IEA INTERNATIONAL ENERGY AGENCY

TRENDS 2015

IN PHOTOVOLTAIC APPLICATIONS EXECUTIVE SUMMARY

PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

Report IEA-PVPS T1-27:2015

FOREWORD

The IEA PVPS Programme is proud to provide you with its 20th edition of the international survey report on Trends in Photovoltaic (PV) Applications up to 2014.

Tracking the global progress in PV markets and industry systematically since 1992, the "Trends Report" is one of the flagship publications of the IEA PVPS Programme and an important source of unbiased and objective information. The unique series of "Trends Reports" has covered the transition of PV technology from its early and expensive niche market developments in the 1990s to the recent large scale global deployment and increased competitiveness. 2014 has confirmed the global markets trends and the consolidated market development observed since 2013. The rise of PV markets in Asia and America has been confirmed. Overall, 34 GW of PV were installed in the IEA PVPS member countries during 2014 (2013: 33 GW), whereas the global PV market is estimated to be at around 40 GW. The global installed total PV capacity is estimated at roughly 177 GW at the end of 2014. PV system prices have seen a slower decline than in the years before or even small increases, confirming that the speed of future cost reduction is likely reduced. On the industry supply side, the "bottom of the valley" appears to be overcome and supply is starting to be renewed and/or increased whereas competition remains high. Policy support continues to be relevant but is quickly moving towards new more market oriented business models. In many regions of the world, PV is becoming one of the least cost options for electricity generation from new renewable energy technologies. All of these developments are accompanied by continuous technology evolution, making PV a growing player in the energy field. With its rising level of penetration in electric grids, PV is more and more affecting electricity systems as a whole and the integration into various technical and economic environments becomes crucial. Quantitatively, the number of countries experiencing PV as an essential part of their electricity supply is increasing, with Italy in first place with around 8% of annual electricity demand coming from PV, followed by Greece (> 7%) and Germany (close to 7%). The number of countries covering more than 1% of their electricity supply from PV has increased to about 20 and 2014 has been the first year, where PV has had a share of more than 1% of the global electricity supply. Altogether, these are encouraging signs of a maturing industry which is however only at the early beginning of its future market relevance. Learn all about the details of this exciting development by reading through our 20th edition of the Trends Report!

Stefan Nowak
Chairman
IEA PVPS Programme

WHAT IS IEA PVPS?

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA carries out a comprehensive programme of energy cooperation among its 29 members and with the participation of the European Commission. The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the collaborative research and development agreements within the IEA and was established in 1993. The mission of the programme is to "enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems."

The participating countries are Australia, Austria, Belgium, Canada, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Solar Electric Power Association, the Solar Energy Industries Association and the Copper Alliance are also members.

The TRENDS 2015 Report

The Trends report's objective is to present and interpret developments in the PV power systems market and the evolving applications for these products within this market. These trends are analysed in the context of the business, policy and nontechnical environment in the reporting countries. This report is prepared to assist those who are responsible for developing the strategies of businesses and public authorities, and to support the development of medium term plans for electricity utilities and other providers of energy services. It also provides guidance to government officials responsible for setting energy policy and preparing national energy plans. This report presents the results of the 20th international survey. It provides an overview of PV power systems applications, markets and production in the reporting countries, as well as elsewhere at the end of 2014 and analyses trends in the implementation of PV power systems between 1992 and 2014.

This executive summary presents some of the most important features of the 20th edition of this IEA PVPS TRENDS 2015 report.

Data: IEA PVPS Reporting Countries and additional contributors (see the full version)
Analysis: Gaëtan Masson, IEA PVPS Task 1
Editing: Mary Brunisholz, IEA PVPS

PICTURE CREDITS
Cover Picture: 100 kW PV system on top of the Denver Museum of Nature and Science

ISBN: 978-3-906042-37-4

THE GLOBAL PV MARKET: 2014, A YEAR OF NON-HOMOGENEOUS GROWTH

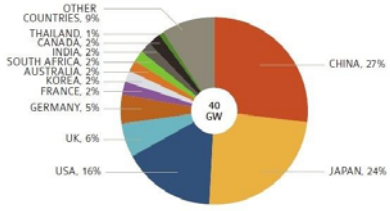
IEA PVPS has distinguished itself throughout the years by producing unbiased reports on the development of PV all over the world, based on information from official government bodies and reliable industry sources. This executive summary of the 20th edition of the "Trends in Photovoltaic Applications" aims at providing a summary of the information about how the PV market developed in the last year. The 20th edition of the IEA PVPS completes "Trends in Photovoltaic Applications" report has been published in October 2015.

