

Islamic Republic of Iran
Organization for investment economic and technical assistance of Iran

"Summary of technical-economical prefeasible study"

The name:
Production of solar panels

Sector: Industry subsector: Electrical machinery and apparatus
ISIC code: 31101330

The owner of:
General Department of Economic Affairs and Finance of Kermanshah
Province

Counselor plan:
Razi University of Kermanshah

The ADDRESS:
Javanrood Industrial Town

Date of P.F.S:

**Manager of Iran Investment Opportunities
SHAHRIG Engineering Company**

shahrig.comwww.



Contents

1- Abstract	2
2- Project's location	4
2-1- Province.....	4
2-2- the County	4
2-3- the project.....	6
2-4- access to the infrastructures.....	7
3-Technical Specifications of plan.....	7
3-1– product.....	7
3-2- project's requirements.....	9
3-2-1-Space and infrastructure required	9
3-2-2-Equipment and machinery	12
3-2-3- Raw materials and intermediate components	21
3-2-4-management and human resources	24
4- Ownership and legal permission.....	27
4-1- ownership of land.....	27
4-2- Intellectual property and incentives	27
4-3- legal permission.....	27
5- Market study and Competition.....	29
5-1- Introduce target market	38
6- Physical Progress of project	45
7- Action plan and Implementation schedule	45
8- Financial projection	46
8-1- The cost estimate.....	46
The cost estimate.....	46
8-2- Estimated revenues.....	48
8-3-Duration of project operation	49
8-4-Break- even analysis.....	49
8-5- Cost-benefit analysis	49
8-6- Sensitivity analysis of IRR.....	50
8-7- Summarize table.....	51
8-8-Estimation of exchange rate changes during the project implementation.....	52
9- Capital needs, the supply and guarantees method	53
9-1- Foreign currency needed	53
9-2- The Way of participation and finance method	53
9-3- Payback period	54
10- Incentives, features and advantages of project	54

1- Abstract:

PROJECT PROFILE - SUMMARY SHEET

Project Introduction	
1- Project title: Production of Solar Panels	
2- Sector: Production	Sub Sector: Industry
3- Products / Services: Polycrystalline and Monocrystalline Solar Panels	
4- location (address): Free Zone <input type="checkbox"/> Economic Special Zone <input type="checkbox"/> Industrial Estate <input checked="" type="checkbox"/> Main Land <input type="checkbox"/>	
5- Project description: This project is related to the production of solar panels in Kermanshah province due to the presence of silica mines in the province, especially in the Javanrood-Ravansar geographical area. More precisely, this project is to set up a large solar panel production factory with a capacity of 20 megawatts (or more) of electricity per year in the form of producing two types of polycrystalline and monocrystalline panels in the Javanrood Industrial town.	

Project Status	
6- Local / internal raw material access: yes	
7- Sale: 5,600,000,000,000 rial - Anticipated local market: 60% - Anticipated export market: 40%	
8 – Project total time (from start of activities to start of commercial operation in years) :24 month	
Schedule	Start of activities: 2024 (1403) Start of works at site 2024 (1403) End of Works: 2025 (1404) Start of commercial operation: 2026 (1406)

9- Project status:

- Feasibility study available? No
- Required land provided? No
- Legal permissions (establishment license, foreign currency quota, environment, etc) taken? Yes No
- Partnership agreement concluding with local /foreign investor? No
- Financing agreement concluding? No
- Agreement with local /foreign contractor(s) concluding? No
- Infrastructural utilities (electricity water supply, telecommunication, fuel, road, etc) procured? No
- List of know- how, machinery, equipment, as well as seller /builder companies defined? No
- Purchases agreement machinery, equipment and know-how concluded? No

Financial Table**10- Financial structure:**

Descriptions	Local Currency Required			Foreign Currency Required Million Euro	Total Million Euro
	Million Rials	Rate	Equivalent in Million Euro		
Fix Capital	5,495,951.6	700000	7.85	7.85	7.85
Current Capital	643,870	700000	0.92	0.92	0.92
Total Investment	6,139,821.6	700000	8.77	8.77	8.77

- Value of foreign equipment / machinery Million Euro
- Value of local equipment / machinery6.50..... Million Euro
- Value of foreign technical know-how..... Million Euro
- Value of local technical know-how.....0.44..... Million Euro
- Net present value (NPV):29.31..... Million Euro
- Internal Rate of Return (IRR):78.76.... %
- Capital Rate of Return: .18.86..... %
- Payback Period2.1..... year

