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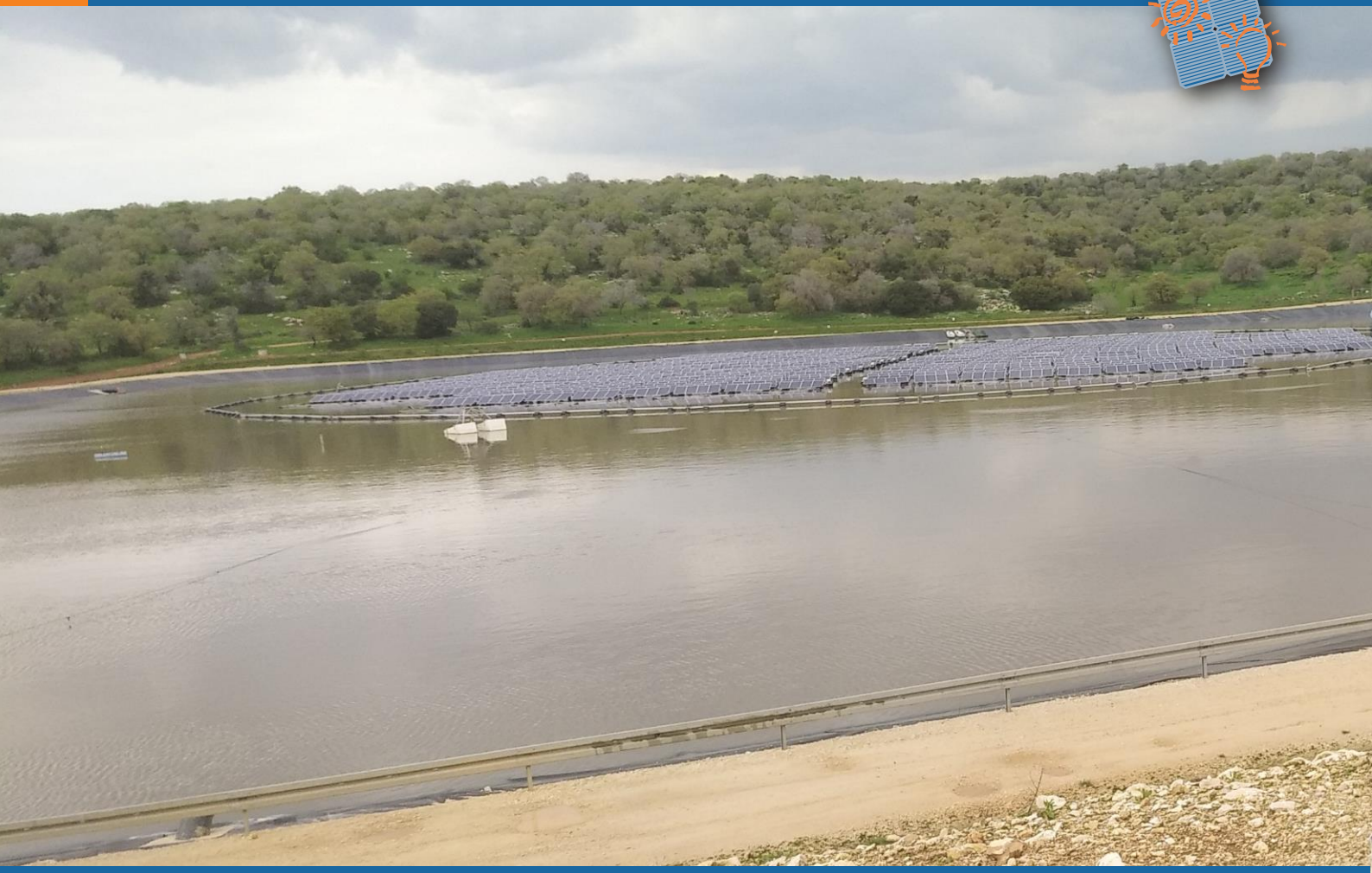

Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in Israel 2018

Prepared by:

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www.energy.gov.il

PHOTOVOLTAIC POWER SYSTEMS
TECHNOLOGY COLLABORATION PROGRAMME

Cover picture:

Mr Gadi Hareli

WHAT IS IEA PVPS TCP

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 30 member countries 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 (technology collaboration programmes) 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*."

