 500 EUR/kWh is granted depending on the storage capacity. Burgenland has a non-refundable rebate of 275 EUR/kWh for storages up to 5 kWh.

**Table 13: PV support measures (summary table)**

| | On-going measures residential | Measures that commenced during 2015 - residential | On-going measures Commercial + industrial | Measures that commenced during 2015 – commercial + industrial | On-going measures Ground-mounted | Measures that commenced during 2015 – ground mounted |
|---|---|---|---|---|---|---|
| Feed-in tariffs | Yes | No | Yes | No | Yes | Yes |
| Feed-in premium (above market price) | No | No | No | No | No | No |
| Capital subsidies | *No* | *No* | *No* | *No* | *No* | *No* |

| | | | | | | |
|---|---|---|---|---|---|---|
| Green certificates | No | No | No | No | No | No |
| Renewable portfolio standards (RPS) with/without PV requirements | *No* | *No* | *No* | *No* | *No* | *No* |
| Income tax credits | *No* | *No* | *No* | *No* | *No* | *No* |
| Self-consumption | Yes | *No* | Yes | *No* | Yes | *No* |
| Net-metering | No | No | No | No | No | No |
| Net-billing | No | No | No | No | No | No |
| Commercial bank activities e.g. green mortgages promoting PV | No | No | No | No | No | No |
| Activities of electricity utility businesses | No | No | No | No | No | No |
| Sustainable building requirements | Yes | Yes | Yes | Yes | Yes | Yes |
| BIPV incentives | Yes | Yes | Yes | Yes | Yes | Yes |
| Other (specify) | No | No | No | No | No | No |

## 3.2 Self-consumption measures

| | | | |
|---|---|---|---|
| PV self-consumption | 1 | Right to self-consume | Self-consumption is legally permitted |
| | 2 | Revenues from self-consumed PV | None |
| | 3 | Charges to finance Transmission & Distribution grids | For systems >25.000kWh/a |
| Excess PV electricity | 4 | Revenues from excess PV electricity injected into the grid | Payment through traditional support schemes such as feed-in tariff (FiT) or green certificates (GC): PV electricity gets a value defined by regulation.<br>Many electricity providers take excess electricity to higher tariffs – but mainly in connection to a supply contract. |

| | | | |
|---|---|---|---|
| | 5 | Maximum timeframe for compensation of fluxes | None |
| | 6 | Geographical compensation | None |
| Other characteristics | 7 | Regulatory scheme duration | 13 years |
| | 8 | Third party ownership accepted | - |
| | 9 | Grid codes and/or additional taxes/fees impacting the revenues of the prosumer | self-consumption fee for systems > 25.000kWh/a |
| | 10 | Regulations on enablers of self-consumption (storage, DSM…) | - |
| | 11 | PV system size limitations | None, support only for systems < 200kWp |
| | 12 | Electricity system limitations | Distributors's License |
| | 13 | Additional features | - |

### 3.3 Tenders, auctions & similar schemes

### 3.4 Direct Support measures

### 3.5 Financing and cost of support measures

Until today public support schemes for PV in Austria have shown some discontinuity. The public support schemes are more or less continuously under discussion and experience at least a yearly change, which allows private users and investors only short time planning. The total available budget for supporting PV systems, especially for PV systems above 5 kWp, generally addresses only a small amount of the huge number of prospective buyers of PV systems in Austria. Because of the fact that no public body finances the feed-in tariff system, all electricity consumers have to come up with coverage.

Austria has mainly three levels of supporting PV systems:

Systems up to 5 kWp are supported by the also limited sources of the governmental Austrian Climate and Energy Fund, which provided a limited incentive in form of a non-refundable rebate for new installations for private households up to 5 kWp. This support scheme provides additional financial benefits to building integrated systems (BIPV). This public initiative launched once a year, was opened for the first time in August 2008 by one tender with a total budget of about 8 MEUR. In 2009, the budget was more than doubled to 18 MEUR. In 2010 the support per kWp installation was reduced significantly according to the lower PV prices. For the year 2011 the budget remained the same as in 2010 (35 MEUR) and for 2012 the budget has been reduced to 25.5 MEUR. In 2013 36 MEUR were provided. In 2013 the investment subsidy of 800 EUR/kWp was reduced to 300 EUR/ kWp or to 400 kWp for Building integrated PV systems. For the first time more money was available in 2013, that was required from buyers of PV systems. In 2013 PV systems with a total capacity of 67,867 kWp have been installed under this funding scheme, more than ever before. In 2014 the

budget has been reduced to 26.8 MEUR. Also the investment subsidy was reduced to 275 EUR/kWp or to 375 EUR/kWp for Building integrated PV systems. In 2014 PV systems with a total capacity of 46,197 kWp have been installed under this funding scheme.

In 2015 the budget has been reduced to 17 MEUR. The investment subsidy was 275 EUR/kWp and 375 EUR/kWp for Building integrated PV systems. In 2015 PV systems with a total capacity of 63,974 kWp have been installed under this funding scheme.

For PV systems above 5 kWp a Feed-in Tariff is provided via the national Green Electricity Act (GEA), first issued in 2002, and meanwhile revised several times. Even though the "new RES" are supported by this act, mainly via up to 13 years guaranteed feed-in tariffs, the financial cap (current regulation: new PV-installations leading to another expenses of 8 MEUR per year) is low. The feed in tariffs are stated by the Federal Ministry for Economics and financed by a supplementary charge on the net price and a fixed price purchase obligation for electricity dealers. A significant change of the public support for PV installations (in order to match leading photovoltaic markets) as well as for other "new renewables" (Austria has about 60 % electricity from large hydro power plants) will also most probably not be achieved within the upcoming year. Photovoltaic-Feed-in-tariffs for new installations are defined on a yearly basis in a separate Feed-in Decree. According to the 2015 Feed-in Decree tariffs ranged from 11.5 Cent/kWh for systems above 5 to 200 kWp installed on buildings or noise protections walls. In addition to the feed-in Tariff a unique investment subsidy of max. 200 EUR/kWp is granted for systems installed on buildings or noise protection walls. From 2015 on, systems on open landscape and systems > 200kWp are no more supported.
In 2015 the governmental Austrian Climate and Energy Fund supported PV systems for the Agriculture and Forestry between 5kW to 30kW. For 2015 the budget has been 4 MEUR.

