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Market Report for Turkey's

PHOTOVOLTAIC PANEL MANUFACTURING

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September 3, 2020

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İstanbul – Türkiye

Executive Summary

This is a market research report on the PV panel manufacturers in Turkey. As a result of extensive research, 22 PV panel manufacturer companies in Turkey were contacted and a questionnaire was submitted. Sixteen companies filled out the questionnaire and provided information such as company shareholding structure, production capacity, product types, investment plans, export-import business, raw material supply chain, product's local content ratios, and their stance on domestic PV panel production. Also included in this report are the other roles these PV panel manufacturers in Turkey take on in the market. In 2011, Solarturk became the first PV panel manufacturer in Turkey. Gazioğlu Solar and Gest Enerji companies followed in 2012. Alfa Solar, Ankara Solar, GTC, Ödül Enerji, and Schmid-Pekintaş are among the companies that started their activities in 2013.

In terms of PV panel manufacturing plant locations in Turkey; three different PV panel manufacturers are located within the borders of Ankara. Thus, Ankara is currently the province with the highest number of domestic PV panel manufacturing plants. Except for these three companies, all other PV panel manufacturers are scattered in different provinces. Antalya with the CW Enerji factory and Kocaeli with the Smart Solar factory, both of which have annual production installed capacity of 1,000 MW, are the provinces with the highest PV panel production installed capacity. They are followed by Istanbul, with the HT Solar factory with a PV panel annual production installed capacity of 800 MW. CW Enerji, Smart Solar and HT Solar are the companies which have the highest PV panel production installed capacities in Turkey. Considering the shareholding structures of the 16 PV panel manufacturers that filled the questionnaire, 14 of them are 100% domestic, one company is a partnership of Turkish and international, and one company is 100% international. When it comes to local content materials used in the PV panel production, the panel with the highest local content ratio is produced by Parla Solar with a rate of 85%. Looking at the various technologies of PV panels produced by companies in Turkey, production of PV panels with passivated emitter and rear cell (PERC) technology is common in every company. The first private R&D center officially registered with the Turkish Ministry of Industry and Technology was established in 2016 by GTC for glass-glass panels.

Reviewing the investment plans of PV panel manufacturers in Turkey; 12 of them are planning to invest in expanding their production lines. Although the market focus of PV panel manufacturers in Turkey is the domestic market, they have been improving their export growth rates and diversifying country/region portfolios in target foreign markets.

The major export regions for PV panels manufactured in Turkey are Europe and the Middle East. The companies who have exported the most in the last five years are HT Solar with 85% followed by CW Enerji with 30% and Schmid-Pekintaş and Gest Enerji with 25%.

Considering the number of employees in the PV panel production in Turkey, Elin Enerji has provided the most employment with 850 employees. Considering gender diversity employment rates, Mirsolar has the highest rate of woman employees with 60% in total employment.

The comments of the companies regarding the regulations to be issued to support domestic PV panel production are also included in the report.

As supplementary information, the inauguration of Kalyon's 500 MW/year PV panel integrated manufacturing plant including module, cell, wafer, and ingot processes in Ankara Baskent Organized Industrial Zone (OIZ), was held on the 19th of August, 2020 and will be considered for the report's revision in Q1 of 2021.

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PV Panel Manufacturing in Turkey Market Research

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Abbreviations

BoM	Bill of Materials
EPC	Engineering, Procurement, and Construction
FiT	Feed-in-Tariff
IPP	Independent Power Producer
Mono	Monocrystalline
MWp	Mega Watt peak
Poly	Polycrystalline
PV	Photovoltaic
RERA	Renewable Energy Resource Area
SPP	Solar Power Plant
YEKDEM	Local Feed-in-Tariff scheme

PV Panel Manufacturers in Turkey

As a result of the market research of PV panel manufacturers in Turkey, 22 manufacturers were reached. Out of these, 16 manufacturers provided feedback by filling out the questionnaires submitted by Stantec.

General Information of PV Panel Manufacturers

The registered company titles of the manufacturers in alphabetical order and their abbreviations are as shown in table 1.

Registered Company Titles	Company Abbreviations
2H Enerji ve Yatırım A.Ş.	2H Enerji
Alfa Solar Enerji İnşaat Sanayi ve Tic. A.Ş.	Alfa Solar
Ankara Solar Enerji İnşaat A.Ş.	Ankara Solar
CW Enerji Mühendislik Ticaret ve Sanayi A.Ş.	CW Enerji
Elin Elektrik İnşaat Müşavirlik Proje Taahhüt Ticaret ve Sanayi A.Ş.	Elin Enerji
Gazioğlu Solar Enerji Sanayi ve Ticaret A.Ş.	Gazioğlu Solar
GEST Enerji Sanayi ve Ticaret A.Ş.	Gest Enerji
GTC Güneş Sanayi ve Ticaret A.Ş.	GTC
HT SOLAR Enerji A.Ş.	HT Solar
Mirsolar Enerji Sanayi ve Ticaret A.Ş.	Mirsolar
Ödül Enerji Taahhüt İnşaat Sanayi Ticaret A.Ş.	Ödül Enerji
Parla Solar Hücre ve Panel Üretim A.Ş.	Parla Solar
Seha Mühendislik Müşavirlik Ticaret ve Makina Sanayi A.Ş.	Seha Solar
Schmid-Pekintaş Güneş Enerji Sistemleri Sanayi ve Ticaret A.Ş.	Schmid-Pekintaş
Smart Güneş Enerjisi Teknolojileri ArGE Üretim Sanayi ve Ticaret A.Ş.	Smart Solar
Solarturk Enerji Sanayi Ticaret A.Ş.	Solarturk

Table 1: PV Panel Manufacturers in Turkey

The report is planned to be updated in the first quarter of 2021. PV panel manufacturers who want to be included in the updated report and/or want to revise their data may contact Stantec. This report has been prepared in line with the written information provided by the companies.

Factory Information of PV Panel Manufacturers

In the table is an overview of the factory information of PV panel manufacturers in Turkey and the inauguration years of their factories.