General Information

11 - Project type: Establishment ☒ Expansion and completion ☐

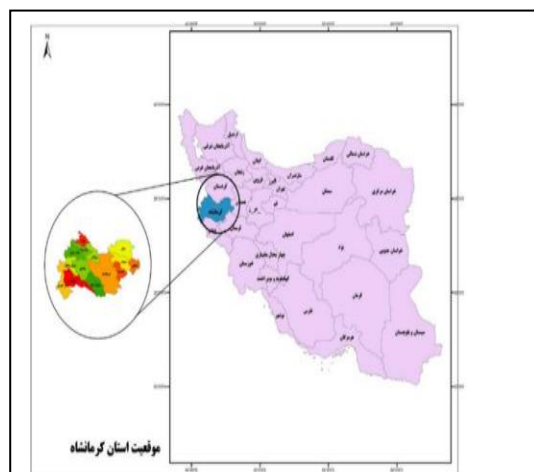
12. Company Profile

- Name (Legal / Natural persons): Industry, Mine and Trade organization
- Company's current activities: Government services
- Address: Next to the Blood transfusion organization, Shahid Beheshti Blvd., Kermanshah
- Tel: 08338239160 Fax: 08338239157
- E-mail: Web Site: www.ksh.mimt.gov.ir
- Company's legal structure:
- Government ☒ non-Governmental ☐ Public non-governmental ☐

2- Project's location:

2-1- Province: Kermanshah

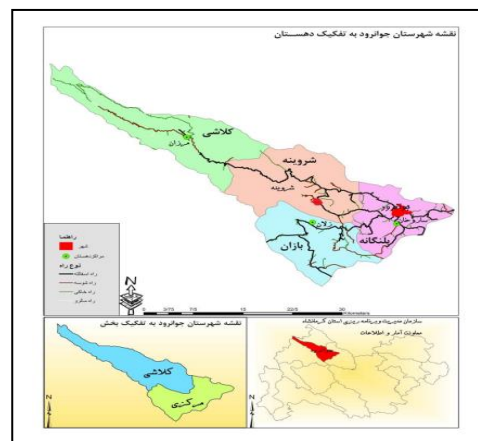
Kermanshah province has a population of over two million people and an area of 25,045.4 square kilometers, with Kermanshah as its center, located in the middle of the western side of the country. It is limited to Hamedan province from the east, Kurdistan province from the north, Ilam and Lorestan provinces from the south. It also borders the Federal Regional Government of Kurdistan from the west. This province is divided into 14 cities, 34 districts, 35 cities and 87 villages. The metropolis of Kermanshah is located in the eastern half of the province, which is one of the ten largest cities in the country and the second most populated city in the western and northwestern regions of the country. In the first period of general census in Iran, Kermanshah province had 178,997 urban inhabitants and 367,909 rural inhabitants. Also, the number of urban points in this period is 6 points. In the last general population and housing census in 2015, the urban population of the province reached 1,468,615 people, and the number of urban points is 35 cities (Rajai et al., 1403 and Statistical Yearbook, 1401).



2-2- the County: javanrood

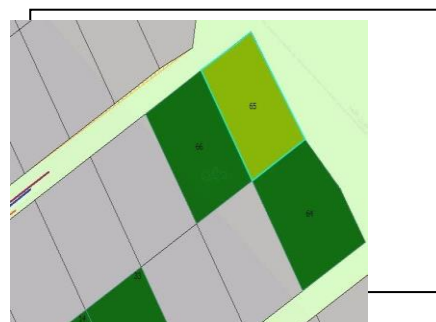
Javanrood city is located in the northwest of Kermanshah province between 34 and 32 minutes to 35 degrees and 2 minutes' north latitude and 45 degrees and 52 minutes east longitude from the Greenwich meridian and 1339 meters

above sea level. It is bounded by Paveh city from the north, Ravansar city from the east, Salas and Babajani cities from the south, and Iraq from the west. Javanrood city has 2 central and Kalashi divisions and 4 villages (Bazan, Shervineh, Pelanganeh and Kalashi) and 89 inhabited villages. According to the country divisions of 2012, it has 141 rural points. According to the census of 2015, it has a population of 75,169, of which 54,354 people live in urban areas and 20,815 live in rural areas (Statistics Center of Iran, 2015). In the mining sector, Tel Sefid mine with an approximate reserve volume of 4 million tons and an annual extraction rate of 15 thousand tons, Shesh Baid Alia mine with a definite reserve volume of 333 thousand tons, and an annual extraction of 16 thousand tons, Shahu Gharb mine with a reserve volume of 2,170,000 and annual extraction ten thousand tons, as well as the Nilaware mine with a reserve volume of nearly 12 million tons and an annual extraction of 25 thousand tons, all are located in the geographical zone of Javanrood-Ravansar. And they have created a high capability for this region and especially for the city of Javanrood. (It should be noted that according to the report of the Ministry of Mines, Industry and Trade in Kermanshah province, out of the 6 active silica mines in Kermanshah province - 4 of which are located in the Javanrud-Ravansar area - only the Shahu Gharb mine located in the Javanrud city has The extracted silica is quality grade 1 and other silica mines in the province have grade 2 extracted silica.