**Table 7: Feed-in tariffs from 2008 to 2014 according to the Feed-in Decree**

| | 2008 (Cent / kWh) | 2009 (Cent / kWh) | 2010 (Cent / kWh) | 2011 (Cent / kWh) | 2012 (Cent / kWh) | 2013 (Cent / kWh) | 2014 (Cent / kWh) | 2015 (Cent / kWh) |
|---|---|---|---|---|---|---|---|---|
| up to 5 kWpeak | 45.99 | 45.98 | - | - | - | - | | |
| above 5 kWpeak up to 10 (20) kWpeak | 39.99 | 39.98 | 35 – 38 | 35 – 38 | 23 – 27.6 | | | |
| above 10 (20) kWpeak | 29.99 | 29.98 | 25 – 33 | 25 – 33 | 19 – 25 | | | |
| above 5 kWpeak up to 500 kWpeak | | | | | | 16.59 – 18.12 | | |
| above 5 kWpeak up to 350 kWpeak | | | | | | | 10.00 (open landscape)- 12.50 (PV on buildings) | |
| above 5 kWpeak up to 200 kWpeak | | | | | | | | 11.50 - 18.00 No support |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | for PV on open landscape |

The total amount of feed-in tariffs paid for PV in 2015 was approximately 131.6 MEUR (2013: 93.3 MEUR), which represents a 70.8 % increase compared to the previous year. The average feed-in tariff paid for PV in 2014 was 25.03 Eurocent/kWh which represents a 7.4 % reduction compared to the previous year (2014: 26.56 Eurocent /kWh).

In addition to the federal incentives almost all provinces continued running their regional support in form of rebates on the costs of the PV system (investment subsidies) in 2015. Burgenland, Salzburg, Styria and Vienna offer such a separate support scheme for PV. Other provinces (Carinthia, Lower Austria, Upper Austria, Styria and Salzburg) offer additional funding by the "Wohnbauförderung" (subsidized housing scheme). Although some subsidy schemes exclude each other, whereas others do not, this situation shows the complex nature of the incentives and the data provided. By this standard only a rough estimate for the total funds spent by the provinces can be provided.

## 3.6 Indirect policy issues

The promotion of electricity from renewable energy sources (RES) is a high European Union (EU) priority for several reasons, including the security and diversification of energy supply, environmental protection and social and economic cohesion.

The 20/20/20 climate and energy targets, set in 2007 by the European Union, have strong influence on Austria. Austria's targets are a total share of the national energy consumption produced from renewable resources to 34 %, a reduction in greenhouse gas emissions of 16 % below 2005 levels emissions in non-ETS sectors and an increase in energy efficiency by 20 % by 2020 as opposed to a business-as-usual scenario.

In the city of Vienna, the local building code foresees the need to install 1 kWp of PV per 100 m² gross floor area at all new industrial and commercial buildings.

In Austria the tax on new cars depends on $CO_2$ pollution-categories.

The Austrian Development Agency (ADA) has co-financed the Caribbean Renewable Energy Development Programme (CREDP) since 2009 and has directly financed investment projects such as the photovoltaic (PV) system at Guyana Energy Agency's (GEA), the PV system at Comision Nacional de Energia in the Dominican Republic, PV-lab Equipment for the Technical Community College in Saint Vincent and the Grenadines, as well as currently on-going projects such as solar water heating at St. Jude's hospital in St. Lucia, PV-LED street lighting in Saint Vincent and the Grenadines, PV system for Government Offices in Antigua and PV-lab equipment for T. A. Marryshow Community College in Granada.
The Austrian Development Cooperation (ADC) supported the establishment of ECREEE since its beginning with the creation of a secretariat in Cape Verde and a network of National Focal Institutions in all 15 ECOWAS member states. ADC will continue to support ECREEE with a core funding to its Business Plan 2011-2016 and the secondment of a technical assistant to ECREEE's secretariat in Cape Verde.

# 4 HIGHLIGHTS OF R&D

## 4.1 Highlights of R&D

For many years, the Austrian PV research activities have mostly been focused on national and international projects: The involved research organisations and companies are participating in various national and European projects as well as in different tasks of the IEA-PVPS Programme and, concerning grid interconnection of renewables, in the IEA ISGAN Implementing Agreement (with Austria joining in 2011). The RTD development approach is widely spread and orientated in a decentralised fashion.

The trend of involvement of Austrian electricity companies investing more and more in renewable power generation has been continued. Sometimes specific departments were founded to establish a business, mainly by investments in new and existing renewable energy plants; due to the insufficient national support for renewables, they frequently invest in other European countries.

PV and the high penetration in some parts of the low voltage network become more and more important drivers for the comprehensive and internationally orientated “Smart Grid” activities in Austria, which are coordinated and supported by the Ministry of Transport, Innovation and Technology. The international “Smart Grids Week” is meanwhile established as one of the main international Smart Grid Events, taking place in different locations in Austria, each time hosted by another utility company.

In addition, the following paragraphs highlight some of the specific PV RTD activities and trends in Austria:

The **Institute of Chemistry and Technology of Materials of the Graz University of Technology** investigates new active materials for solution based PV-technologies. Examples are new organic solar cells, nanocrystal-polymer hybrid solar cells and kesterites.

The **AIT Austrian Institute of Technology GmbH**, Energy Department focuses on the strategic research fields “Electrical Infrastructure” and “Energy for the Built Environment.” The integration of PV into Smart Electricity Networks is in the centre of research efforts in the field of distributed energy resources (DER). Low and high voltage technology, power quality, safety and reliability analysis are investigated. Further, AIT Energy runs a fully-fledged Photovoltaic Module Test

Laboratory, accredited according to EN 17025, for R&D on crystalline and thin-film modules. With this background, research focuses on new PV technologies, advanced experimental investigation, characterisation and modelling of PV modules, cells and systems, as e.g. facility assessment and quality measures for big PV facilities. Regarding PV performance, the simulation of system output and life cycle testing as well as building integrated PV systems (BIPV) are addressed. For the analysis of ageing and failure detection, quantified electroluminescence measurement is available for PV cells and modules of all technologies (crystalline and thin film) as well as the spectrometer radiation measurement in the range of ultra violet, visible light and infrared. On a European level, AIT Energy is participating in the DERlab Network of Excellence, which will become a key partner in the Smart Grid International Research Facility Network (SIRFN). It is involved in large-scale projects like METAPV and EcoGRID as well as in the EU projects DERri (Distributed Energy Resources Infrastructure) and SOPHIA (Photovoltaic European Research Infrastructure), offering access to its research infrastructures in the areas PV, inverter and power technologies. Within the European Energy Research Alliance (EERA) the AIT contributes to develop next-generation energy technologies. On an international level, AIT Energy is engaged in standardisation development for distributed generation and PV systems. It takes part in several IEA PVPS activities, such as Task 13 (Performance and Reliability of Photovoltaic Systems), and holds the lead in Task 14 (High Penetration of PV Systems in Electricity Grids). Further it is partner in the IEA-SHC Task 51 and Task 53.