Company	Inauguration Year of Factory	Factory Address	Province
2H Enerji	2018	Büyükkayacık OSB Mah. 102. Cd No.3/1 Selçuklu	Konya
Alfa Solar	2013	Kırıkkale 1. OSB Kızılırmak Cad. 2. Sk. Yahşihan	Kırıkkale
Ankara Solar	2013	Samsun Yolu Üzeri 20. km Gökçeyurt Serpmeleri No: 362 Mamak	Ankara
CW Enerji	2016	Antalya OSB 1. Kısım Atatürk Blv. No: 20 Döşemealtı	Antalya
Elin Enerji	2017	Başkent O.S.B. 23. Cadde #2 Malıköy Sincan	Ankara
Gazioğlu Solar	2012	Ç.O.S.B. Mah. 7.Cad. No:124 59500 Çerkezköy	Tekirdağ
Gest Enerji	2012	Güngör Uydukent Gest Energy Antakya	Hatay
GTC	2013	Organize Sanayi Bölgesi 1. Cadde No:2, Merkez	Adıyaman
HT Solar	2016	İstanbul Endüstri ve Ticaret Serbest Bölgesi, Aydınlı SB Mahallesi 1. Sokak, No:1 Tuzla	Istanbul
Mirsolar	2017	Sakarya 1. Organize Sanayi 11. Cadde No:10B Arifiye	Sakarya
Ödül Enerji	2013	Mimarsinan Organize Sanayi Bölgesi No:12, 38350 Mimarsinan, Melikgazi	Kayseri
Parla Solar	2015	Denizli Organize Sanayi Bölgesi 2. Kısım Ali Rıza Öztürk Cd. No:14 Honaz	Denizli
Seha Solar	2016	Hazar Caddesi No:3 Sincan OSB	Ankara
Schmid-Pekintaş	2013	2.Organize Sanayi Bölgesi, 317.Ada, 1. Parsel, Cumhuriyet Mah., 1.Cd., No:5, 81600 Beyköy	Düzce
Smart Solar	2017	GOSB Tembelova Alanı, Cadde 3200 N3207/1 Gebze	Kocaeli
Solarturk	2011	2.Organize sanayi Bölgesi 83226 nolu cadde No.19 Başpınar Şehitkamil	Gaziantep

Table 2: Factory Information of PV Panel Manufacturers

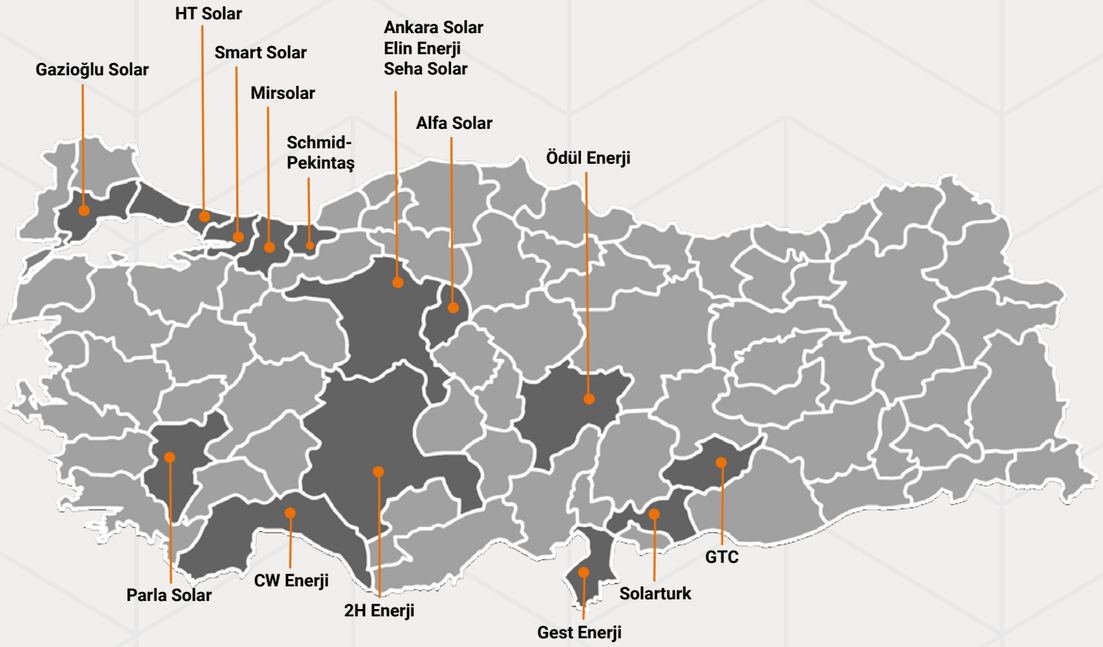


Figure 1: Geographical Distribution of PV Panel Manufacturers in Turkey

Shareholding Structure

The shareholding structure of the PV panel manufacturers in Turkey are as follows.

Company	%100 Domestic	Turkish – International Partnership	%100 International
2H Enerji	✓		
Alfa Solar	✓		
Ankara Solar	✓		
CW Enerji	✓		
Elin Enerji	✓		
Gazioğlu Solar	✓		
Gest Enerji	✓		
GTC	✓		
HT Solar			✓
Mirsolar	✓		
Ödül Enerji	✓		
Parla Solar	✓		
Seha Solar	✓		
Schmid-Pekintaş		✓	
Smart Solar	✓		
Solarturk	✓		

Table 3: Shareholding Structure of PV Panel Manufacturers

According to this information, only one out of 16 manufacturers is 100% international (HT Solar), one is a partnership of Turkish and international companies (Schmid-Pekintaş), and all other manufacturers are 100% Turkish. If we look at the percentages, 87.5% of the manufacturers are domestic.

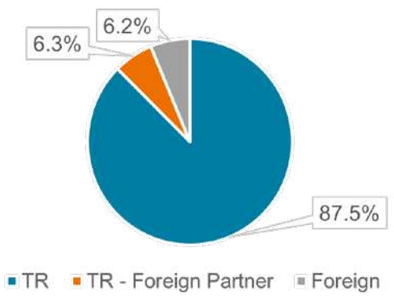


Figure 2: Distribution of PV Panel Manufacturers by Shareholding Structure

Manufacturers Operating as Both EPC and/or IPP (Investors)

While some of the manufacturers in Turkey only produce PV panels, there are others who also provide engineering, procurement, and construction (EPC) services and/or are both manufacturers of PV panels and independent power producers (IPP), i.e. investors.