2-3- the project:

Due to a series of factors including access to the network of silica mines as a part of the raw materials needed in the production of solar cells, proximity to the border market of Iraq, land conditions and required infrastructure (which is mentioned in Table 1)), the industrial town of Javanrood has been suggested as a suitable location for the solar panel production project. The industrial town of Javanrood is located in Kermanshah province, Javanrood city and 5 Tehseh street. The total area of Javanrood Industrial Town approved in 2010 is 43 hectares, 13 hectares of which are operational. Currently, there are infrastructure facilities including electricity transmission lines, water, sewage collection, road lighting and gas distribution network lines in the industrial town. In terms of access to silica mines and access to transportation routes and proximity to the Iraqi border, this town is in a very convenient location. Also, the survey of lands ready for transfer in this geographical area shows that the total of two plots (65 and 66) in the industrial town of Javanrood, with an area of 8 thousand square meters in metal pieces, have suitable conditions for setting up a solar panel factory production plan. Plot 65 has latitude 46.581801 and longitude 34.815077 and plot 66 has latitude 34.813647 and longitude 46.575017. According to the table below, access to infrastructure is available in each plot of 4,000 square meters and the facilities of the industrial town are at the disposal of the units; Also, the land does not need to spend heavy expenses on leveling, etc.



2-4-access to the infrastructures:

No.	Needed infrastructures	distance to the project	The supply infrastructures
1	water	0	Javanrood Industrial Town
2	electricity	0	Javanrood Industrial Town
3	gas	0	Javanrood Industrial Town
4	Telecommunications	0	Javanrood Industrial Town
5	High way	1 km	Javanrood -Paveh road
6	Sub way	0	Industrial town
7	airport	115 km	Isfahani Ashrafi Airport
8	port	-	-
9	Rail way	120 km	Kermanshah Railway

3- Technical Specifications of plan:

3-1 –product:

Solar panel is an electronic device that consists of a number of solar cells in series and parallel circuits and is placed in aluminum frames and a glass protective plate (Solar Grade). Solar panels are made by means of photovoltaic cells, which means that sunlight is directly converted into electricity by using a silicon semiconductor (Chao & Li, 2010). Solar cells convert light into electricity only when sunlight is available. Therefore, the solar power system needs energy storage, which usually uses a battery for this purpose (Chang, 2009). Many solar cells are needed in a solar panel to generate electricity (Sozen et al, 2008). In order to obtain higher output power, series and parallel combination of solar panels is used to produce electric power. The ideal model of a solar cell is described by a parallel current source with a diode (Huang & Sun, 2007).



Types of solar panels in terms of construction type

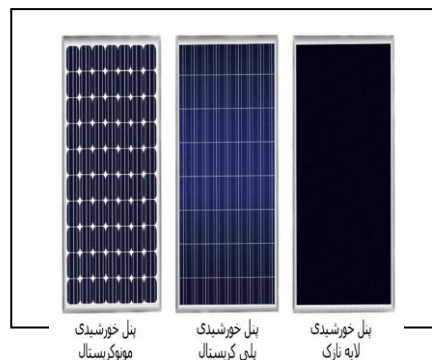
(1) Silicon polycrystalline solar panel (Poly Crystal):

This type of panel includes solar cells that are made of different single crystal grains. These panels are produced from several solar cells, each of which is made of thin tablets of silicon crystals. The efficiency of these panels in direct sunlight is much better and between 13% and 16% compared to thin layer samples. The useful life of these panels is more than thin layer samples and the expected amount is estimated to be around 25 years. In contrast to these improvements, the most important advantage of thin-layer panels is that their electricity generation is better in cloudy weather and even on moonlit nights than high-crystal samples. The manufacturing process of full crystalline solar panels is somewhat complicated and in this sense, their initial price is between 20% and 30% more expensive than thin layer samples.

(2) Silicon monocrystalline solar panel

This type of panel, which is made of pure silicon crystal, has all the characteristics of high crystal samples, but due to the high efficiency, if we consider the production capacity as the criterion, they should be the smallest and most compact panels. calculate Considering the high cost of making these panels, it is obvious that their price will be higher than other types. Normally, the price of a single-crystal panel is between 35 and 50% more than the equivalent multi-crystal solar panel (Rezaei et al., 1400). The efficiency of monocrystalline solar panels is higher than that of polycrystalline solar panels. For this reason, in places where there is a lack of space, monocrystalline solar panels are used because the electricity produced by monocrystalline solar panels is more than that of polycrystalline solar panels in the same space. But in projects that have a suitable infrastructure, taking economic factors into

account, polycrystals are used because the cost of producing and purchasing polycrystalline solar panels is more affordable than monocrystalline solar panels (www.famcocorp.com).