**Vienna University of Technology, Energy Economics Group (EEG)** covers major topics of teaching and research on Photovoltaics: diffusion of technology and market penetration on national and international level, technology roadmapping and monitoring, non-technical obstacles and supporting factors for diffusion of technology (e.g. socio-economic impact parameters), energy policy design and political economy effects of PV, selected aspects of life cycle analysis (LCA) like energy payback time and CO2 avoidance costs and and life cycle cost. Furthermore PV integration in buildings as well as medium and long term diffusion scenarios of PV.

At the ENERGYBase, one the largest passive solar office building in Austria, the **University of Applied Sciences Technikum Wien** offers Bachelor and Master programmes with a strong focus on PV and other solar technologies. Research at the Department for Renewable Energy is focused on PV strategies as well as on system and building integration. Currently the most promising research project in the building-integrated PV sector is “Dem4BiPV”. The aim of the “Dem4BiPV” project is to develop an innovative and multidisciplinary high quality course for Building-integrated Photovoltaics (BIPV) to train the BIPV professionals of the future. The course will be implemented at the postgraduate level and will be part of a Master’s in Sustainable Energy in a number of leading universities in Europe. Another ambitious project deals with photovoltaic in the climatic-sensible regions with high solar irradiation. The project INFINITY will tackle these challenges by developing innovative components, like climate-sensitive materials, and PV modules tailored for operation under different environmental conditions, and load profiles for emerging markets. These Austrian innovations will be established on global markets and show their viability under real world conditions.

Since 2013 the Department for Renewable Energy also takes part in the IEA PVPS Task 12 (PV Environmental Health and Safety). UAS Technikum Wien has the national lead of the IEA PVPS Task 15 BIPV with a consortium of five partners. Additional UAS Technikum Wien are members of the expert pool BIPV at the EU PV Technology platform and the Austria Technology platform PV.

The research activities of **Austria Solar Innovation Center (ASIC)** are in the field of data evaluation of PV-power plants, also in combination with electrical storage systems, and the development of fault detection systems for inverters. A growing interest can be seen in the integration of PV in energy supply systems and the consideration of PV in energy management systems. Besides this, ASiC

offers consultation for PV as well as teaching and training in collaboration with the Upper Austria University of Applied Sciences, degree programme Eco-Energy Engineering (BSc, MSc). Students have lectures and laboratory classes, where also the 17 kWp PV system - 5 different module types, 5 different inverter types, 2 monitoring/data logging systems, meteorological station - is used for practical training.

The **Institute of Polymeric Materials and Testing (IPMT)** was established in 09/2009 as one of the key institutes towards the implementation of a strong Polymer Technology and Science program at Johannes Kepler University Linz (JKU). As of 10/2011, new premises in the new Science Park (Buildings 2 and 3), amounting to about 1.300 m² for offices and laboratory space and equipped with most modern infrastructure, have been made available to the Institute.
The IPMT research profile is dedicated to the overall theme of "polymeric materials for technologies promoting Sustainable Development". Main research activities are related to the following fields:

- Water supply and disposal: plastics pipes and fittings for fresh water, waste water and sanitation, agriculture, etc.
- Energy services: polymeric materials for renewable energy technologies (solar, wind, water) and enhanced energy efficiency.
- Mobility and transport: polymeric materials and composites for light and ultra-light vehicles.
- Economic and ecological perspectives: role of polymeric materials and polymer technologies in Sustainable Development scenarios.

Due to the experience and proven competency of JKU-IPMT in managing large multi-partner research programs, the institute also acts as project coordinator in currently on-going projects. In 2010, the JKU-IPMT started the solar research project SolPol-3 ("Solar-electrical Systems based on Polymeric Materials: Novel Polymeric Encapsulation Materials for PV Modules"; www.solpol.at).

The **Polymer Competence Center Leoben (PCCL)** is working in the field of polymeric encapsulation materials for PV modules. Since 2003 the main focus of the research is set on durability testing, lifetime modelling and aging characterization of polymeric materials and components as well as the evaluation and qualification of new materials for PV encapsulation. A further research focus is the establishment of correlations between material properties, processing parameters and PV module quality and reliabilty.

**CTR Carinthian Tech Research AG** is an industry-oriented research and development centre for smart sensors and systemintegration. As the largest non-university research centre in southern Austria, CTR has gained a reputation for expertise in R&D sensor technologies serving science and industry at both a national and international level. CTR features in the COMET programme with "ASSIC Austrian Smart Systems Integration Research Center" as a K1 centre of excellence. Besides this strong focus to sensors and system integration also energy research is a main topic. Resreach and development along the whole renewable energy value chain, especially in photovoltaics is done by CTR.

**Austrian Research Institute for Chemistry and Technology (OFI)**, is working on cooperative research projects (R&D&I) in the field of PV-material, component and modul reliability testing with special focus on the analytical evaluation of ageing and degradation effects of polymeric components and anorganic surfaces. Failure analysis, material compatibility testing as well as accelerated ageing experiments under varying environmental and climatic conditions are our core areas. The development of facade-elements with PV-active layers is currently our main project in the area of Building integrated Photovoltaics (BIPV).

## 4.2 Public budgets for market stimulation, demonstration / field test programmes and R&D

The major institutions dealing with research and development policy are the Federal Ministry of Transport, Innovation and Technology (BMVIT) and the Austrian Climate and Energy Fund (KLIEN. These are the major organizer and facilitator for public R&D activities in Austria. The majority of public R&D programmes operate under these institutions and there are several programmes, which focus on energy-related fields. There is no programme specifically dedicated to PV R&D, but the topic is mainly funded within the framework of the energy R&D programmes.