Company	EPC (MWp)	IPP (MWp)	Comments
2H Enerji	-	24	
Alfa Solar	-	6	
Ankara Solar	-	-	
CW Enerji	400	30	
Elin Enerji	300	17	17 MW Afta Enerji Üretim A.Ş. and Solana Enerji Üretim A.Ş. power plants located in Konya, Karapınar district are the investments of Elin Enerji.
Gazioğlu Solar	-	-	
Gest Enerji	Yes	Yes	Panel production is the predominant activity, and the company may optionally cooperate in large-scale projects as EPC. As an investor, Gest Enerji installs its own solar power plants to face the energy demand of their factory and group investments.
GTC	10	6	GTC employs 65 engineers and provides free of charge power plant engineering services and 100% power plant monitoring after-sales services.
HT Solar	-	-	
Mirsolar	-	-	
Ödül Enerji	-	-	
Parla Solar	45	-	
Seha Solar	10	-	EPC references are available for 10 MWp of special projects. However, normally it is not a company providing EPC services.
Schmid-Pekintaş	-	~ 100	It is both a PV panel manufacturer and an investor. There are approximately 100 MWp power plant investments in Turkey and overseas.
Smart Solar	> 250	> 100	235.78 MW of EPC works have been completed and 74 MW of EPC work is under construction.
Solarturk	-	-	Only PV panel production and consortium for high capacity investments.

Table 4: Fields of Activity of PV Panel Manufacturers

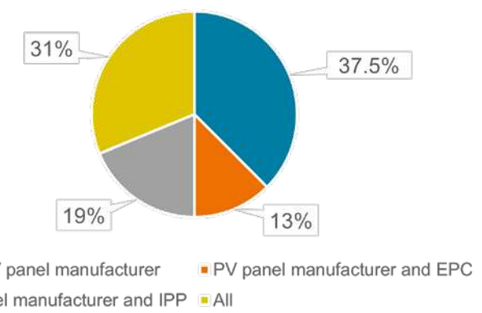


Figure 3: Fields of Activity of PV Panel Manufacturers (PV Panel Manufacturer, EPC, IPP)

37.5% of the PV panel manufacturer companies in Turkey are only manufacturers, 31% of them prefer to operate in all three fields (as PV panel manufacturer, EPC, and IPP), 13% of the companies are PV panel manufacturers and EPCs, and 19% are PV panel manufacturers and IPPs.

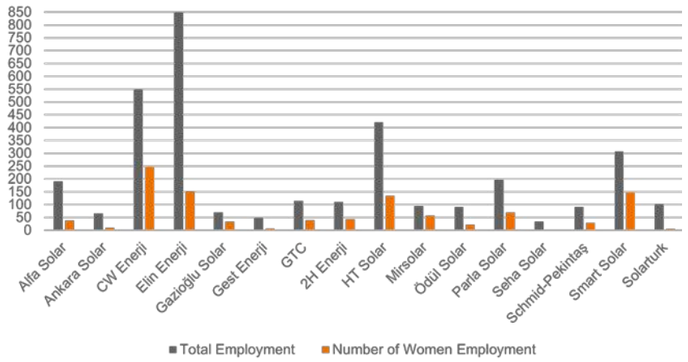
Employment

According to the information obtained from 16 manufacturers, the number of employees in the PV panel production sector is observed as 3,343 people. Women account for approximately 31.2%, a total of 1,043.

Company	Total Employment	Women Employees in Overall Employment (%)
2H Enerji	110	40%
Alfa Solar	190	20%
Ankara Solar	65	15%
CW Enerji	550	45%
Elin Enerji	850	18%
Gazioğlu Solar	70	50%
Gest Enerji	50	15%
GTC	1151	35%
HT Solar	422	32%
Mirsolar	95	60%
Ödül Enerji	91	25%
Parla Solar	198	35%
Seha Solar	35	0%
Schmid-Pekintaş	92	32%[2]
Smart Solar	308	48%
Solarturk	102	6%
Total	**3,343**	

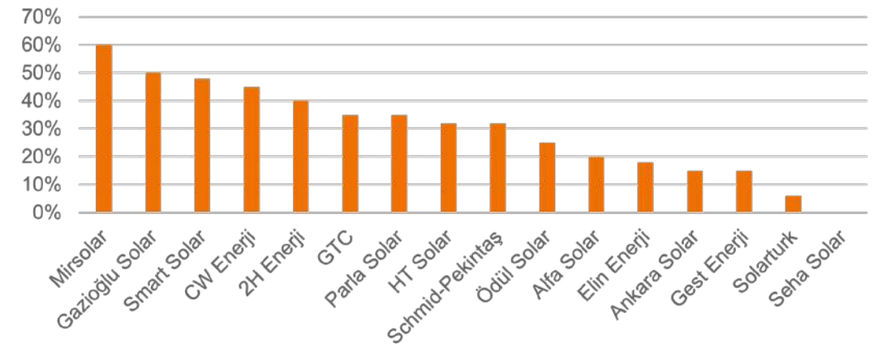
Table 5: Overall Employment of PV Panel Manufacturers and Percentage of Women in Employment

Figure 4: Overall Employment of PV Panel Manufacturers and Women in Employment



[1] The firm stated that 65 employees are engineers and 24 of those engineers are women (60% of the 35% of women employment).
[2] The firm stated that all the decision-making and critical positions in the management staff are women, and that the female employment in the administrative staff is 60%.

Figure 5: Women Rates in Employment of PV Panel Manufacturers



Capacity & Plans

The total PV panel production installed capacity of all 16 manufacturers is 5.61 GW/year and the total cell production installed capacity is 630 MW/year.

PV Panel and Cell Production Installed Capacity

The distribution of PV panel and cell production installed capacities by the manufacturers are given in the table below.