In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas. This report has been prepared under Task 1, which deals with market and industry analysis, strategic research and facilitates the exchange and dissemination of information arising from the overall IEA PVPS Programme.

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

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WHAT IS IEA PVPS task 1

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 2018. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

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DISCLAIMER:

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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 2018 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2018, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

Over 95% of renewable energy in Israel comes from PV instillation that are vastly connected to the grid. In 2018 capacity of 407 MW PV power was installed in Israel which resulted in a total PV installed capacity of 1,358 MW. Out of the total PV capacity installed, 29% are small BAPV systems, 71% are medium, and large ground mounted PV.

1.2 Total photovoltaic power installed

In Israel all grid connected PV system have to be registered at Public Utility authorities (PUA), the following information was collected form their annual report therefore accuracy of these data can be assumed better than ± 1 %.

Table 1: Annual PV power installed during calendar year 2018.

		Installed PV capacity in 2018 [MW]	AC or DC
PV capacity	Off-grid	N/A	
	Decentralized	0	0
	Centralized	406	DC
	Total	406	DC

Table 2: PV power installed during calendar year 2018.

			Installed PV capacity in 2018 [MW]	Installed PV capacity in 2018 [MW]	AC or DC
Grid-connected	BAPV	Residential	121	10	DC
		Commercial		111	
		Industrial			
	BIPV	Residential	N/A		
		Commercial			
		Industrial			
	Utility-scale	Ground-mounted	282	291	DC
		Floating		0	
		Agricultural		0	
Off-grid		Residential	N/A		
		Other			
		Hybrid systems			
Total			406		DC

Table 3: Data collection process.

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	For ground mounted PV coefficient conversion of 1.2 and for rooftops 1.3
Is the collection process done by an official body or a private company/Association?	Official body
Link to official statistics (if this exists)	https://pua.gov.il/Publications/PressReleases/Pages/doch_mashek_2018.aspx
	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 4: The cumulative installed PV power in 4 sub-markets.

Year	Off-grid [MW]	Grid-connected distributed [MW]	Grid-connected centralized [MW]	Total [MW]
2012	N/A	232	40	272
2013	N/A	248	129	377
2014	N/A	284	304	588
2015	N/A	326	446	771
2016	N/A	363	514	877
2017	N/A	403	549	951
2018	N/A	524	831	1358

Table 5: Other PV market information.

	2018 Numbers
Number of PV systems in operation in your country	17,000
Capacity of decommissioned PV systems during the year [MW]	0
Capacity of repowered PV systems during the year [MW]	N/A
Total capacity connected to the low voltage distribution grid [MW]	524
Total capacity connected to the medium voltage distribution grid [MW]	300
Total capacity connected to the high voltage transmission grid [MW]	534

Table 6: PV power and the broader national energy market.

	2017 numbers	2018 numbers
Total power generation capacities [GW]	16.9	17.2
Total renewable power generation capacities (including hydropower) [GW]	1.03	1.4
Total electricity demand [TWh]	62.8	64.1
Total energy demand [TWh]		
New power generation capacities installed in 2018 [GW]	0.1	0.3
New renewable power generation capacities installed in 2018 (including hydropower) [GW]	0	0.1
Estimated total PV electricity production (including self-consumed PV electricity) in [TWh]	1.82	2.54
Total PV electricity production as a % of total electricity consumption	2.9%	4%

1.3 Key enablers of PV development

Table 7: Information on key enablers.

	Description	Annual Volume	Total Volume	Source
Decentralized storage systems	N/A	N/A	N/A	N/A
Residential Heat Pumps [#]			N/A	Ministry of energy
Electric cars [#]	Full EV IPV	4,405	9,048	Ministry of transportation
Electric buses and trucks [#]		23	93	Ministry of transportation

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 8: Typical module prices for a number of years.