In 2014, the PV market experienced a new year of development, with a limited expansion globally. The 24 IEA PVPS countries installed at least 34,3 GW of PV in 2014, with a minimum worldwide installed capacity amounting to 39,8 GW. However, the limited growth hides many contrasted developments in various regions. Firstly, the stabilisation of the Chinese PV market with 10,6 GW and secondly, the rapid growth of the Japanese PV market which reached more than 9,7 GW, confirm Asia as the first world region for PV. Next to these two giants, other markets have confirmed their maturity: Australia, Korea, Thailand and Taiwan are now established PV markets. Many others are also showing signs of possible rapid PV development in the coming years, such as Malaysia and the Philippines. On the other hand, India's installation number above 600 MW contrasts slightly with the country's positive policy tone towards PV.

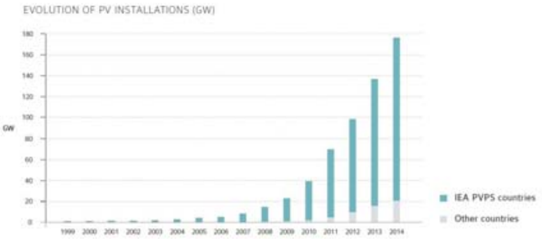
In the Middle East, Israel remained the very first market but the announcement of a 200 MW plant in Dubai with the lowest PPA (58,5 USD/MWh) ever granted, shows that there is ample activity elsewhere. While it remains to be shown that this system can be commercially viable, it shows how the cost decline of PV systems in the last years has brought down PV electricity production costs.

In Europe, the market continued to decline, despite the growth of the UK market that established itself as first place in Europe with 2,4 GW in 2014. Germany experienced another market decline to 1,9 GW, with extremely competitive incentives. France grew again to close to 1 GW while the Italian market, as all markets where feed-in tariffs (FiT) were phased-out, descended to a rather low level (424 MW). Some medium-size European markets continued to progress, such as the Netherlands and Switzerland, while others declined (Austria, Denmark and Romania), although staying at reasonable levels. Former GW markets experienced a complete shutdown, with between nothing and a few MW installed: Spain, Czech Republic, Belgium, Greece and Bulgaria.

GLOBAL PV MARKET IN 2014



PV MARKET DEVELOPMENT TRENDS



More than twenty years of PV market development have resulted in the deployment of around 177 GW of PV systems all over the world. However, the diversity of PV markets calls for an in-depth look at the way PV has been developing in all major markets, in order to better understand the drivers of this growth.

The IEA PVPS countries represent 156 GW of cumulative PV installations altogether, mostly grid-connected, at the end of 2014. The other 38 countries that have been considered and are not part of the IEA PVPS Programme represented 21 additional GW, mostly in Europe: UK with close to 5,3 GW, Greece with 2,6 GW, the Czech Republic with 2,1 GW installed, Romania with 1,2 GW and Bulgaria with 1,0 GW, and below the GW mark, Ukraine and Slovakia. Outside of Europe, the major countries that accounted for the highest cumulative installations in 2014 were India with more than 3 GW, South Africa with 0,9 GW, Taiwan with 0,6 GW and in Chile with 0,4 GW. Numerous countries all over the world have started to develop PV but few have yet reached a significant development level in terms of cumulative installed capacity at the end of 2014, outside the ones mentioned above.

POLICY FRAMEWORK EVOLUTION

About only 3,7% of the world PV market has been driven by pure self-consumption or the sole competitiveness of PV installations in 2014. It also means 96,3% of the global PV

market depends on financial support schemes or PPAs above the market prices.

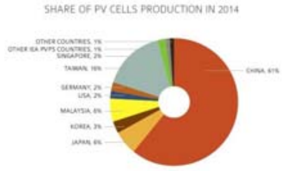
A large part of the market remains dominated by FiT schemes (more than 65%) granted with or without a tender. Subsidies aiming at reducing the upfront investment (or tax breaks) represent more than 19% of the incentives (up from 16%). Incentivised self-consumption, including net-billing and net-metering, was the main incentive in 2014 for 16% of the world market. Various forms of incentivized self-consumption schemes exist (and are often called improperly "net-metering"), such as in Italy, Israel, or Germany. Historically the dominance of FiTs and direct subsidies is even more visible.

