IEA INTERNATIONAL ENERGY AGENCY

Ministry of Energy
www.energy.gov.il

National Survey Report of Photovoltaic Applications in Israel 2017

PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

Prepared by

Yael Barash-Harman & Honi Kabalo

Contact:

Yael Harman
Yaelh@energy.gov.il

Honi Kablao
honi@pua.gov.il

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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

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 2017. 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 systems 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 2017 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2017, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

Over 90% of renewable energy in Israel comes from PV instillation which are vastly connected to the grid. In 2017 capacity of only 102 MW PV power was installed in Israel which resulted in a total PV installed capacity of 978 MW. Out of the total PV capacity installed 44% are small BAPV systems and 56% are medium and large ground mounted PV. To date Israel has no floating PV systems.

1.2 Total photovoltaic power installed

It is necessary to know the accuracy of the data provided in section 2.2. Please provide a very brief summary here of the methods used to collect, process and analyse these data. If, in your estimation, the accuracy of any of the data in this section is worse than ±10 % you may provide the data as a range and also provide a statement explaining why there are difficulties in achieving accuracy. Also, if a country cannot provide any of the required data please give the reason here.

Table 1: PV power installed during calendar year 2016

AC			**MW installed in 2017**	**MW installed in 2017**	**AC or DC**
Grid-connected	BAPV	Residential	67.5	430	DC
		Commercial			
		Industrial			
	BIPV (if a specific legislation exists)	Residential	N/A		
		Commercial			
		Industrial			
	Utility-scale	Ground-mounted	35	35	DC
		Floatting		0	
		Agricultural		0	
Off-grid		Residential (SHS)	N/A		
		Other			
		Hybrid systems			
		Total	**102.5**		DC

Table 2: Data collection process:

Is the collection process done by an official body or a private company/Association?	Official body – The Israeli Public Utility authorities (PUA)
Link to official statistics (if this exists)	https://pua.gov.il/Publications/PressReleases/Pages/doch_pua_2015.asp
Data collection process	All grid connected PV system have to be registered at Public Utility authorities (PUA), accuracy of these data can be assumed better than ± 1 %.

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

MW-GW for capacities and GWh-TWh for energy	2017 numbers	2016 numbers
Total power generation capacities (all technologies)	17,609MW	17,628 MW
Total power generation capacities (renewables including hydropower)	1037MW	934MW
Total electricity demand (= consumption)	68.1 TWh	67.3 TWh
New power generation capacities installed during the year (all technologies)	243MW	137MW
New power generation capacities installed during the year (renewables including hydropower)	103MW	125MW
Total PV electricity production in GWh-TWh	**Total RE 1.64 TWh**	**Total RE 1.65 TWh**
Total PV electricity production as a % of total electricity consumption	**3%**	**3%**

Table 4: Other information

	2017 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	11,000
Capacity of decommissioned PV systems during the year in MW	**0**
Total capacity connected to the low voltage distribution grid in MW	430 MW
Total capacity connected to the medium voltage distribution grid in MW	312 MW

Total capacity connected to the high voltage transmission grid in MW	235 MW

Table 5: The cumulative installed PV power in 4 sub-markets (MWp).

Year	Off-grid (including large hybrids)	Grid-connected distributed (BAPV, BIPV)	Grid-connected centralized (Ground, floating, agricultural…)	Other uses (VIPV, wearables…)	Total
2012	0	232	40	0	272
2013	0	248	129	0	377
2014	0	284	303	0	587
2015	0	326	445	0	771
2016	0	362	513	0	875
2017	0	430	548	0	978

1.3 Key enablers of PV development

Please fill here the available information about the following subjects which connects to PV development directly or indirectly. If the information is an estimate (expert guess), please indicate it. If it comes from an official source, please indicate it. Additional information is welcome.