Two national programmes, "Energieforschung" by the Austrian Climate and Energy Fund, as well as "Stadt der Zukunft" by the Ministry of Transport, Innovation and Technology cover broad research items on energy technologies including a specific PV focus. "Energieforschung" follows in the footsteps of its predecessor "e!MISSION.at" to further the goal of more research in the areas cost reduction of clean power and highly efficient technologies. Both programmes connect science and economy on a profitable level with a focus on scientific breakthroughs and sustainable product placement in the market. It is important to provide Austrian companies with the possibility to thrive in this very important sector also on a transnational level. Thus, Austria participates in SOLAR-ERA.NET „Solar Electricity for the Implementation of the Solar Europe Industry Initiative".

The total amount of energy related research funding indicated for the year 2015 was 128.4 MEUR (2014: 143.1 MEUR, 2013: 124.5 MEUR, 2012: 120 MEUR, 2011: 121 MEUR). In 2014 renewable energy received about 22.1 MEUR (17.2 %) of the Austrian Energy R&D, compared to 32.4 MEUR (22.64 %) in 2014. The area of energy efficiency received 44,4 % (2013: 43 %) and the area of Storage and Grid received 27.9 %. These three areas clearly show the priority of the publicly financed energy research in Austria. About 950 R&D projects and activities were registered and analysed for the year 2015 (2014: 1,100). In 2015 the overall public spending for PV research and development was about 22.1 MEUR (2014: 19.4 MEUR).[8]

Not included in these figures is the return from European Community (EC) R&D projects. As a member of the European Union, Austria contributes to the EC R&D framework programmes (FP), hence the return can be ultimately regarded as a part of public spending.

There are no specific figures available for the share of Demonstration or Field Test activities but as there was no demonstration or field test programme running in 2014 and 2015.

The total governmental budget allocated for PV R&D and Demonstration is shown in Table 14.

**Table 14: Public budgets for R&D, demonstration/field test programmes and market incentives.**

| | R & D | Demo/Field test |
|---|---|---|
| National/federal | 22.1 MEUR(2015)<br>19.4 MEUR(2014) | N/A |
| State/regional | N/A | N/A |
| Total | 22.1 MEUR(2015)<br>19.4 MEUR(2014) | |

[8] Andreas Indinger, Marion Katzenschlager (2016) Energieforschungserhebung 2015 – Ausgaben der öffentlichen Hand in Österreich. BMVIT Schriftenreihe 14/2016

## 4.3 Production of feedstocks, ingots and wafers (crystalline silicon industry)

No production facilities for silicon feedstock or wafers existed in Austria in 2015.

However there is substantial production of photovoltaic thin film components. The company **Plansee High Performance Materials** – headquartered in Tyrol - manufactures components made of refractory metals and metallic composite materials. For the production of back contacts and absorber layers in CIGS solar cells the company supplies high quality sputtering targets. Sputtered layers are highly reflective and conductive and are therefore used for increasing the efficiency on solar panels. The material portfolio includes: molybdenum, tungsten, copper, aluminium, CuGa, CuInGa, and new alloys such as molybdenum-sodium and corrosion resistant molybdenum-tantalum.

There are no producers of silicon feedstock, ingot or wafer producers active in Austria.

**Table 15: Production information for the year for silicon feedstock, ingot and wafer producers**

| Manufacturers (or total national production) | Process & technology | Total Production | Product destination (if known) | Price (if known) |
|---|---|---|---|---|
| - | Silicon feedstock | tonnes | | |
| - | sc-Si ingots. | tonnes | | |
| - | mc-Si ingots | tonnes | | |
| - | sc-Si wafers | MW | | |
| - | mc-Si wafers | MW | | |

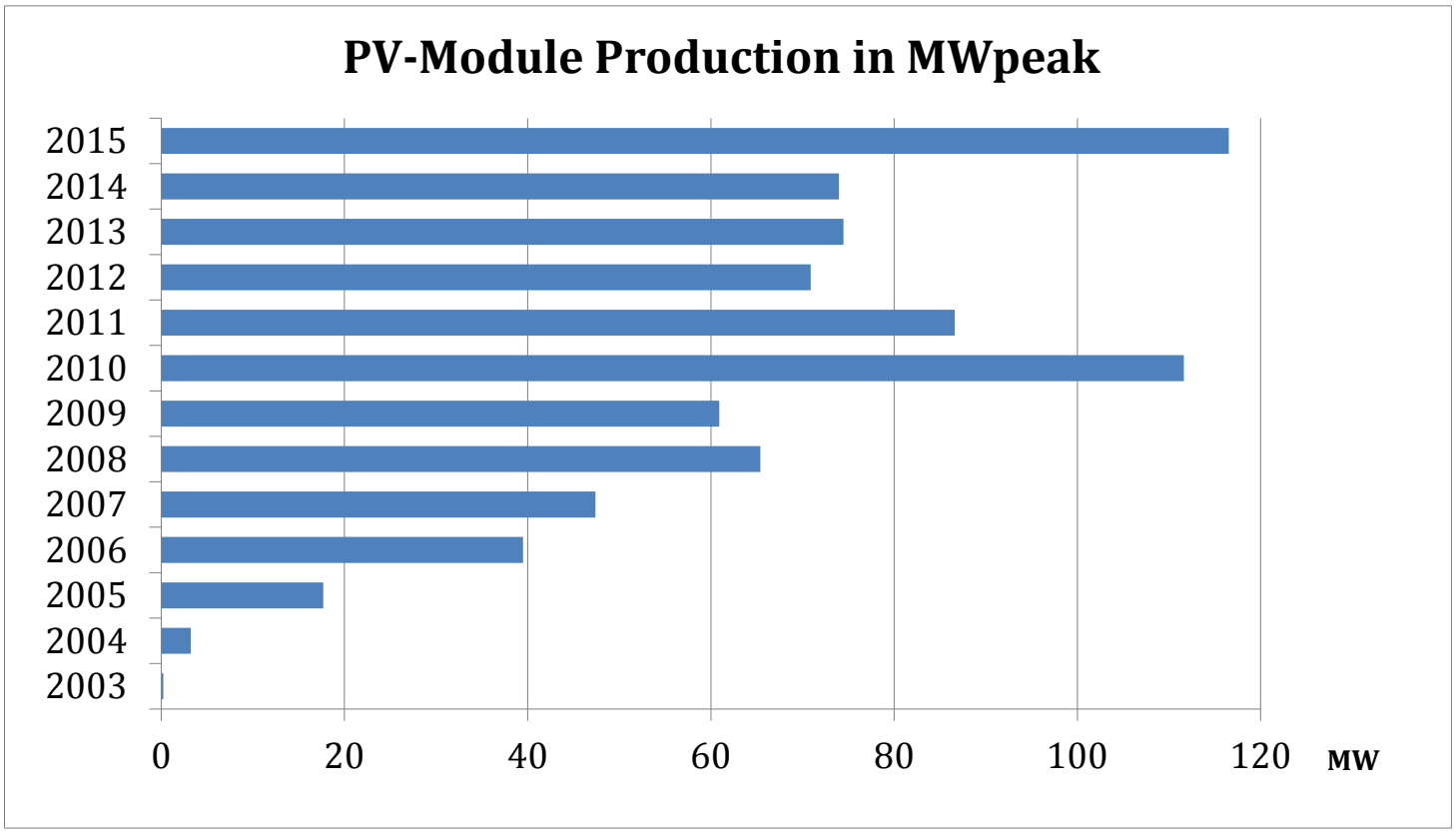
**Describe briefly the overseas activities of any key companies also operating in other countries.**