Year	Typical price of a standard module crystalline silicon
2012	2.425/w
2013	2.093/w
2014	1.856/w
2015	1.862/w
2016	1.497/w
2017	1.296/w
2018	1.22/W
2019	0.9537/w

2.2 System prices

Table 9: Turnkey PV system prices of different typical PV systems.

Category/Size	Typical applications and brief details	Current prices [NIS/W]
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes.	5-6NIS / W
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	3.5-3.8NIS / W
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	3-3.2 NIS / W
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	N/A
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	2.6-2.77NIS/W

Table 10: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5-10 kW **[NIS/W]**	Small commercial BAPV Grid-connected, roof-mounted, distributed PV systems 10-100 kW **[NIS/W]**	Large commercial BAPV Grid-connected, roof-mounted, distributed PV systems 100-250 kW **[NIS/W]**	Small centralized PV Grid-connected, ground-mounted, centralized PV systems 10-20 MW **[NIS/W]**
2009	28			
2010				
2011				
2012				
2013				
2014				
2015		6		
2016				
2017				
2018		3.4	3.3	3.2

2.3 Financial Parameters and specific financing programs

Table 11: PV financing information in 2018.

Different market segments	Loan rate [%]
Average rate of loans – residential installations	Prime +2%
Average rate of loans – commercial installations	
Average cost of capital – industrial and ground-mounted installations	

2.4 Specific investments programs

Table 12: Summary of existing investment schemes.

Investment Schemes	Introduced in Israel
Third party ownership (no investment)	Yes
Renting	Yes
Leasing	Yes
Financing through utilities	No
Investment in PV plants against free electricity	Yes
Crowd funding (investment in PV plants)	Yes
Community solar	Yes
International organization financing	No

2.5 Additional Country information

Table 13: Country information.

<table>
<tr><td>Retail electricity prices for a household [ILS/W]</td><td colspan="3">0.47</td></tr>
<tr><td>Retail electricity prices for a commercial company [ILS/W]</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 [ILS/W]</td></tr>
<tr><td>Population at the end of 2018</td><td colspan="3">9,000,000</td></tr>
<tr><td>Country size [km^2]</td><td colspan="3">20,770 km^2</td></tr>
<tr><td>Average PV yield in [kWh/kW]</td><td colspan="3">1,750 KWh/KWp /year (capacity factor of about 0.2)</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.

Table 14: Summary of PV support measures.

	On-going measures in 2018 – Residential	Measures introduced in 2018 – Residential	On-going measures in 2018 – Commercial + Industrial	Measures introduced in 2018 – Commercial + Industrial	On-going measures in 2018 – Centralized	Measures introduced in 2018 – Centralized
Feed-in tariffs	Yes	-	Yes	-	Yes *	-
Feed-in premium (above market price)	-	-	-	-	-	-
Capital subsidies	-	-	-	-	-	-
Green certificates	-	-	-	-	-	-
Renewable portfolio standards (RPS) with/without PV requirements	-	-	-	-	-	-
Income tax credits	-	-	-	-	-	-
Self-consumption	-	-	-	-	-	-
Net-metering	Yes	-	Yes	-	Yes	-
Net-billing	-	-	-	-	-	-
Collective self-consumption and virtual net-metering	-	-	-	-	-	-
Commercial bank activities e.g. green mortgages promoting PV	-	-	-	-	-	-
Activities of electricity utility businesses	-	-	-	-	-	-
Sustainable building requirements	-	-	-	-	-	-
BIPV incentives	-	-	-	-	-	-

3.1 National targets for PV

Israel target 17% renewable energy by 2030, out of which 85% is predicted to be generated by solar energy.

3.2 Direct support policies for PV installations

3.3 Self-consumption measures

Table 15: Summary of self-consumption regulations for small private PV systems in 2018.