Table 6: information on key enablers

	Description	Annual Volume (Units)	Total Volume (Units)	Source
Decentralized storage systems	N/A	N/A	N/A	
Residential Heat Pumps	*	N/A	10,000	Ministry of energy
Electric cars – PIEV & EV	Full EV IPV	2290	4,643	Ministry of transportation
Electric buses		35	70	Ministry of transportation

* Israel is hot country and heat pumps are not abundant and considered a premium product.

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

In Table 10 please add year 2017 module prices (excluding VAT/TVA/sales tax): for small (typical?) and large (best price?) orders, if possible; OR an indicative national figure. Please clarify whether you are reporting an average price, a representation of all known prices, a typical example, or so on.

Also, if possible, please report separately the minimum price that has been achieved in 2016, noting whether this is an import or locally manufactured.

Table 7: Typical module prices for a number of years source:

Year	2012	2013	2014	2015	2016	2017
Standard module crystalline silicon price(s): Typical	2.425/ w	2.093/ w	1.856/ w	1.862/ w	1.497/ w	1.296/ w
Lowest prices						
Highest prices						

2.2 System prices

Please give in the following table turnkey prices (excluding VAT/TVA/sales tax) per W for the various categories of installation. Prices should not include recurring charges after installation such as battery replacement or operation and maintenance. Additional costs incurred due to the remoteness of the site or special installation requirements should not be included. Please indicate whether you are reporting an average price, a range of all known prices, a typical example, or so on.

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

Table 8: **Turnkey Prices of Typical Applications – local currency**

Category/Size	Typical applications and brief details	Current prices per W
OFF-GRID Up to 1 kW (SHS)	N/A	
OFF-GRID > MW scale	N/A	
Grid-connected Rooftop up to 5-10 kW (residential BAPV)	10 KW	5-6NIS / W
Grid-connected Rooftop from 10 to 250 kW (commercial BAPV)	100 KW	3.5-3.8NIS / W
Grid-connected Rooftop above 250kW (industrial BAPV)	The price is an evaluation of 400 kW system by the PUA. Next year we are expected to get a more accurate number as rooftop tender is about to be published	3-3.2 NIS / W
Grid-connected Ground-mounted above 10 MW	The price is an evaluation by the PUA. Next year we are expected to get a more accurate price	2.6-2.77 NIS / W
Other category (hybrid diesel-PV, hybrid with battery…)	N/A	

Floating PV	Price evaluation by a private company	3.6-5.4 NIS/W
Agricultural PV	N/A	
Residential BIPV (tiles, or complete roof).	N/A	
Industrial BIPV	N/A	

Table 9: National trends in system prices (current) for different applications – local currency without taxes

Price/Wp	2009	2015	2016	2017
Residential PV systems < 5-10 KW	5KW: 140,000		5kW:45,000 55,000	5kW:30,000 -40,000 10kW:50,000 65,000
Commercial and industrial BAPV		50kw: 300,000		50-60kw: 170,000 -200,000
Ground-mounted > 10 MW				10MW:32,000,000

2.3 Cost breakdown of PV installations

The data are approximation and were collected through interviews with buyers and suppliers.

2.3.1 Residential PV System < 5-10 kW

Table 10: 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	1.4	1.3	1.5
Inverter	0.35	0.252	0.4
Other (racking, wiring…)			
Soft costs			
Installation	0.3	0.2	0.35
Customer Acquisition			
Profit	20-40%		

Other (permitting, contracting, financing…)	Prime+ 2% Permit		
Subtotal Hardware	1.5		
Subtotal Soft costs	1.5		
Total	3		

2.3.2 Utility-scale PV systems > 10 MW

Table 11: 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	1		
Inverter	0.25-0.4		
Other (racking, wiring, etc.)	0.26		
Soft cost			
Installation Labor	0.6		
Customer acquisition			
Profit	8-10%		
Other (contracting, permitting, financing etc.)	Finance 3% Permitting 800,000		
Subtotal Hardware	1.75		
Subtotal - Soft cost	3		
Total Installed Cost	4.75		

2.4 Financial Parameters and specific financing programs

Please indicate the average cost of capital for a PV system in your country. A detail per market segment is required.