Company	PV Panel Production Installed Capacity (MW/year)	Cell Production Installed Capacity (MW/year)
2H Enerji	250	-
Alfa Solar	300	-
Ankara Solar	200	-
CW Enerji	1,000	-
Elin Enerji	450	-
Gazioğlu Solar	140	-
Gest Enerji	150	-
GTC	135	100
HT Solar	800	400
Mirsolar	200	-
Ödül Enerji	235	-
Parla Solar	150	130
Seha Solar	100	-
Schmid-Pekintaş	250	-
Smart Solar	1,000	-
Solarturk	250	-
Totals	**5,610**	**630**

Table 6: Annual PV Panel and Cell Production Installed Capacities

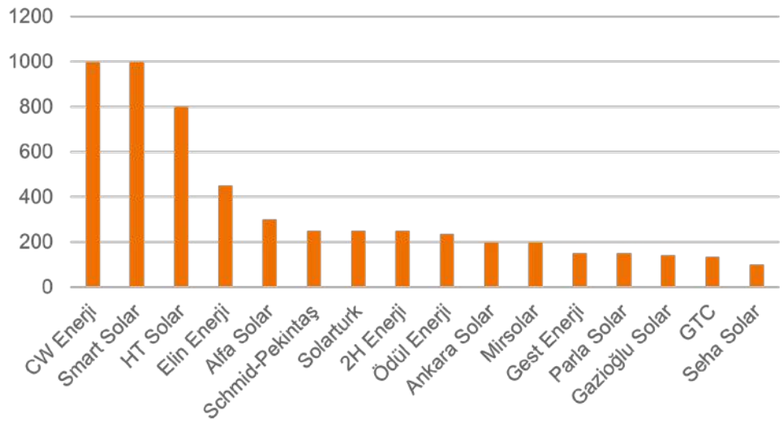


Figure 6: Annual PV Panel Production Installed Capacity in Turkey

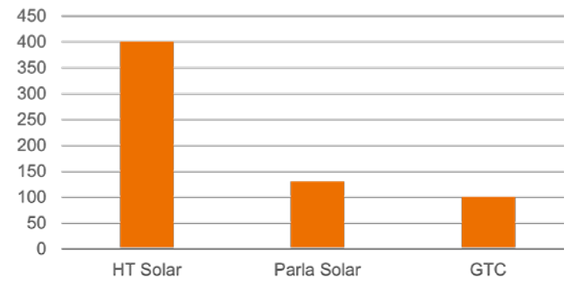


Figure 7: Annual Cell Production Installed Capacity (MW/year)

Approximately 50% of the annual installed capacity in PV panel production belongs to three companies (CW Enerji, Smart Solar, HT Solar). Regarding the annual cell production installed capacity, only three companies (HT Solar, Parla Solar, GTC) cover the total installed capacity.

Province	PV Panel Production Installed Capacity (MW/year)
Adıyaman	135
Ankara	750
Antalya	1,000
Denizli	150
Düzce	250
Gaziantep	250
Hatay	150
Istanbul	800
Kayseri	235
Kırıkkale	300
Kocaeli	1,000
Konya	250
Sakarya	200
Tekirdağ	140
Total	**5,610**

Table 7: Annual PV Panel Production Installed Capacities on Provincial Basis

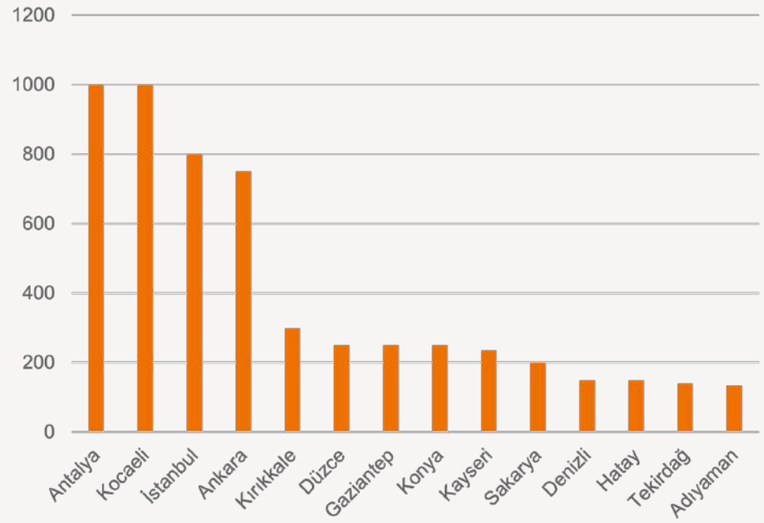


Figure 8: Annual PV Panel Production Installed Capacities by Provinces

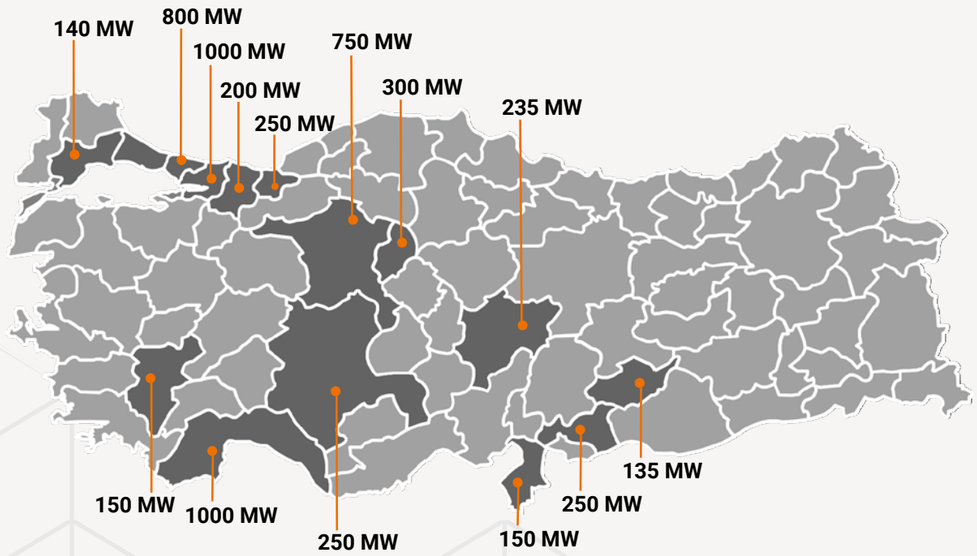


Figure 9: Distribution of PV Panel Production Installed Capacities by Provinces on the Map

Investment Plans

The feedbacks of the PV panel manufacturers in Turkey show various types of investment plans. The plans are mainly focused on increasing the existing panel production line capacity, keeping up with new PV panel technologies, and revising the production lines according to these technologies. Energy storage and cell production investments come to the fore, as well.