## 4.4 Production of photovoltaic cells and modules (including TF and CPV)

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

In total, Austrian module manufacturers had to register an increase in their production compared to the previous year. The total module production in 2015 amounted to 116.52 MWp. Compared to 73.98 MWp in 2014 this figure represents a decrease of 57.5 % (see **Figure 1**). About 57 MWp of this production volume was sold to Austrian companies, which represents an increase of 47.6 %. At the same time, the export rate of Austrian modules increased by 67.8 % from 35.10 MWp in 2014 to 58.85 MWp in 2015.

**Figure 1: Development of PV module production in Austria since 2003; Data source /graph: Technikum Wien**




Currently the following Austrian companies are involved in the production of PV-modules, namely:

**Kioto-Photovoltaic**, since 2004 produces mono- and multi-crystalline solar modules based on 6“ wafers in St.Veit/Carinthia.

Although present in PV market as a contractor from 1995, **Energetica Energietechnik GmbH** has been producing PV modules since 2004 at its own production facility. The core competences are the production of PV-modules but Energetica also acts as a system provider and project contractor on a global scale.

**Ertex Solartechnik GmbH** realized approximately 1000 BIPV projects in the past 10 years. Their main product is the laminated safety glass module (VSG), which can be also easily assembled to insulating glass. ertex solar is merging the glass world with the PV world. Therefore the company hold since several years the approval from the German DIBt (Deutsches Institut für Bautechnik) and also the IEC certification form the PV industry.

**PV Products GmbH** is renamed into PVP Photovoltaik GmbH in April 2015. The current production capacity is 30MW and the production focus is next to standard glass-foil modules also for double glass modules. These double glass modules can be used for standard applications and also for BIPV projects, based on laminated safety glass. PVP produced also all the PV modules for the biggest photovoltaic façade in middle Europe: TU-Wien, with around 328kWp of PV installation in the facade.

**PVT-Austria** is the first manufacturer of high quality silicon solar panels in Austria since the year 2001. In 2006 PVT-Austria started its own silicon solar cell production, the first and only one in Austria and produces standard silicon solar cells, coloured silicon solar cells, transparent silicon solar cells and silicon solar cells with asymmetric angles.

**Sunplugged GmbH**, based in Tyrol, develops and manufactures flexible photovoltaic modules for the integration into vehicles, devices and building skins. Sunplugged´s expertise comprises lightweight

PV modules for mobile applications as well as a proprietary flexible thin-film solar cell for building and product integrated photovoltaics.

Since 2013 **MGT-esys**, located in Vorarlberg, is producing tailor made PV modules for BIPV applications.

**DAS Energy GMBH** was founded in 2010. Headquarter is located in Wiener Neustadt on the premises of Diamond Aircraft Group. Core competence lies in the innovative development of an ultra-lightweight, flexible PV module.

The **Sun Value (SV) Modulproduktion GmbH** is an international project developer of solar projects, which has independently and successfully developed and built numerous projects in recent years. The SV Modulproduktion GmbH has proven to be very reliable and innovative company in emerging markets and has constructed projects in time, even under the most difficult conditions. In 2011, SV Modulproduktion GmbH in Ostermiething / Austria, in contrast to many migrating companies, built its own production facility for crystalline solar modules with an annual capacity of 100 MWp. With this move, SV Modulproduktion GmbH is able to supply projects with high-quality modules from its own production.

Total PV cell and module manufacture together with production capacity information is summarised in Table 16 below.

**Table 16: Production and production capacity information for 2015**

| **Cell/Module manufacturer (or total national production)** | **Technology** (sc-Si, mc-Si, a-Si, CdTe) | **Total Production (MW)** | | **Maximum production capacity (MW/yr)** | |
|---|---|---|---|---|---|
| | | Cell | Module | Cell | Module |
| *Wafer-based PV manufactures* | | | | | |
| **1 Ertex Solar** | | a | | b | 3 |
| **2 Energetica Industries GmbH** | | c | 16 | e | 103 |
| **3 Others** | | | 101 | | 161 |
| Total | | | *117* | | |
| *Thin film manufacturers* | | | | | |
| **1** | | x | *x* | y | *y* |
| **2** | | | | | |
| | | | | | |
| *Cells for concentration* | | | | | |
| **1** | | g | | h | |
| | | | | | |
| | | | | | |
| **TOTALS** | | **a+c+x+g** | **117** | **b+e+y+h** | **261** |

## 4.5 Manufacturers and suppliers of other components

Besides PV-module production, various other companies are manufacturing components for modules and BOS-components like batteries, inverters, cell wiring or mounting systems.

PV Inverters:

Austria has a long tradition as one of the largest inverter producing countries in Europe. **Fronius International** has developed and produced inverters for grid-connected PV systems since 1992. With a current production capacity of approx. 2.2 GW of inverter power, Fronius is among the top inverter manufacturers in the world. The Solar Energy division has sales subsidiaries in 14 countries such as Australia, Germany, Italy, France, Turkey and USA.

In 2014 a total of 1,350 MW of inverters (rated AC output capacity) were produced. Compared to 2014 with an output of 587 MW there was increase of 43%. Since the majority of the market for the local producers lies in export (~ 91 %), the global situation of budget cuts carries through to the sales numbers.

Balance of System:

Besides inverter manufacturing, Austria hosts some of the largest manufacturers of specialised BOS and other components for the production of PV modules.