Table 12: PV financing scheme

Average rate of loans – residential installations	Prime+2%
Average rate of loans – commercial installations	
Average cost of capital – industrial and ground-mounted installations	

2.5 Specific investments programs

Please describe whether utilities or other companies (specify) have set up specific PV acquisition or leasing programs. Describe briefly how they work.

Table 13: Specific investment programs

Third Party Ownership (no investment)	Roof renting,
Renting	
Leasing	
Financing through utilities	
Investment in PV plants against free electricity	
Crowdfunding (investment in PV plants)	
Community solar	Does not exist
Other (please specify)	

2.6 Additional Country information

This paragraph provides additional information regarding the country's population and additional parameters linked to its electricity system.

Table 14: Country information

<table>
<tr><td>Retail Electricity Prices for an household (range)</td><td colspan="3">47.26 NIS cents /kwh</td></tr>
<tr><td>Retail Electricity Prices for a commercial company (range)</td><td colspan="3" rowspan="2"><table><tr><td>Low voltage</td><td>Medium voltage</td><td>high voltage</td></tr><tr><td>34-107</td><td>26-93</td><td>24-85</td></tr></table>Changes by the time of the day and the session</td></tr>
<tr><td>Retail Electricity Prices for an industrial company (range)</td></tr>
<tr><td>Population at the end of 2017 (or latest known)</td><td colspan="3">8,842,000</td></tr>
<tr><td>Country size (km^2)</td><td colspan="3">20,770 km^2</td></tr>
<tr><td>Average PV yield (according to the current PV development in the country) in kWh/kWp</td><td colspan="3">1,750 KWh/KWp /year (capacity factor of about 0.2)</td></tr>
<tr><td>Name and market share of major electric utilities.</td><td colspan="3">IEC is a vertical monopoly controlling over 80% of the market, additional 13% is produced by private manufacturers (Dalia, Dorad & O.P.C) and 3% by renewable energy.</td></tr>
</table>

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 2017

3.1.1.1 Climate change Commitments

In 2016 the Israeli government decided on a series of steps designed to ensure that Israel meets its target of 17% Renewable Energy (RE) electricity production (in energy terms) by 2030, with interim targets of 13% in 2025 and 10% in 2020. This included funds allocated to encourage energy efficiency projects for which a target of 17% energy efficiency improvement was previously set, and a long series of procedural steps to promote RE and energy efficiency.

3.1.1.2 Description of support measures (excluding BIPV, VIPV and rural electrification)

Government support for RE was initially given in the form of guaranteed Feed In Tariff (FIT) for 20-25 years. FITs varied by project nature, size, installation year and other parameters. FIT have decreased considerably over time. Installations are devided to 4 categories: residential (up to 15 KWp); commercial (up to 50 KWp), Medium-Utility Scale (up to 12 MWp) and Large-Utility Scale (above 12 MWp). This was updated for solar systems according to the following guidelines:

- Small systems (<100kW) can still get a FIT.
- Commercial BAPV (>100kW) are treated through tenders and net metering programs.
- Large ground mounted systems must participate in competitive tenders.

Additional incentives

- Smaller PV systems (< 700kW) are exempt from obtaining a building permit.
- PV system that are installed on rooftops smaller than 7,000 m^2 are exempt from Betterment levy.
- Residential rooftops with income of less than 24,000 NIS/year are exempt from income tax, VAT, and reporting requirement.

3.1.1.3 BIPV development measures

There were no special measures favouring the development of PV as building element in Israel in 2017.

3.1.1.4 Utility-scale measures including floating and agricultural PV

Cost of national land and property tax for PV systems is flat nationwide, and determined by the government (and not by local authorities).