Company	PV Panel Production	Cell Production	IPP/Power Plant Investments	Energy Storage System Investments
2H Enerji	Increasing capacity with the establishment of full automation and the production of multi busbar and Big Cell panels.	-	Continuing investments in the solar fields of Ukraine.	-
Alfa Solar	Production line revision to manufacture compatible with the half-cut and multi busbar technology.	-	There is a 15 MWp biomass investment for 2020.	-
Ankara Solar	-	-	-	-
CW Enerji	Increasing the PV panel production capacity from 1,000 MW to 1,300 MW.	Investment decision has been made. It will be commissioned in the medium term.	Investment decision has been made. Approximately 100 MW of power plants will be commissioned.	The R&D center and production of lithium battery technology investment decisions have been made. They will be commissioned in the medium term.
Elin Enerji	-	Cell factory investment depending on RERA tender	Domestic/foreign power plant investments	-
Gazioğlu Solar	The necessary investments by following the technological requirements and developments.	-	-	-
Gest Enerji	To increase the efficiency-oriented panel production.	Has worked on cell production investment, and it is planned to be implemented in parallel with new investments.	Installs its own solar power plants to provide the energy needs of PV panel production factory and provide the energy needs of the group investments.	-
GTC	Increasing PV panel production capacity by +100 MW in light of technological requirements and developments.	Investment in cell production with big cell/ silicon heterojunction technology by increasing the already established 100 MW MonoPERC Bifacial cell production capacity by 100 MW.	-	-
HT Solar	Increasing production capacity and revising production lines to produce new types of PV panels with M6-166mm cells and M10-182mm cells	Increasing solar cell production installed capacity	-	-
Mirsolar	Investing in production line and equipment with respect to developing technologies and increasing capacity	-	-	-
Ödül Enerji	Increasing the total annual production installed capacity to 500 MW by investing in the necessary machinery and equipment with respect to the developing technologies.	-	-	-
Parla Solar	Capacity increase, technology upgrade	Capacity increase, technology upgrade	-	-
Seha Solar	Increasing capacity and Half Cut Multi Busbar PV panel production	-	-	-
Schmid-Pekintaş	-	-	-	Co-investment in Turkey with their partner company Schmid Groups in production of the Vanadium Redox technology energy storage systems invented by Schmid Group
Smart Solar	-	New investment for 500 MW/year	Continuing SPP investments as IPP in Italy, Spain, Hungary, Poland, Turkey, and Ukraine	-
Solarturk	Renovation, technological investments	-	-	-

Table 8: Investment Plans of PV Panel Manufacturers

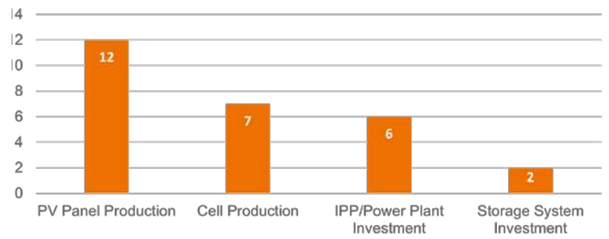


Figure 10: Distribution of the Investment Plans of the PV Panel Manufacturers

Shown in Figure 10, there are 12 manufacturers planning PV panel investments out of 16, 7 manufacturers planning cell production investments, 6 manufacturers planning power plant investments, and 2 manufacturers planning to invest in energy storage systems.

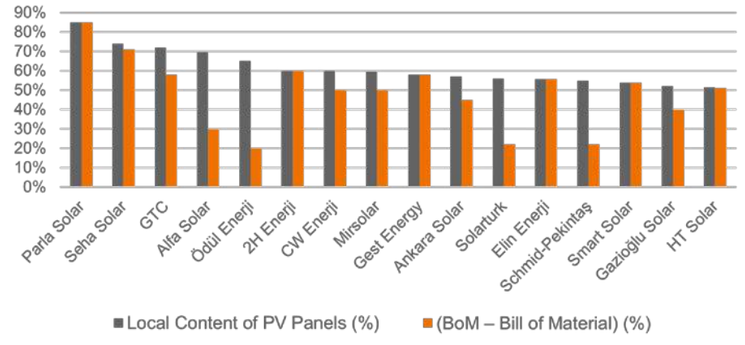
Supply Chain & Local Content Ratio

In the table and graph below, percentages of the domestic PV panel raw material supply and local content ratios can be seen.

Company	Local Content Ratio of PV Panel (%)	Domestic Supply Chain (BoM – Bill of Material) Cost Ratio (%)
2H Enerji	50 - 60%	50 – 60%
Alfa Solar	69.80%	30%
Ankara Solar	57%	45%
CW Enerji	50 - 60%	45 - 50%
Elin Enerji	55.80%	55.80%
Gazioğlu Solar	52%	40%
Gest Enerji	58%	58%
GTC	72%[3]	58%
HT Solar	51.50%	51%
Mirsolar	59.70%	50%
Ödül Enerji	55 – 65%	20%
Parla Solar	85%	85%
Seha Solar	74%[4]	71%
Schmid-Pekintaş	55%	22%
Smart Solar	53 – 54%	54%
Solarturk	56%	22%

Table 9: Local Content Ratios and Raw Material Supply Chain of PV Panel

Figure 11: Local Content Ratios and Raw Material Supply Chain of PV Panel.[5]



[3] This value is the actual local content ratio obtained with the domestic cell and domestic front / back glass of PV panel.
[4] Different BoM lists are available. It is the percentage value in the case of the highest local content.
[5] The graph was created using the maximum value of the PV panel local content rates given as range values.

Portfolio & Distribution

Overviews of the PV panel types produced in Turkey and division of sales to local sales and international export.

PV Panel Types in the Portfolio of Manufacturers

The distribution of PV panel types produced in Turkey according to the manufacturers can be seen in the table below.