(3) Thin-Film solar panel

They do not have a regular crystal structure and are made in small thicknesses. They are somewhat flexible and can be used on different surfaces; But they have low efficiency (around 7%). The cheapest technology for making solar panels is their amorphous or shapeless type, which is also called thin film solar panels. Among other technologies, this sample does not have a significant efficiency and is finally able to convert only 7% of the received light into electricity. Nevertheless, the said panels have good performance even on cloudy days and continue to produce electricity, and some of their samples show acceptable performance even under the moonlight. Due to the low efficiency of thin layer panels, to produce a specific power, the dimensions of these samples are much larger than the equivalent polycrystalline panels (Rezaei et al., 1400).

3-2-project's requirements:

3-2-1-Space and infrastructure required:

In order to build a large solar panel production factory in Javanrood industrial town, according to the existing production capacity, a land of 5000 thousand square meters is needed. As shown in the basic table below; Necessary infrastructure includes production and assembly space, clean rooms and warehouse.

Factory size	Total area required	clean room	Production and assembly space	Storage space and storage of raw materials
Small factory (production capacity of 1 megawatt per year)	About 1000 to 2000 square meters	200 to 300 square meters	500 to 1000 square meters	100 to 200 square meters
Medium plant (production capacity of 10 megawatts per year)	About 3000 to 5000 square meters	300 to 500 square meters	1500 to 3000 square meters	200 to 500 square meters
Large factory (production capacity of 20 megawatts or more)	5000 square meters and more	500 square meters and more	3000 square meters and more	500 square meters and more

In addition, the construction of a solar panel production factory is also dependent on other construction requirements. Based on this, the characteristics of the land, main buildings and other required side buildings and investment in them have been analyzed as described in the table below.

Table 3- Plan investment in land, landscaping and building

	Solar panel design space and infrastructure requirements	Description	Investment required for the plan		total cost (in Rials)
			Amount/me required ter	The price of the purchase/construction unit (in Rials)	
1	Earth to dimensions	Kermanshah-Javanrood city-Javanrood industrial town	8000	10,000,000	80,000,000 000.

2	Landscaping operations	According to the calculations	8000	3,000,000	24,000,000 000.
3	Construction	Production and assembly shed (with warehouse)	6000	60,000,000	360,000,000 000
		clean room	500	70,000,000	35,000,000 000.
		Office building and sales	400	120,000,000	48,000,000 000.
		Support building (security, dressing room and prayer room, restaurant and toilet)	300	100,000,000	30,000,000 000.
		Pavement, sidewalk, parking lot, asphalt, green space	800	6,000,000	4,800,000 000
Total					581,800,000 000

Table 4- General facilities

	Name of machine/equipment/tool and...	Unit of measurement	Type of equipment	Investment required for the plan		Total cost (million Rials)
				Number	unit price (million Rials)	
1	Distribution of electricity / demand price	kw	facilities	150	./24	350
2	Electrical installations (transformer, cabling, switchboard...)	Complete series	facilities	1	5000	5000
3	Water branches	Subscribe	facilities	1	100	100
4	Installations and other water transfer equipment	Complete series	facilities	1	1000	1000
5	Fire alarm and extinguishing equipment	Complete series	facilities	1	1500	1500
6	Gas facilities (gas	Complete	facilities	1	5000	5000

	pipng, meter and gas meter)	series				
7	100 g gas branching	Subscribe	facilities	1	800	800
8	Refrigeration and heating equipment (water heater, cooler and heater)	series	facilities	1	5000	5000
Total				-	-	18750

3-2-2-Equipment and machinery:

- Solar panel production line

The following image is related to a solar module production line that shows the different stages of solar panel assembly. This process involves several key steps, from loading the glass to testing the performance of the panels.

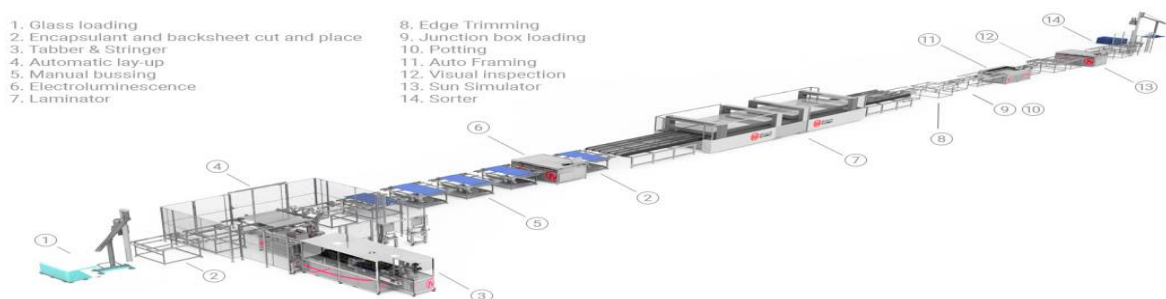


Figure 1- Solar module production line in the factory

- Different stages of solar panel assembly line

(1) The first step: loading glass

At this stage, the protective glasses that are placed on the panels enter the production line. These glasses are used as the front layer of the panel that protects the solar cells from environmental conditions.