3.1.1.5 Rural electrification measures

No (except that grid connection fees are flat nationwide)

3.1.1.6 Support for electricity storage and demand response measures

No. Plans to institute measures to encourage storage and demand response in 2019.

3.1.1.7 Support for electric vehicles (and VIPV)

Existing measures for supporting EV deployment include reduced purchase tax for EV of 10% of the vehicle cost, compared to approx. 60% for ICE vehicles. In addition, the Israeli Government will support deployment of EV public charging stations, including fast charging (DC) as well as slow charging (AC). The budget for this program is 25 million NIS and is expected

to support instalment of a total of 60 fast and ultra-fast charging stations and approx. 1500 public, semi-public and workplace charging stations during 2019.

Support for EV car sharing pilot of about 100 vehicles in Haifa.

Support for 70 electric buses in a few pilots.

Table 15: PV support measures (summary table)

	On-going measures residential	Measures that commenced during 2017 - residential	On-going measures Commercial + industrial	Measures that commenced during 2017 – commercial + industrial	On-going measures Ground-mounted, including floating	Measures that commenced during 2017 – ground mounted, including floating
Feed-in tariffs	Yes	No	Yes	No	Yes *	No
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	Yes	No	No	No	No	No
Self-consumption	No	No	No	No	No	No
Net-metering	Yes	No	Yes	No	Yes	No
Net-billing	No	No	No	No	No	No
Collective self-consumption and virtual net-metering	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	No	No	No	No	No	No
BIPV incentives	No	No	No	No	No	No

* Result of historic obligation all the future program are based on competitive tenders.

3.2 Self-consumption measures

Please described self-consumption measures according to the methodology defined in the new self-consumption report methodology document: here

Table 16: Self-Consumption Schemes

PV self-consumption	1	Right to self-consume	Yes (but there is a national cap)
	2	Revenues from self-consumed PV	Savings on the electricity bill
	3	Charges to finance Transmission & Distribution grids	Yes, but low
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Yes, but must be declared ahead and tariff is low.
	5	Maximum timeframe for compensation of fluxes	Credit can be accumulated for 2 years
	6	Geographical compensation	No
Other characteristics	7	Regulatory scheme duration	20-25 years
	8	Third party ownership accepted	No
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	Backup fee NIS 0.00-0.06, Balancing fee NIS 0.015
	10	Regulations on enablers of self-consumption (storage, DSM…)	No
	11	PV system size limitations	5MW
	12	Electricity system limitations	400MW Net metering cap.
	13	Additional features	

3.3 Collective self-consumption, community solar and similar measures

No.

3.4 Tenders, auctions & similar schemes

Please describe whether your country uses tenders, auctions, reverse auctions or similar processes to grant PPAs for PV systems. Please mention if the process is compulsory, which segments it targets, who takes the decision, how the PV electricity is paid (PPA?), who finances it etc. the goal is to better understand how it works.

In 2017 the PUA declared a plan for six ground mounted PV tenders for the years 2017-2019. Four out of the six will be connected to the distribution grid (<10MW) and two will be connected to the transmission grid (>10MW). In 2017 two tenders where completed, with 340MW bids accepted at a price of NIS 0.199.

3.5 Financing and cost of support measures

The cost of the electricity in Israel increased by 5% (about NIS 0.02) as a result of integrating 3% renewable energy, but this is not visible in the monthly consumer bill – the extra costs are shared by all electricity consumers equally.

4 INDUSTRY

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

Please complete the following table if appropriate.

Give in Table below the following information for the year:

a) List by name all manufacturers **operating in your country**. **Alternatively please report a total figure for your country.**

b) Type of process and technology eg polysilicon, silicon ingots, EFG ribbon wafers, silicon wafers and so on.

c) Total production of each manufacturer for 2017.

Table 17: 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.

4.2 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.

The information to be collected should include all manufacturers having production facilities in the responding country, irrespective of their ownership structures.