Company	PV Panel Types
2H Enerji	poly, mono, mono PERC, bifacial (double-sided), glass to glass, full-black, big cell
Alfa Solar	poly PERC, mono PERC
Ankara Solar	poly, mono, PERC, bifacial (double-sided)
CW Enerji	poly, mono, poly PERC, mono PERC, bifacial (double-sided), half-cut, flexible modules, smart modules, high voltage modules, full black, tight modules, innovative facade cladding PV panels, innovative greenhouse panels. It was stated that with the new investment, which will be commissioned soon, multi busbar and 210 mm x 210 mm (solar cell) PV panels will be produced.
Elin Enerji	poly, mono, PERC and half-cut 5BB 1.000-1.500 V, poly, mono, PERC and half-cut MBB 1.000-1.500 V, poly, mono, PERC and half-cut MBB, bifacial 1.000-1.500 V
Gazioğlu Solar	poly, mono PERC
Gest Enerji	poly, mono, PERC, bifacial, half-cut and others
GTC	glass/glass bifacial heterojunction, glass/glass bifacial n-type mono PERC, and glass/glass bifacial half-cut. Note: GTC that realized the production of glass/glass PV panel as a project output of TUBITAK established the first private R&D center registered by the Ministry of Industry and Technology in 2016.
HT Solar	mono, mono PERC, half-cut, double glass bifacial (double-sided), transparent backsheet bifacial (glass + transparent backsheet – double-sided), double glass bifacial half-cut, transparent backsheet bifacial half-cut, full black (black frame and black backsheet), big cell mono PERC (158,75 mm x 158,75 mm), big cell half-cut mono PERC (158,75 mm x 79,375 mm). In addition, as of the first quarter of 2021, m6 big cell half-cut mono PERC (166 mm x 83 mm) and m10 big cell half-cut mono PERC (182 mm x 91 mm) will be produced.
Mirsolar	poly PERC, mono, mono PERC, half-cut, bifacial, PERC
Ödül Enerji	poly, mono, mono PERC, poly PERC, half-cut, bifacial, glass to glass, shingling
Parla Solar	poly, mono, PERC, al-bsf, bifacial
Seha Solar	poly, mono, PERC, bifacial, half-cut
Schmid-Pekintaş	poly, mono, mono PERC Preparations for the transition to m6 (166 mm x 166 mm) big cell technology are almost complete. There is a technical infrastructure for half-cut and bifacial products in the production lines and they plan the production according to demand.
Smart Solar	poly, mono, mono PERC, half-cut bifacial (framed/unframed), glass to glass, glass-backsheet, full-black, big cell, high efficiency big cell mono PERC m4-9b-r tipi 166 mm.
Solarturk	poly, mono, PERC, bifacial, half-cut, special products (table-tennis table, flowers)

Table 10: PV Panel Types in the Portfolio of PV Panel Manufacturers

Company	Poly	Mono	PERC	Bifacial	Half-Cut	Others
2H Enerji	✓	✓	✓	✓		✓
Alfa Solar	✓	✓	✓			
Ankara Solar	✓	✓	✓	✓		
CW Enerji	✓	✓	✓	✓	✓	✓
Elin Enerji	✓	✓	✓	✓	✓	
Gazioğlu Solar	✓		✓			
Gest Enerji	✓	✓	✓	✓	✓	✓
GTC		✓	✓	✓	✓	✓
HT Solar	✓	✓	✓	✓	✓	✓
Mirsolar	✓	✓	✓	✓	✓	
Ödül Enerji	✓	✓	✓	✓	✓	✓
Parla Solar	✓	✓	✓	✓		
Seha Solar	✓	✓	✓	✓	✓	
Schmid-Pekintaş	✓	✓	✓			✓
Smart Solar	✓	✓	✓	✓	✓	✓
Solarturk	✓	✓	✓	✓		

Table 11: PV Panel Types in the Portfolio of Manufacturers (Classified)

Export

The distribution at what percentage the PV panels are used in the domestic market, at what percentage exported abroad, and which countries are the target foreign markets for those exported can be seen in the table below.

Company	Sales Ratio in Turkey – Average of Last 5 Years (%)	Export Ratio – Average of the Last 5 Years (%)	Major Markets Abroad - Countries	Major Markets Abroad - Regions
2H Enerji	90%	10%	Bulgaria, Central and South Africa, Cyprus, Germany, Greece, Morocco, South America, Syria, and Ukraine	Europe, Middle East, Far East
Alfa Solar	90%	10%	Egypt, Israel, Portugal, Vietnam	Europe, Middle East
Ankara Solar	80%	20%	Cyprus, Germany, Poland, Syria, Yemen	Europe, South Africa, South Asia, North Africa, Middle East, Far East
CW Enerji	70%	30%	Afghanistan, Bangladesh, Cyprus, Ethiopia, Germany, Israel, Iraq, Jordan, Kenya, Macedonia, Morocco, Netherlands, Nigeria, Palestine, Romania, Serbia, Syria, Tunisia, United Arab Emirates	South Asia, North Africa, Middle East
Elin Enerji	85%	15%	Algeria, Cyprus, Jordan, Morocco, Palestine, Qatar, Singapore, Tunisia	Europe, Africa, Turkic Republics
Gazioğlu Solar	98%	2%	Africa, Europe, Balkan Countries, Turkic Republics	Europe, Middle East
Gest Enerji	75%	25%	European and Middle Eastern Countries	North America
GTC	100%	0%	USA (Export started with cell production.)	Europe, South America, North Africa, Central and South Africa, Middle East
HT Solar	15%	85%	France, Germany, Hungary, Mexico, Netherlands, Slovenia, Syria, UAE, Ukraine, USA	Europe, South America, North America, Middle East
Mirsolar	80%	20%	African Countries, Europe, Middle East USA[6]	North Africa, Central and South Africa
Ödül Enerji	80%	20%	Azerbaijan, Germany, Morocco, Netherlands, Pakistan, Syria, USA	South Asia, North America, North Africa, Middle East, Turkic Republics
Parla Solar	95%	5%	Middle East Countries	Middle East
Seha Solar	85%	15%	Afghanistan, Cyprus	South Asia, Middle East
Schmid-Pekintaş	75%	25%	Azerbaijan, Cyprus, France, Germany, Israel, Italy, Turkmenistan, Ukraine	Europe, Middle East, Turkic Republics
Smart Solar	90%	10%	Austria, Bulgaria, Germany, Greece, Middle East, North Africa, Romania, Ukraine	Europe, Middle East, North Africa
Solarturk	92%	8%	African Countries, Middle East	North Africa, Middle East, Central and South Africa

Table 12: Sales Percentage of PV Panels in the Domestic Market and their Export to the Foreign Markets

[6] It is stated that there will be projects in the American market in 2021.