(2) The second step: cutting and placing the protective layer and backing

The protective layer and backing are placed behind the cells to protect the cells and provide moisture and thermal insulation. At this stage, these materials are cut to appropriate dimensions and placed on the glass and cells.

(3) The third step: connecting tabs and strings

At this stage, the solar cells are connected to each other through metal strips (heat) and connecting wires so that the electric current is properly transferred from one cell to another. The machine is connecting the solar cells with thin metal strips and placing them in a precise arrangement to assemble the modules.

(4) The fourth step: automatic arrangement

Solar cells are automatically arranged on layers of glass and protective layers after being connected to each other.

(5) The fifth step: manual bus connections (Manual Bussing)

At this stage, the final connections used to conduct electrical current through the entire panel are added manually or semi-automatically.

(6) The sixth stage: electroluminescence

This step involves testing the panels to identify invisible defects such as small cracks in the cells using electroluminescence technology.

(7) The seventh step: laminator

This machine compresses and laminates the layers of glass, cells, protective layer and backing. This work leads to the integrity and strength of the panel.

(8) The eighth step: cutting the edges

At this stage, the excess edges of the laminated material are trimmed to make the final panel standard dimensions.

(9) The ninth step: installing the connection box

The junction box, which contains wires and protective diodes, is installed on the back of the panel. This junction box connects the panel with the external electrical system

(10) 10th stage: Protective cover

The junction box and other electrical parts of the panel are covered with protective materials (resin or silicone gel) to prevent the penetration of moisture and dust.

(11) Eleventh step: Auto Framing

At this stage, the aluminum frame is placed around the panel to give more strength and stability to the panel and make it easier to install the panel.

(12) The twelfth step: visual inspection

At this stage, the solar panels are visually inspected to ensure that there are no visible defects or manufacturing defects.

(13) 13th stage: solar simulator

Solar panels are tested using a solar simulator that simulates sunlight to evaluate their efficiency and electrical performance.

(14) Fourteenth step: classification

After performing various tests, the panels are sorted based on efficiency and quality to prepare for packaging and shipping to the customer.

Table 5- Main machinery and equipment required for a 20 MW solar panel production line

	Product name and description of use	amount /number	The price in dollars	Sum of each item with the highest amount/number and price
1	Ultrasonic washing machine for washing small dimensions. Washing machine (Cleaning Machine) for large and industrial sizes/ Recommended model: Ecolab's Clean-in-Place System	1	100.000– 150.000\$	150.000\$
2	Etching system/ Model: SPTS Delta 200	1	70.000– 100.000\$	100.000\$
3	ppe safety devices Suggested model: 3M P100 Respirator (breathing mask) Protective clothing	40	30–50\$	2.000\$
4	Silicon doping and oxidation device - 4FDO model	1	150.000– 300.000\$	300.000\$
5	Silicon melting furnaces for the production of silicon ingots SEI Silicon Melter LEAD MELTING FURNACE GMF-L7T	All systems of items 5 to 10 are together in one furnace system. \$250,000-300,000 For 1 melting machine		300.000\$
6	Furnace temperature control system			
7	Furnace ventilation system			
8	Casting system for shaping silicone			
9	Motion system in furnace			
10	Silicon cooling system out of the furnace			
11	Silicon ingot wire cutting machine Disco DAD3350 Meyer Burger DW 28 Diamond Wire Slicing System	1	100.000– 150.000\$	150.000\$

12	Measuring system for cut wafers Spectroscopic Ellipsometer with Automation TFProbe MSP300	1	150.000–250.000\$	250.000\$
13	Silicon ingot wire cutting/Machine Meyer Burger DW 28 Diamond Wire Slicing System	1	500.000–800.000\$	800.000\$
14	Silicon wafer polishing machine LAPMASTER WOLTERS AC 2000-P4	1	200.000–300.000\$	300.000\$
15	Polishing pads			
16	Plasma enhanced CVD coating system for deposition of silicon nitride, amorphous silicon and microcrystalline silicon thin films CY-PECVD-450	1	200.000–\$300.000	300.000\$
17	LPCVD is a low pressure chemical vapor deposition system/ ANGSTROM 200 LPCVD	1	250.000–400.000\$	400.000\$
18	Czochralski Crystal Growth System/ This machine is designed to produce silicon ingots using the Czochralski method /CTI Czochralski System	1	350.000–600.000\$	600.000\$
19	Fluidized Bed Reactor System To produce silicon powder through fluidization process/ Recommended model: AFS Fluidized Bed Reactor	1	150.000–250.000\$	250.000\$
20	LPE System for Epitaxial Growth. This device is for growing thin layers of silicon or other semiconductor materials on a wafer using the Liquid Phase Epitaxy method/ Recommended model: LPE-100 Epitaxial Growth System	1	250.000–350.000\$	350.000\$
21	IV Curve Tracer System. This device is used to measure and analyze the current-voltage (IV) characteristics of solar cells./ Recommended model: Solartron 1260	1	15.000–30.000\$	30.000\$
22	Digital Multimeter system/ Recommended model: Fluke 87V	1	300–500\$	500\$
23	A digital multimeter is an essential tool in the solar cell production line that is used to measure voltage, current, and resistance. Laminators: This device automatically combines	1	700.000–1.000.000\$	1.000.000\$