Give in Table below the following information for the year:

a) List by name all manufacturers **operating in your country**. **Alternatively please report a total figure for your country.**

b) Type of technology.

c) Total production (i.e., module, cell, concentrators) of each manufacturer (please ensure this figure is for total production and not just production of modules >40 W.) Production specifically for non-power applications, such as for calculators, watches etc. should not be included.

d) Maximum module, cell and concentrator production capacity. It should be noted that the different steps in the production process might have different capacities.

e) Thin film and solar concentrator manufacturers should be reported separately within the table (see below) **with an equal production amount entered in both the cell and module columns (thin films)**.

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

Table 18: Production and production capacity information for 2017

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		a		b	
2		c	d	e	f
3 etc					
Total					
Thin film manufacturers					
1		x	*x*	y	*y*
2					
Cells for concentration					
1		g		h	
TOTALS		**a+c+x+g**	**d+x**	**b+e+y+h**	**f+y**

The following additional information **may** also be provided in text:

a) Whether the manufacturer produces their own cells in-house or whether they are purchased on the international market, or both.

b) An indication of the amount of production (cells, modules, other components, systems) exported from the country.

c) Availability of specially designed products (large size modules, modules with thermal benefits, facade and roof top modules, home system kits etc.).

d) New developments and new products that arrived on the market during 2014.

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

4.3 Manufacturers and suppliers of other components

Balance of system component manufacture and supply is an important part of the PV system value chain. Please briefly comment on the nature of this industry in your country, paying particular attention to recent trends and industry outlook, under the headings of:

- PV inverters (for grid-connection and stand-alone systems) and their typical prices
- Storage batteries
- Battery charge controllers
- DC switchgear
- Supporting structures

5 PV IN THE ECONOMY

This chapter aims to provide information on the benefits of PV for the economy.

5.1 Labour places –

Provide an estimate of labour places in the following (where these are mainly involved with PV):

a) Public research and development (not including private companies);

b) Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D;

c) All other, including within electricity companies, installation companies etc.

Table 19: Estimated PV-related labour places in 2017

Research and development (not including companies)	
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	
Electricity utility businesses and government	
Other	
Total	

5.2 Business value – mandatory calculation

Provide an estimate of the value of PV business in your country (similar to Gross Domestic Product estimations) using Table below.

Table 20: Value of PV business

Sub-market	**Capacity installed *in 2017* (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			*b*	
Grid-connected distributed			*c*	
Grid-connected centralized			*d*	
				a+b+c+d
Export of PV products				*e*
Change in stocks held				*f*
Import of PV products				*g*
Value of PV business				***a+b+c+d+e+f-g***

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.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Short description of the electricity industry landscape - structure – vertically integrated or separate generation, transmission, distribution; - retailers and network businesses – integrated or separate; - ownership – private – public (state owned or municipal) - Electricity industry regulator?	

6.2 Interest from electricity utility businesses

Please briefly report on the key drivers and barriers for PV activity by electricity utility businesses in your country (you may also wish to list references for relevant studies that have been published in your country).

Please outline key PV business models that have been implemented or are being considered **by electricity utility businesses** in your country (eg PV plant development / ownership, PV power purchase arrangements, customer PV support initiatives and so on, self-consumption polices, storage policies, electric vehicules…).

6.3 Interest from municipalities and local governments

Please briefly report on the key drivers and barriers for PV activity by municipalities and local governments in your country (you may also wish to list references for relevant studies that have been published in your country). Please outline key models that have been implemented or are being considered by these authorities.

7 HIGHLIGHTS AND PROSPECTS

Please highlight key aspects of PV deployment or production in your country during 2017.

Please give one paragraph maximum on forward looking issues within your country such as:

- Details from industry of planned increases in PV module production capacity
- Any significant developments in technologies

Please specify any long-term targets for installed PV power capacity that exist, or future energy scenarios that are being discussed, within your country.