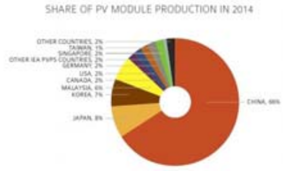
The emergence of calls for tenders has been confirmed again in 2014, with new countries using this legal tool to attribute remunerations to PV projects under certain conditions. Germany, Dubai (UAE), Jordan and many others have joined the list of countries using calls for tenders to grant PPAs for PV plants. The result of these calls for tenders is a guaranteed payment for PV electricity, or in other words, a FiT. Such tenders represented around 5,6% of the world market in 2014 and is increasing.

In some cases, utilities are proposing specific deployment schemes to their own customers, generally in the absence of national or local incentives, but sometimes to complement them.

TRENDS IN THE PV INDUSTRY

In 2014, the PV industry saw clear signs of further growth of the global PV market and major PV module manufacturers started to announce capacity enhancement. Trade conflicts affected the selection of production sites and plans for manufacturing in emerging markets were also reported. Meanwhile, the market prices of silicon feedstock, PV cells and modules stabilized in 2014. The prices continued to decline until 2012 and increased slightly in 2013. In 2014, the prices continued to level off and moderately decreased throughout the year. Some manufacturers have shifted focus to downstream business, such as PV project development. Lower profit margins also contributed to the ongoing





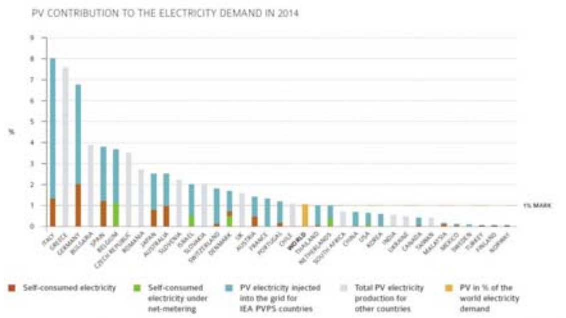
consolidation of manufacturers, PV system installers and developers.

Global PV cells (crystalline silicon PV cells and thin-film PV cells) production in 2014 is estimated to be around 46,7 GW (estimation based on reported figures and other sources, and exclude, at least partially, the so called "double counting"). Just like in 2013, China reported the largest production of PV cells with around 28 GW in 2014, a 27% increase compared to 2013.

China now covers more than half of the global share of PV cells production. Yingli Green Energy and JA Solar produced 3,1 GW of solar cells in 2014 followed by Trina Solar (2,7 GW) and Jinko Solar (1,9 GW). Besides China, other major IEA PVPS countries producing PV cells are Japan, Malaysia, Germany, the USA, and Korea. In 2014, the IEA PVPS countries accounted for around 80% of the global solar cells production.

The major Non IEA PVPS countries manufacturing solar cells are Taiwan, the Philippines, Singapore and India. Taiwan has more than 10 GW/year of production capacity, the second largest capacity after China.