Exactly 25% of the manufacturers export less than 10% of their products, 68.8% of the manufacturers export 10% -30% of their products, and only one company exports 85% of their products. Therefore, it can be said that the PV panel production in Turkey is mainly focused on the domestic market in the current situation, but the manufacturers have been increasing their export rates and country/region portfolios. Considering the export regions, the main markets are Europe and the Middle East.

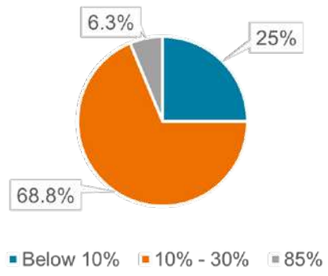


Figure 12: Use of PV Panels in the Domestic Market and Export to Foreign Markets

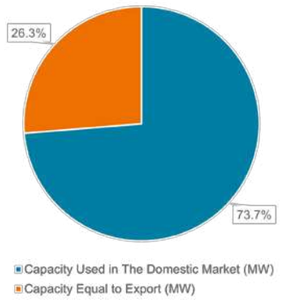


Figure 13: Production Capacity Used in the Domestic Market and Exported Abroad (%)

Company	Annual Production Installed Capacity (MW)	Installed Capacity Corresponding Export (MW)
2H Enerji	250	25
Alfa Solar	300	30
Ankara Solar	200	40
CW Enerji	1,000	300
Elin Enerji	450	67.5
Gazioğlu Solar	140	2.8
Gest Enerji	150	37.5
GTC	135	0
HT Solar	800	680
Mirsolar	200	40
Ödül Enerji	235	47
Parla Solar	150	7.5
Seha Solar	100	15
Schmid-Pekintaş	250	62.5
Smart Solar	1,000	100
Solarturk	250	20
Total	**5,610**	**1,474.8**
(%)	100%	26.3%

Table 13: Use of PV Panels in Domestic Market as Capacity and Export Data

According to the information submitted by these 16 manufacturers, the annual production installed capacity is 5,610 MW in Turkey. Based on an assumption of 100% capacity usage ratio, manufacturers export 1,474.8 MW of this capacity to the foreign markets. The remaining capacity, 4,135.2 MW, is sold in the domestic market. In the next revision, these values will be updated by collecting approximate capacity utilization ratios from companies. The capacity exported abroad is equal to 26.3% of the overall capacity.

Company	Europe	South America	South Asia	North Africa	North America	Middle East	Central & South Africa	Turkic Republics	Far East
2H Enerji	✓	✓		✓		✓	✓		
Alfa Solar	✓					✓			✓
Ankara Solar	✓					✓			
CW Enerji	✓		✓	✓		✓	✓		✓
Elin Enerji			✓	✓		✓			
Gazioğlu Solar	✓			✓			✓	✓	
Gest Enerji	✓					✓			
GTC					✓				
HT Solar	✓	✓			✓	✓			
Mirsolar	✓			✓		✓	✓		
Ödül Enerji			✓	✓	✓	✓		✓	
Parla Solar						✓			
Seha Solar			✓			✓			
Schmid-Pekintaş	✓					✓		✓	
Smart Solar	✓			✓		✓			
Solarturk				✓		✓	✓		

Table 14: Distribution of Regions where Manufacturers Export Products to the Foreign Markets

When the export markets of Turkish PV panel manufacturers are examined, the most important market is the Middle East with 27.5%, the second is Europe with 19.6%, and the third is the North Africa with 15.7%.

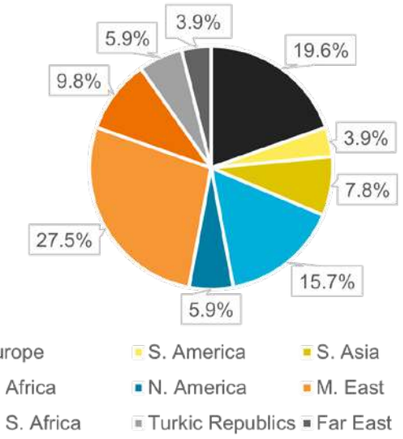


Figure 14: Distribution of Regions where PV Panel Manufacturers Export Products to the Foreign Markets

Opinion

We asked the 16 manufacturers of PV panels in Turkey “What would be the regulations to support domestic PV panel production and what are the barriers to market development?” Here’s is what they had to say.

PV Panel Manufacturer Companies' Opinions to Support Domestic PV Panel Production

In this section, opinions from all 16 manufacturers are compiled, all of which are advisory, and they do not include Stantec's additional comments and opinions.

It was stated that it is important to continue various policies to conserve the PV panel producers' production capacities and that increasing the support for PV panel exports could also increase export rates. Incentives to increase R&D studies and technological infrastructure in relation to PV panel technology, especially domestic cell production and domestic PV panel basic raw material production (such as EVA, backsheet) will benefit the PV panel sector. However, to compete with imported producers, sectoral subsidies will relieve the domestic producers in the short and medium term. To illustrate, regulations regarding customs taxation in raw material purchases and regulations regarding VAT in sales may be introduced. In addition, incentives for global PV panel producers that produce PV panel raw materials to establish production facilities in Turkey increase the raw material production knowledge of the domestic producers and enable them to compete in the long term. Under current circumstances, price competitiveness of domestic producers in the international markets, considering the Far Eastern PV panel producers, may be difficult.

One of the most important points is to ensure the healthy growth of the market and to make regulations that will ensure the PV panel producers to manufacture products in accordance with international standards and that they are controlled for quality. PV panel manufacturing quality standards should be checked regularly. Ten and 25-years PV panel production warranties provided by PV panel manufacturers may be misleading in some installations due to PV panels that cannot provide these values. The control mechanism of PV panel production quality, if properly implemented and used, will increase the PV panel quality standards produced in Turkey. It will raise the minimum standards for future investments.