	solar cells with glass or plastic. / Suggested brands: Meyer Burger Technology AG – 2.5 gw/ Schmid Group, Suntech Power.			
24	Cutting and Packaging Machines. The possibility of cutting solar cells to specific dimensions with high precision along with automatic packaging/ Suggested brands: KUKA KR AGILUS, ABB IRB 6700, BOSCH Packaging Technology Pack 301, FANUC, Schmid Group's Cutting Machine	1	350.000– 500.000\$	500.000\$
25	Ventilation Systems: This ventilation system is designed for industrial environments and can effectively remove dangerous gases and harmful vapors from the environment. / Recommended brand: Greenheck Model Vector	1	35.000– 50.000\$	50.000\$
26	Air and Water Purification Systems. This water purification system is specifically designed to reduce chemical and biological pollution. Recommended model: Aqua Aerobic Systems - AquaNereda	1	300.000– 500.000\$	500.000\$
27	Air and Water Purification Systems Recommended model: Camfil - City Air This air purification system is designed to remove suspended particles, harmful gases and unpleasant odors. This device can be effective in improving the indoor air quality of the factory.	1	15.000– 20.000\$	20.000\$
28	Silicon Wafer Cutting Machine Recommended model: DISCO DAD 2H/6T	1	250.000– 400.000\$	400.000\$
29	Diffusion Furnace. /Recommended model: BTU International's Pyramax	1	200.000– 300.000\$	300.000\$
30	Coating Machine./Recommended model: MPM's AP Series	1	150.000– 250.000\$	250.000\$
31	Solar Cell Tester./ Recommended model: Newport's Oriel Solar Cell Tester	1	30.000– 50.000\$	50.000\$

32	Electrical Tester. / Recommended model: Fluke Solar I-V Curve Tracer	1	10.000– 15.000\$	15.000\$
33	Temperature Control System. / Recommended model: Watlow's EZ-ZONE	1	2.000– 5.000\$	5.000\$
34	Assembly Machine. / Recommended model: Hanwha Q CELLS Assembly Line	1	600.000– 1.500.000\$	1.500.000\$
35	Automation system. / Brand: Siemens, Rockwell Automation, Siemens S7-1200, Allen-Bradley ControlLogix	1	10.000– 20.000\$	20.000\$
36	<p>Factory Management System (Manufacturing Execution System - MES)</p> <p>Suggested systems:</p> <p>1. Siemens - Opcenter</p> <p>Opcenter is a comprehensive MES system that allows us to manage all production stages from planning to execution and quality control. This system can be integrated with other ERP software and automation systems.</p> <p>2. Rockwell Automation – FactoryTalk</p> <p>FactoryTalk is an MES platform that helps us collect, analyze and manage manufacturing data. This software allows us to monitor the performance of the production line in real time.</p> <p>3. Schneider Electric – Wonderware.</p> <p>Wonderware is an MES solution that allows us to optimize manufacturing processes and improve factory performance. This system has strong capabilities for production monitoring and quality management.</p> <p>4. SAP - SAP Manufacturing Execution.</p> <p>This MES system is part of the SAP software suite</p>	1	250.000– 350.000\$	350.000\$

	<p>and helps us to manage the production processes completely. This system integrates well with other SAP modules such as ERP.</p> <p>5. Honeywell - Manufacturing Execution System. This MES system allows us to optimize production operations and guarantee product quality. Honeywell has extensive experience in various industries and can meet your specific needs.</p>			
37	<p>Proposed electrical system for a medium-sized factory.</p> <p>An average solar cell manufacturing plant typically requires about 500 to 1,000 kilowatts (kW) of electricity. This amount may vary depending on the type of equipment and production processes.</p> <p>Recommended generator: Brand: Caterpillar, Cummins Caterpillar C4.4 Cummins C220D5</p>	1	20.000– 35.000\$	35.000\$
38	<p>In general, for an average solar cell manufacturing plant, about 500 to 1000 cubic meters of water may be needed per day. This value can be different depending on the specific conditions of the factory.</p>	–	–	–
39	<p>Conveyor belt for a medium production line</p> <p>Conveyor specifications:</p> <ol style="list-style-type: none"> 1. Conveyor type: Belt Conveyor 2. Strip width: 60 to 120 cm (depending on the size of the material) 3. Tape length: 10 to 30 meters (depending on the design of the production line) 4. Tape speed: 0.5 to 2 m/s (adjustable) 5. Load capacity: 100 to 500 kg/m 6. Belt material: PVC or rubber resistant to heat and chemicals 	1	10.000– 15.000\$	15.000\$