SHARE OF PV IN THE ELECTRICITY DEMAND IN 2014



CUMULATIVE INSTALLED PV CAPACITY (MW) FROM 1992 TO 2014

COUNTRY	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
IEA PVPS COUNTRIES																							
AUSTRALIA	7,3	8,9	10,7	12,7	15,9	18,7	22,5	25,3	29,2	33,6	39,1	45,6	52,3	60,6	70,3	82,5	104,5	187,6	570,9	1376,8	2415,0	3226,0	4130,1
AUSTRIA	0	0	0	0	0	0	0	0	0	0	0	0	21,1	24,0	25,6	28,7	32,4	54,4	97,3	186,9	364,6	627,7	787,0
BELGIUM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23,7	108,5	647,7	1066,1	2105,4	2818,9	3077,2	3156,4
CANADA	1,0	1,2	1,5	1,9	2,6	3,4	4,5	5,8	7,2	8,8	10,0	11,8	13,9	16,8	20,5	25,8	32,7	94,6	281,1	558,3	827,0	1271,5	1904,1
CHINA	0	0	0	0	0	0	0	0	19,0	23,5	42,0	52,1	62,1	70,0	80,0	100,0	140,0	300,0	800,0	3300,0	6700,0	17700,0	28330,0
DENMARK	0	0	0	0	0	0	0	0	0	0	1,6	1,9	2,3	2,7	2,9	3,1	3,2	4,6	7,1	16,7	407,7	563,3	605,6
FINLAND*	0	0	0	0	0	0	0	0	0	0	0,3	0,7	1,0	1,3	1,8	2,4	2,9	4,9	6,9	8,4	8,4	8,4	8,4
FRANCE	1,8	2,1	2,4	2,9	4,4	6,1	7,6	9,1	11,3	13,9	17,2	21,1	24,2	25,8	36,8	71,5	112,9	370,2	1200,3	2962,4	4086,6	4736,7	5677,8
GERMANY	2,9	4,3	5,6	6,7	10,3	16,5	21,9	30,2	103,4	222,5	343,6	496,0	1165,0	2100,6	2950,0	4230,1	6193,1	10566,1	17956,4	25441,0	33045,6	36349,9	38249,9
ISRAEL	0	0	0	0	0	0,2	0,3	0,4	0,4	0,5	0,5	0,5	0,9	1,0	1,2	1,8	3,0	24,5	70,1	189,7	236,7	480,7	680,9
ITALY	8,5	12,1	14,1	15,8	16,0	16,7	17,7	18,5	19,0	20,0	22,0	26,0	30,7	37,5	50,0	120,2	458,3	1181,3	3502,2	12802,9	16450,3	18197,5	18621,8
JAPAN	19,0	24,3	31,2	43,4	59,6	91,3	133,4	208,6	330,2	452,8	636,8	859,6	1132,0	1421,9	1708,5	1918,9	2144,2	2627,2	3618,1	4913,9	6700,9	13600,2	23409,4
KOREA	0	0	1,7	1,8	2,1	2,5	3,0	3,5	4,0	4,7	5,4	6,0	8,5	13,5	35,8	81,2	356,8	523,7	650,3	729,1	959,1	1469,1	2398,1
MALAYSIA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0,0	0,6	0,8	1,1	1,5	2,5	26,8	78,3	167,8
MEXICO	0	0	8,8	9,2	10,0	11,0	12,0	12,9	13,9	15,0	16,2	17,1	18,2	18,7	19,7	20,7	21,7	25,0	30,6	40,1	52,1	112,1	179,1
NETHERLANDS	0	0,1	0,1	0,3	0,3	1,0	1,0	5,3	8,5	16,2	21,7	38,7	45,4	45,4	47,5	48,0	52,8	63,9	84,7	142,7	362,7	722,8	1122,8
NORWAY	0	0	0	0	0	0	0	5,8	6,1	6,2	6,4	6,6	6,9	7,3	7,7	8,0	8,3	8,7	9,1	9,5	10,0	11,6	12,8
PORTUGAL	0	0	0	0	0	0	0	0	0	0	0	2,0	3,0	3,0	4,0	15,0	58,0	98,0	135,0	169,0	238,0	281,0	391,1
SPAIN	0	0	1,1	1,1	1,1	1,1	1,1	2,3	2,3	4,5	7,9	10,0	27,0	53,2	166,8	777,8	3626,2	3848,3	4329,7	4711,8	5104,1	5353,8	5376,4
SWEDEN	0,8	1,1	1,3	1,6	1,8	2,1	2,4	2,6	2,8	3,0	3,3	3,6	3,9	4,2	4,9	6,2	7,9	8,8	11,5	15,8	24,1	43,2	79,4
SWITZERLAND	4,7	5,8	6,7	7,5	8,4	9,7	11,5	13,4	15,3	17,6	19,5	21,0	23,1	27,1	29,7	36,2	47,7	73,3	110,3	211,1	437,0	756,0	1061,0
THAILAND	0	0	0	0	0	0	0	0	0	0	2,8	4,3	10,8	23,9	30,5	32,5	33,4	43,2	49,2	242,7	388,6	823,8	1298,5
TURKEY	0	0	0	0	0	0	0	0	0,1	0,3	0,8	1,0	1,5	2,0	2,3	3,0	3,7	4,7	5,7	6,7	11,7	17,7	57,7
USA	0	0	0	0	0	0	0	0	0	0	0	0	119,0	190,0	303,0	463,0	761,0	1180,0	2040,0	3961,0	7330,0	12060,0	18317,0
TOTAL IEA PVPS	46,0	58,8	85,4	104,9	133,0	180,5	238,9	343,7	572,7	843,2	1197,0	1629,6	2770,2	4159,5	5601,7	8107,5	14515,1	21924,6	36641,7	64128,2	88894,8	120695,2	156022,7
TOTAL NON IEA PVPS	0	0	0	0	0	0	0	0	1,1	2,2	3,4	16,5	26,1	33,5	38,3	46,7	134,6	767,5	2841,8	5417,6	9071,9	15468,1	20980,0
TOTAL	46,0	58,8	85,4	104,9	133,0	180,5	238,9	343,7	573,8	845,4	1200,4	1646,1	2796,3	4193,1	5639,9	8150,2	14649,7	22692,1	39483,1	69809,8	98967	137163,4	177002,7