**ISOVOLTAIC AG**, headquartered in Lebring/Styria, is the global market and technology leader in the development and production of backsheets for photovoltaic modules. The well-established ICOSOLAR® backsheets and encapsulants provide long-term protection for solar cells and ensure that sunlight can be efficiently converted into energy. The company has more than 25 years of experience in the development and production of high-quality composite protective sheets for solar cells. About 98 % of all production is exported.

**Ulbrich Solar Technologies**, Inc. is a world leader in the manufacture of tin coated copper wire (PV ribbon) for the solar industry.

**Plansee High Performance Materials** is a subsidiary of the Plansee Group manufacturing refractory metals for diverse applications; more particularly metallic targets for thin film solar cells.

**HEI Technology** International GmbH is a leading Austrian Energy Technology Company specialised in developing and manufacturing of solar stand-alone as well as grid-connected LED outdoor lighting systems. The products combine superior design together with innovative technology into a uniform and integrated whole. The company started production in 2007 and is rapidly expanding fabrication facilities. At present, lighting projects are done mainly in Southern Europe, the Middle East and North Africa.

**Lisec Austria GmbH** provides fully automatic production lines for any kind of PV modules based on the Lisec encapsulation technology, which benefits from 50 years of experience in the production of insulating glass. The tempered thin glass used for the glass-glass modules and the additional edge sealing guarantees more robust, absolutely diffusion proof and highly efficient PV-modules.

**Welser Profile** is the leading manufacturer of special profiles, tubes and complete profile systems from steel and non-ferrous metal, for almost all market sectors. The Welser Group supplies the photovoltaic industry with products such as support posts, module carrier frames and longitudinal beams. These specially tailored profiles are designed to meet the static loading requirements of PV modules and solar collector frames. Through expert advice and guidance on the right choice of material and cross-section, custom-made solutions are designed and manufactured to provide quick and easy installation.

**Ebner Industrieofenbau** is a leading manufacturer of industrial controlled atmosphere heat treatment furnace facilities. In the area of renewable energy, solutions for the thermal treatment of

Thin Film precursors are offered. These applications benefit from the experience Ebner has collected in supplying precision controlled atmosphere furnace technology for the steel, aluminium and copper-base metal industries. The pioneering concepts for the renewable energy applications create new perspectives in offering environmentally friendly and energy efficient high productivity solutions.

**Phoenix Contact**, has many years of experience in overvoltage limiting devices which are produced for the photovoltaics industry.

Storage batteries and Battery charge controllers:

**Banner GmbH** is Austria's only battery producer, focussed on automotive batteries, but also producing batteries, which can be used for storage systems for PV.

**Neovoltaic AG** is offering battery storage systems for PV from 5 kWh to 54 kWh.

The Tyrolean company **enerChange Gmbh** is developing a new generation of storage systems for mobile as well as for stationary purposes. The "changePack" is especially developed for electric vehicles – instead of charging for hours, the batteries can be changed within minutes.

Beside the production of inverters **Fronius International** is developing the world's first TÜV Süd certified hydrogen-powered fuel cell system that generates electricity without any emissions. The Energy Cell converts the energy stored in hydrogen directly into electrical power. For quarter 4/2014 Fronius launched a battery storage system, consisting of a new hybrid inverter for PV and storage, a solar battery and a Smart Meter.

**Energy 3000 GmbH** is offering battery storage systems for PV and E-mobility.

**Akkutron Handels GmbH** was founded in 2008 as a distributor for battery systems. In 2013 Akkutron started the development of a LiFePO4-Battery for customer specific requirements.

**BlueSky Energy Entwicklungs- & Produktions GmbH** produces batteries and storage solutions for micro-grids and renewable energy sources. Together with the strategic partner ViZn Inc. BlueSky is producing innovative zinc iron redox flow batteries.

Supporting Structures:

Since 2008, the **Austrian Photovoltaic Technology Platform** brings together industries with a production site in Austria with R&D institutes and universities. The platform is aiming at joint innovation processes as well as improving the frame conditions for the Austrian PV industry development. The University of Applied Sciences Technikum Vienna currently coordinates the platform.

**Austrian Institute of Technology, Energy Department**, is known as internationally accredited PV module test institute for crystalline modules (since 2003) according to the IEC/EN 61215, and for thin film modules, according to the IEC/EN 61646 and module safety qualification according to the EN 61730. Another industry related activity at the AIT are PV inverters, in particular their performance (MPP, efficiency aspects) and their grid compatibility (Control, Fault-Ride-Through). The AIT PV inverter laboratory attracts worldwide inverter manufacturers for collaboration.

# 5 PV IN THE ECONOMY

## 5.1 Labour places

In total it can be estimated that at the end of 2015 approximately 2,936 full-time jobs (2013: 3,213 jobs) were directly linked to PV R&D, manufacturing and installation in Austria. In the various sectors

the following figures (Table 17) represent an estimation of existing work places, based on information from the manufacturing companies and R&D institutions.

**Table 17: Estimated PV-related labour places in 2015**

| | |
|---|---|
| Research and development (not including companies) | 578 |
| Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D | |
| Distributors of PV products | |
| System and installation companies | 2358 |
| Electricity utility businesses and government | N/A |
| Other | N/A |
| **Total** | 2,936 |

## 5.2 Business value

In 2015 about 152 MWp (2014: 159 MWp) of PV systems were installed in Austria, which led to a cumulated total installed capacity of 937 MWp. As a consequence the sum of produced renewable electricity by PV plants in operation amounted to 937 GWh in 2015.The average specific price of a grid-connected 5 kWp photovoltaic plant in Austria decreased from 1,752 EUR/kWp to 1,658 EUR/kWp. This observation confirms a high economic learning rate, which is highly correlated to the strongly increasing world market. Based on this average turnkey price for on-grid connected systems, the estimated value of the national installation market increased to about 252 MEUR (2014: 280 MEUR). Table 18 provides an overview on the estimated value of PV business in Austria, total export and import of PV products as well as the domestic market.

**Table 18: Value of PV business**

| **Sub-market** | **Capacity installed *in 2015* (MW)** | **Price per W** *(from table 7)* | **Value** | **Totals** |
|---|---|---|---|---|
| **Off-grid domestic** | *X* | *Y* | *a = X x Y x 1 000 000* | |
| **Off-grid non-domestic** | 0.046 | *~ 5.00 EUR/W* | *b* | *230.000 EUR* |
| **Grid-connected distributed** | 151.806 | 1.658 *EUR/W* | *c* | *251.694.000 EUR* |
| **Grid-connected centralized** | | | *d* | |
| | | | | *a+b+c+d* |
| **Export of PV products** | | | | *N/A* |
| **Change in stocks held** | | | | *N/A* |
| **Import of PV products** | | | | *N/A* |
| *Value of PV business* | | | | ***251.924.000*** |

If possible, please provide some brief comment on the industry value chain in your country or provide references to articles, reports dealing with this topic.