	<p>7. Drive system: electric motor with gearbox</p> <p>8. Height adjustable: for easy portability</p> <p>9. Safety system: including emergency stop sensors and overload protection</p>			
40	<p>Clean room and its features</p> <p>Clean room features:</p> <ol style="list-style-type: none"> 1. Cleanliness level: Depending on the type of production, usually Class 1000 (ISO Class 6) or higher is appropriate. 2. Temperature and humidity control: Temperature and humidity must be controlled within a certain range. 3. HEPA filters: to purify the air and remove suspended particles. 4. Air circulation system: so that clean air flows continuously in the room. 5. Wall and floor coverings: made of materials that are easy to clean and do not absorb pollution. 6. Measuring devices: to control the air quality in the room. <p>Recommended systems:</p> <ol style="list-style-type: none"> 1. HEPA filters <ul style="list-style-type: none"> - Suggested model: Camfil H12 HEPA Filter <p>Features: Ability to remove 99.97% of particles with a size of 0.3 microns.</p> 2. HVAC heating, ventilation and air conditioning system: <ul style="list-style-type: none"> - Suggested model: Trane XR Series - Features: air conditioning systems with the ability to control temperature and humidity. 3. Air quality monitoring device: <ul style="list-style-type: none"> - Suggested model: Aeroqual Series 200 	1	300.000–500.000\$	500.000\$

Features: Ability to measure suspended particles and control air quality.			
4. Wall and floor covering: - Suggested model: Armstrong Flooring - BioBased Tile - Features: resistant to pollution and washable.			
total sum			9.492.500\$ 4.556.400.000.000 (Rial)

Table 6- Means of transportation

	Name of machine/ equipment/tool and...	measurement unit	Equipment type	Investment required for the plan		Total cost (million Rials)
				number Unit	price (million Rials)	
1	Manual pallet jact	device	Vehicles	2	150	300
2	3-ton forklift	device	Vehicles	1	17500	17500
Total				-	-	17800

3-2-3- Raw materials and intermediate components:

A solar panel consists of metals such as lead, copper, and an aluminum frame, and solar cells are made of pure crystal silicon covered with a layer of plastic. The lifespan of a solar panel is 20 to 30 years, which depends on the environment in which it is used (Sajadi and Bogha, 2018).

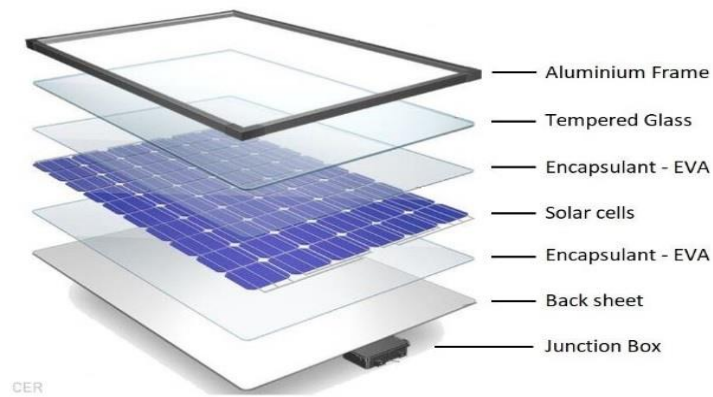


Figure 2- Different layers of a solar module

Table 7- Components of a solar panel

Solar panel components	Technical specifications	Description
Solar cell	60 or 72 cells	Solar cells are made of semiconductor materials such as silicon and convert sunlight energy into electricity.
Aluminum frame	Aluminum 6063-5T	The aluminum frame protects and shapes the solar panel.
glass	tempered glass	The glass protects the solar panel from the elements and allows it to transmit sunlight to the solar cells.
Cell protector	Metal sheet	The cell protector protects the solar cells from impact and scratches.
Encapsulant	Eva	Encapsulant is the material that holds the solar cells in the solar panel and protects them from weather.
back page	Polymer	The back plate protects the solar panel from the elements and helps it dissipate heat.
Connection box	Aluminum or plastic	The junction box connects the solar panel wires to the battery or grid.
Yield	15–20%	Solar panel efficiency is the percentage of solar energy that the panel can convert into electricity.