In Yenilenebilir Enerji Kaynak Alanı (YEKA)/ Renewable Energy Resource Area (RERA) tenders, the use of PV panels made of locally produced solar cells may be required. Increasing the local content ratio required in solar energy investments by the institutions such as public buildings, universities and hospitals, and in tenders, will contribute to the development of the domestic PV panel manufacturers and the national economy.

Regarding YEKDEM (local feed-in tariff scheme), it was stated that it should be extended by one year in its current form and that it should be 15% subtractive every year from the current price reward table for the new YEKDEM 2021-2026 period.

Implementing additional tariff support and interest rates cut in investment incentives are among the opinions stated. In addition, shortening the solar energy investment permit processes is an important issue in realizing the investments faster.

Ease of access to finance and suitable, diverse financing opportunities are always the most important issues of the sector and it is one of the issues that should be on the agenda to increase solar energy investments. In addition, accepting the PV power plant itself as collateral in project financing will also ease access to solar energy finance.

It was stated that the organized and small industrial zones and the beneficiaries with insufficient roof area should be given permission for solar power plant installation for self-consumption on non-arable land.

It has been suggested that there is no limitation in self-consumption and that the right to be able to sell excess energy at the cost of active energy price should always be continued and no restrictions be imposed.

There are also opinions that ground-mounted SPPs to be allowed for self-consumption investments with monthly net-metering if they are in the same distribution area.

If the infrastructural works aimed at increasing the capacity rates in electricity generation can be done, the problems of capacity insufficiency in rooftop PV installations as it happened before in ground type installations may be avoided.

Supporting irrigation cooperatives for solar PV energy projects to reduce energy costs will contribute to the national economy. It is important that farmers irrigate their lands on time and prevent salinization by watering the soil at night. Contribution can be made to the agricultural sector by allowing annual net-metering for SPP installations of agricultural irrigation cooperatives, with installed capacity 10% higher than cumulative pump power. They can be supported with grant component as well.

Ensuring stability in energy generation legislation will provide a safer environment for the potential SPP investors.

ADDITIONAL

Team & Document Information

Our Energy Engineering Team

Stantec is at the forefront of solving environmental, climate change, and energy challenges. To address these issues, we promote improvements in renewable energy and energy efficiency, developing advanced environmentally-friendly energy generation solutions and helping to reduce greenhouse gas emissions.

Our team of energy engineers provides a comprehensive range of energy services, including the development of energy roadmaps, energy efficiency auditing programmes, power generation solutions, management of sustainable energy credit lines, feasibility studies, conceptual, basic and detailed design, environmental eligibility checks, gap analysis, construction monitoring and supervision, and action plans.

Elif Aksoy Karaman

Energy Engineer
Writer

Elif has studied energy systems engineering. Working at Stantec since 2017, she has been involved as a long-term renewable energy engineer in consultancy services for the Renewable Energy Component (the Project) is one of the four components of the Energy Sector Technical Assistance Project which is financed under EU's 2012 IPA program to Turkey. The execution of the Project is led by the Ministry of Energy and Natural Resources (MENR) and administered by the World Bank (WB). Her responsibility was to prepare the PARs (project assessment reports) about solar PV projects. Also she gave support financing mechanism report of solar PV sector.

Elif has been working as TurSEFF project assistant since 2017. TurSEFF is Turkey Sustainable Energy Financing Facility developed by the European Bank for Reconstruction and Development.

Selen Inal

TurSEFF Business Development Manager
Writer

Selen Inal has been working as TurSEFF business development manager at Stantec Turkey since November 2019. TurSEFF is the Turkey Sustainable Energy Financing Facility developed by the European Bank for Reconstruction and Development. She has 19 years of experience in various segments of the energy business including power plant investments, electricity trading, renewable energy, electricity market and engineering and design. She approaches energy projects from technical, financial, legal and commercial points of view. She has developed business for international energy projects covering more than 2,200 MW having an accumulated knowledge of different types of power plants–natural gas combined cycle, hydro, solar, wind, and waste-to-energy. Previously, she managed the development process of a high-technology and high-efficiency integrated PV panel manufacturing plant project of one GW/year ingot - wafer - cell - module, which was granted with "special project" status and the incentives offered by the Turkish government totaling up to 4.2 billion Turkish Lira. She has also consulted leading global renewable energy companies and international financial institutions. Moreover, she has been active in entrepreneurship ecosystem, mentoring various renewable energy start-ups and working to advance the role and recognition of women working in the energy sector in Turkey and globally.

Ahmet Çelik

Energy Engineer
Writer

Ahmet has studied Energy Systems Engineering and has completed MSc in energy systems operation and technologies. Working at Stantec since 2015, he has been involved as a sustainable energy engineer and expert for numerous resource efficiency projects in industrial (energy efficiency, water efficiency, and waste management), renewable energy projects (solar, wind, biomass) and sustainable energy financing schemes and consulting from local and international clients such as EBRD, World Bank, public bodies, and private institutions.

Alican Özden

Energy Engineer
Reviewer

After studying electrical engineering with a focus on renewable energy systems, and completing MSc in renewable energy, Alican worked at an EPC company where his focus was on rooftop solar PV installations. Here, he undertook roles from sales, sourcing, engineering, installation, to regulatory licensing of multiple solar power projects. Working at Stantec since 2016 as an energy engineer, he supported local and international experts during many projects for international clients such as the EU, World Bank, and EBRD.

Since 2008, he has been working as the deputy team leader of TurSEFF. Alican reviewed the final draft of the Market Research and supported the authors in finalize it.

Koray Goytan

Senior Energy Engineer
Approver

Koray has been involved in project management, project design, design coordination, sustainability consultancy, and commissioning authority stages of commercial building projects such as large-scale office, hotel, shopping center, hospital, and data center projects for nearly ten years. In this way, he managed as a whole the expectations and priorities of various stakeholders such as investors, financiers, and contractors as well as design teams during the design, implementation, and operation stages of the projects. He solved problems identified at different stages in advance and worked to optimize procedures. His experience was developed by working with multinational teams in Turkey, Italy, and the GCC countries.

In the third phase of TurSEFF, Koray joined the team as deputy team leader, and he's been working as team leader since April 2018.

Table List

Figure List

Design with
community in mind