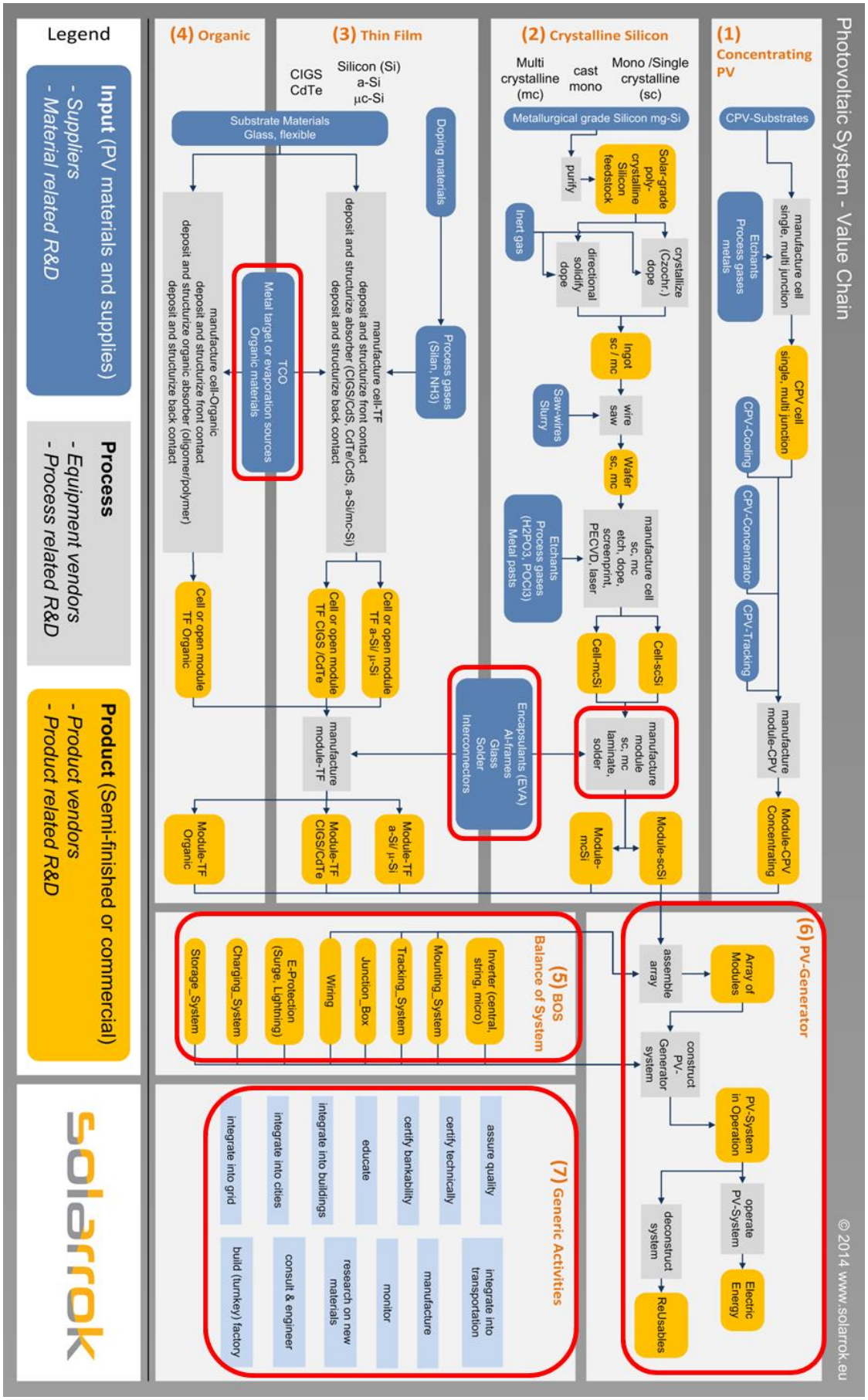
In 2015 about 50.5 % of the Austrian PV module production was exported, compared to almost 47.4 % in 2014. The export ratio of the Austrian inverter production (91 %) remains high, also the production volumes increases significantly in 2014 from 587 MWp to 1.350 MWp. Due to the variety of PV related products manufactured by Austrian industry, no reliable estimation can be provided for the import/export and business value of these products.

Industry value chain:

The following PV value chain gives an overview of the PV industry in Austria (Figure 2). All inputs, products and processes produced or operated by Austrian companies are marked with a red border. Austrian producers can be found in the following areas:

- encapsulants (EVA), all-frames, glass, solders, interconnectors
  e.g. Isovoltaic AG, Ulbrich of Austria, Lisec Austria GmbH
- TCO, metal targets and evaporation sources, organic materials
  e. g. Plansee High Performance Materials
- manufacture module sc, mc, laminate, solder
  e. g. Energetica Energietechnik GmbH, Ertex Solartechnik GmbH, Kioto-Photovoltaic, PV Products GmbH, PVT-Austria, SED Produktions GesmbH, Sunplugged GmbH, MGT-esys
- Balance of system
  e. g. Fronius International, Welser Profile, LEBAU Partnernetzwerk & Bau GmbH, Phoenix Contact, Gebauer & Griller Kabelwerke Gesellschaft m.b.H.

Figure 2: PV value chain for Austria; Data source: SOLARROK 2014



# 6 INTEREST FROM ELECTRICITY STAKEHOLDERS

## 6.1 Structure of the electricity system

Short description of the electricity industry landscape

Since the fully liberalization in 2001 the Austrian electricity market operates within a framework that consists of the relevant legislation at EU (Electricity Directive 2009/72/EC), Austrian (Electricity Act – ELWOG Elektrizitätswirtschafts- und organisationsgesetz) and provincial level (e.g. the Vienna Electricity Act - Wiener Elektrizitätswirtschaftsgesetz).

During the course of the liberalization, a number of great technical and organisational changes resulted for market participants. First of all, the operation of the grids was separated from competitive activities, such as generation, wholesale and retail, which means an unbundling of the vertically integrated electricity utilities in Austria.