* DATA CONCERNING THE PV MARKET IN FINLAND WAS PROVIDED BY SOLARPOWER EUROPE

SOURCE IEA PVPS, BECQUEREL INSTITUTE, CREARA, RTS CORPORATION, SOLARPOWER EUROPE, WERNER CH., ET AL., 2015

PV ELECTRICITY STATISTICS IN IEA PVPS REPORTING COUNTRIES 2014

COUNTRY	FINAL ELECTRICITY CONSUMPTION 2014 (TWH)	HABITANTS 2014 (MILLION)	GDP 2014 (BILLION USD)	SURFACE (KM²)	PV INSTALLATIONS IN 2014 (MW)	PV CUMULATIVE INSTALLED CAPACITY 2014 (MW)	PV ELECTRICITY PRODUCTION (TWH)	2014 INSTALLATIONS PER HABITANT (W/HAB)	CAPACITY PER HABITANT (W/HAB)	CAPACITY PER KM² (KW/KM²)	PV PENETRATION (%)
AUSTRALIA	228	24	1 454	7 692 024	904	4 130	5,8	38	176	1	2,5%
AUSTRIA	57	9	436	83 879	159	787	0,8	19	93	9	1,4%
BELGIUM	79	11	533	30 528	79	3 156	3,0	7	282	103	3,6%
CANADA	511	36	1 787	9 984 670	633	1 904	2,2	18	54	0	0,4%
CHINA	5 523	1 364	10 360	9 596 961	10 640	28 330	36,8	8	21	3	0,7%
DENMARK	34	6	342	43 094	42	606	0,6	8	108	14	1,7%
FINLAND	83	5,4	270,67	338424	NA	8	0,0	0	2	0	0,0%
FRANCE	465	66	2 829	640 294	939	5 678	6,2	14	86	9	1,3%
GERMANY	519	81	3 853	357 114	1 900	38 250	35,0	23	473	107	6,7%
ISRAEL	49	8	304	22 072	200	681	1,0	24	83	31	2,0%
ITALY	308	61	2 144	301 336	424	18 622	24,7	7	305	62	8,0%
JAPAN	965	127	4 601	377 930	9 740	23 409	24,6	77	184	62	2,5%
KOREA	478	50	1 410	99 828	909	2 398	3,0	18	48	24	0,6%
MALAYSIA	119	30	327	330 803	88	168	0,2	3	6	1	0,2%
MEXICO	234	124	1 283	1 964 375	67	179	0,3	1	1	0	0,1%
NETHERLANDS	111	17	870	37 354	400	1 123	1,1	24	66	30	1,0%
NORWAY	126	5	500	323 782	2	13	0,0	0	3	0	0,0%
PORTUGAL	49	10	230	92 090	110	391	0,6	11	38	4	1,2%
SPAIN	223	46	1 404	504 645	23	5 376	8,6	0	116	11	3,8%
SWEDEN	136	10	571	450 295	36	79	0,1	4	8	0	0,1%
SWITZERLAND	58	8	659	41 277	305	1 061	1,1	37	129	26	1,8%
THAILAND	169	67	374	513 120	475	1 299	1,8	7	19	3	1,1%
TURKEY	196	76	800	783 562	40	58	0,1	1	1	0	0,1%
USA	3 869	319	17 419	9 371 175	6 211	18 317	23,8	19	57	2	0,6%
WORLD	20 000	7 200	-	510 100 000	39 839	177 003	212,4	6	25	0,3	1,1%

SOURCE IEA PVPS

IEA INTERNATIONAL ENERGY AGENCY

ISBN 978-3-906042-37-4