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 & Renewable Levies	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 (virtual self-consumption or metering)	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	

3.3.1 Description of support measures –

In 2018 the PUA published a new rooftop regulatory framework for the next three years. The scheme included net metering, FITs for small-scale solar, and a series of tenders. The scheme regulates the installation PV on household roofs, commercial and industrial facilities, public buildings, parking lots, pergolas, water reservoirs and fishponds. Under the new framework, PV projects up to 15 kW will be eligible for net metering, or apply for a 25-year FIT (not indexed to inflation) of 0.48 ILS (0.137 USD)/kWh. Furthermore, the framework will support PV systems ranging in size from 15 kW to 100 kW, with a 25-year FIT of 0.45 ILS 0.129 USD)/kWh (not indexed to inflation). The framework entails a series of tenders, starting in the upcoming summer. The minimum capacity to be allocated in a single tender will be 50 MW. A participant can either sell all electricity to the grid at the winning tariff, or sell the electricity to other consumers who are connected to same solar rooftop. Lastly, the PUA permits construction of PV outside of the framework for self-consumption with a low tariff of only 0.16 ILS (0.0045 USD)/kWh for surplus. This is a major change of PUA rules, as in Israel the bilateral sale of renewable electricity was not allowed prior to the introduction of these new provisos. Quota for net metering were finished in 2018 and are not expected to be extended.

3.4 Collective self-consumption, community solar and similar measures

No.

3.5 Tenders, auctions & similar schemes

In 2018 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 0.198.

3.6 Other utility-scale measures including floating and agricultural PV

3.7 Social Policies

3.8 Retrospective measures applied to PV

3.9 Indirect policy issues

3.9.1 Rural electrification measures

3.9.2 Support for electricity storage and demand response measures

3.9.3 Support for electric vehicles (and VIPV)

EVs in Israel enjoy significantly reduced purchase tax rates, further accentuated in the light of the high base purchase tax for ICE cars, which at a current rate of 83% is among the highest in OECD countries (OECD, 2016). The purchase tax for BEV is 10% and for PHEV 20%, and both also receive a tax-value discount over car safety systems (which applies to ICEs as well), resulting in a possible effective discount of few additional percent (Israel Tax Authority,2016).

In addition, employees who make use of company car, which is an EV (either BEV or PHEV), receive a fairly significant discount on value-of-use tax of 990 ILS per month.

3.9.4 Curtailment policies

3.9.5 Other support measures

3.10 Financing and cost of support measures

In 2018 the price of electricity increased by 2.9% to 0.47 ILS (excluding VAT), 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)

Table 16: Silicon feedstock, ingot and wafer producer's production information for 2018.

Manufacturers	Process & technology	Total Production	Product destination	Price
	Silicon feedstock [Tonnes]			
	sc-Si ingots. [Tonnes]			
	mc-Si ingots [Tonnes]			
	sc-Si wafers [MW]			
	mc-Si wafers [MW]			

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.

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

Table 17: PV cell and module production and production capacity information for 2018.

Cell/Module manufacturer (or total national production)	Technology (sc-Si, mc-Si, a-Si, CdTe, CIGS)	Total Production [MW]		Maximum production capacity [MW/yr]	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
Thin film manufacturers					
Cells for concentration					
Totals	N/A	N/A	N/A	N/A	N/A

4.3 Manufacturers and suppliers of other components

5 PV IN THE ECONOMY

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

5.1 Labour places

Table 18: Estimated PV-related full-time labour places in 2018

Market category	Number of full-time labour places
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	
Research and development (not including companies)	
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Total	**N/A**

5.2 Business value

Table 19: Rough estimation of the value of the PV business in 2018 (VAT is excluded).

Sub-market	Capacity installed in 2017 [MW]	Average price [currency/W]	Value	Sub-market
Off-grid				
Grid-connected distributed				
Grid-connected centralized				
Value of PV business in 2018				N/A

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

6.2 Interest from electricity utility businesses

6.3 Interest from municipalities and local governments

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

7.2 Prospects