Furthermore so-called balance groups were introduced to enable consumers, generators, suppliers and wholesalers to trade or conclude deals with each other. Whoever takes electricity off the grid, feeds in or trades must be member of a balance group.

The E-Control is the politically and financially independent regulator of the Austrian Electricity market. The main tasks are to strengthen competition and ensure that this does not compromise security of supply and sustainability.

At the end of 2014 about 140 distribution system operators (DSO) existed in Austria. These distribution system operators are responsible for secure grid operation, for metering and for handling and processing grid user.

## 6.2 Interest from electricity utility businesses

In 2014 and 2015 some Austrian DSOs announced that PV has reached a critical penetration in some network segments. This question of PV grid integration becomes an important national enabler for Smart Grids in Austria.
As already mentioned, some electricity utilities started public participation models for PV.

## 6.3 Interest from municipalities and local governments

From 2014 almost all provinces offered support in form of investment subsidies in addition to the federal incentives. Salzburg, Styria, Tyrol and Vienna offer a separate support scheme for PV. Other (Burgenland, Carinthia, Lower Austria, Upper Austria, Styria and Salzburg) offers additional funding by the subsidized housing scheme. Only in Vorarlberg and Lower Austria no regional support was available in 2015. Since 2014 decentralized electricity storages in combination with PV systems are supported in some provinces.

## 7 HIGHLIGHTS AND PROSPECTS

Highlights:

In 2015, off-grid and grid connected PV systems with a total PV power of 151.85 MWp have been installed, which led to a cumulated total installed capacity of 937.1 MWp at the end of 2015. In 2015 1.6 % of the total electricity consumption in Austria was provided by photovoltaic (2014: 1.4%). This is an important step towards the target of the Austrian Photovoltaic Association, who announced 8 % of total electricity by PV to be realistic until 2020, if the support system will become more reliable and some framework conditions will be changed accordingly.

For the second year in a row the home market became more important for Austrian module manufacturer than the export market. Nevertheless the international PV market will remain the basis for growth and will help to strengthen the position of Austria as an important supplier of components for PV systems.

The annual National Photovoltaic Conference 2015 (a two day event), organised by some of the main PV stakeholders and supported by the Ministry of Transport, Innovation and Technology, was once again a great success, with more than 300 experts participating. This conference is established as The annual come together of the Austrian PV stakeholders.

Prospects:

Austrian photovoltaic R&D is conducted in thin layer technology, grid integration and building integration. Especially the development of building integrated photovoltaic elements is of high importance and can represent a very attractive market segment for future development of the Austrian photovoltaic industry. High added value seems to be achievable in this market branch. In this context the OFI together with 8 partners started the project PV@Fassade - Fassadenelement mit PV-aktiven Schichten“ in spring 2014. Another national project named “Shape-PV – The shape of BIPV to come: Concept” aims to perform a screening of the existing technical solutions for the energy balance of buildings in Austria. Moreover, it covers building engineering aspects, structural physics, and legal frameworks for each architectural period, and highlights obstacles or barriers. A screening of an energy efficiency analysis is performed considering regional aspects and the specific Austrian situation. The concept comprises technical as well as economic issues in a number of analyses and expert evaluations (adaptation of architectural and technical requirements, PV system aspects). These projects, sponsored by the Austrian Climate and Energy Fund, are dealing with the integration of PV in facades. In international context Austria is participating in the “Dem4BiPV” project. “Dem4BiPV“ is based on the principle of European cooperation through which innovative educational material utilizing ICTs will emerge on the topic of BIPV, which is of crucial importance for the future development and penetration of the PV market in Europe with a potential significant contribution in meeting Europe’s energy challenges. Education and training are crucial for both economic and social progress, and aligning skills with labour market needs plays a key role in this.

Austria is participating in IEA PVPS Task 15 BIPV and is member of the expert pool BIPV at the EU PV Technology platform. The national technology platform Photovoltaics, is also strong focused on BIPV. To strengthen the competitiveness and expand the value creation for the Austrian market the Technology Platform Photovoltaic (TPPV) was founded in 2009 by companies involved in the PV production of PV components.

Furthermore, due to the increased deployment of PV-systems, the question of PV grid integration becomes an important national enabler for Smart Grids.

## Definitions, Symbols and Abbreviations

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40 W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/$m^2$, cell junction temperature of 25°C, AM 1,5 solar spectrum – (also see 'Rated power').

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

CPV: Concentrating PV

Hybrid system: A system combining PV generation with another generation source, such as diesel, hydro, wind.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as 'stand-alone PV power system'. Can also provide power to domestic and community users (plus some other applications) via a 'mini-grid', often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as 'stand-alone PV power system'.

Grid-connected distributed PV power system: System installed to provide power to a grid-connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer's premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated with storage battery maintenance/replacement are excluded. If additional costs are incurred for

reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunication system in a remote area are excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, electricity utility businesses etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is EUR.

PV support measures:

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| Feed-in tariff | an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh that may be higher or lower than the retail electricity rates being paid by the customer |
| Capital subsidies | direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost |
| Green electricity schemes | allows customers to purchase green electricity based on renewable energy from the electricity utility business, usually at a premium price |
| PV-specific green electricity schemes | allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price |
| Renewable portfolio standards (RPS) | a mandated requirement that the electricity utility business (often the electricity retailer) source a portion of their electricity supplies from renewable energies |
| PV requirement in RPS | a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside) |
| Investment funds for PV | share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends |
| Income tax credits | allows some or all expenses associated with PV installation to be deducted from taxable income streams |

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| Compensation schemes (self-consumption, net-metering, net-billing…) | These schemes allow consumers to reduce their electricity bill thanks to PV production valuation. The schemes must be detailed in order to better understand if we are facing self-consumption schemes (electricity consumed in real-time is not accounted and not invoiced) or net-billing schemes (the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity account is reconciled over a billing cycle). The compensation for both the electricity self-consumed and injected into the grid should be detailed. Net-metering schemes are specific since they allows PV customers to incur a zero charge when their electricity consumption is exactly balanced by their PV generation, while being charged the applicable retail tariff when their consumption exceeds generation and receiving some remuneration for excess electricity exported to the grid |
| Commercial bank activities | includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems |
| Activities of electricity utility businesses | includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models |
| Sustainable building requirements | includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development |

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