useful life	25 years	Solar panels can produce energy for more than 25 years.
-------------	----------	---

Table 8- Estimated cost of raw materials

	Product name and description of use	amount - number	Price in dollars	Sum of each item with the highest amount/number and price
1	Silicon powder for a factory with a capacity of 10 megawatts per year	120 تڨ For 20 MW	1.500- 2.500\$ For 1 ton	300.000\$
2	phosphorus	300-400 kg	30-40\$ For 1 kg	16.000\$
3	Bor	300-400 kg	60-40\$ For 1 kg	16.000\$
4	Cleaning agents such as acids and bases HCl, NaOH	300-400 lit	HCl : 100-150\$ For lit 100 NaOH 50-100\$: For 100 lit	600\$ 400\$
5	Aluminum	2000-3000 kg	2500-3000\$ For 1 ton	9.000\$
6	Amorphous silica	1400- 2000 kg	300- 400\$ For 1 ton	800\$
7	Aluminum oxide for initial polishing	300-400 kg	250-300\$ For 1 ton	120\$
8	Silicon oxide for final polishing	300-400 kg	150-250\$ For 1 ton	100\$
9	Special coated glass (Tempered glass with AR coating)	130000 m ²	3/90 -6/50\$	650.000\$

10	back page (Backsheet TPT)	132000 m ²	2/00\$	264.000\$
11	Ethylene vinyl acetate	262000 m ²	1/10 –1/30\$	340.600\$
12	Junction boxes	80.000 عدد	3/50\$	280.000\$
13	Soldering tape	6000 kg	12\$	72.000\$
14	Silicone sealant	17.000 عدد	0/61\$	10.370\$
Total				1.959.990\$ (Rial) 940.795.200.000

3-2-4-management and human resources:

Table 9 - Description of required human resources, number and cost

	job Title	Number	Work field	Monthly salary	Annual salary (Rials)
1	CEO	1	Management	٥٥٠,٠٠٠,٠٠٠	٩,٠٢٠,٠٠٠,٠٠٠
2	Production Manager	1	Production	٤٠٠,٠٠٠,٠٠٠	٤,٨٠٠,٠٠٠,٠٠٠
3	Marketing and Sales Manager	1	Sales	٤٥٠,٠٠٠,٠٠٠	٧,٢٠٠,٠٠٠,٠٠٠
4	Commercial Manager	1	Sales	٤٠٠,٠٠٠,٠٠٠	٤,٨٠٠,٠٠٠,٠٠٠
5	Finance and Accounting Manager	1	Administrative-Financial	٤٠٠,٠٠٠,٠٠٠	٤,٨٠٠,٠٠٠,٠٠٠
6	R&D Manager	1	Consulting	٤٠٠,٠٠٠,٠٠٠	٤,٨٠٠,٠٠٠,٠٠٠
7	Quality Manager	1	Production	٤٠٠,٠٠٠,٠٠٠	٤,٨٠٠,٠٠٠,٠٠٠
8	Security and	1	Other	٣٠٠,٠٠٠,٠٠٠	٣,٦٠٠,٠٠٠,٠٠٠

	Physical Protection Manager				
9	Electronics Specialist	1	Consulting	₹००,०००,०००	₹,६६०,०००,०००
10	Materials and Metallurgy Specialist	1	Consulting	₹००,०००,०००	₹,६६०,०००,०००
11	Chemistry Specialist	1	Consulting	₹००,०००,०००	₹,६६०,०००,०००
12	Electrical Specialist	2	Production	₹२५०,०००,०००	₹,८,२००,०००,०००
13	Mechanical Engineering Specialist	1	Other	₹२५०,०००,०००	₹,४,१००,०००,०००
14	Industrial Engineering Specialist	1	Production	₹२५०,०००,०००	₹,४,१००,०००,०००
15	Machine Operator Technician	2	Production	₹२५०,०००,०००	₹,८,२००,०००,०००
16	Assembly Technician	1	Production	₹२५०,०००,०००	₹,४,१००,०००,०००
17	Quality Control Technician	2	Production	₹२५०,०००,०००	₹,८,२००,०००,०००
18	Marketing Specialist	1	Sales	₹२५०,०००,०००	₹,८,२००,०००,०००
19	Sales Specialist	1	Sales	₹२५०,०००,०००	₹,८,२००,०००,०००
20	General Laborer	45	Production	₹१५०,०००,०००	₹,११,००,०००,०००
21	Accountant	2	Administrative-Finance	₹२००,०००,०००	₹,६,६६०,०००,०००
22	Guard and innkeeper	3	Administrative-Finance	₹१५०,०००,०००	₹,४,३८०,०००,०००
23	Warehouse keeper	2	Other	₹१५०,०००,०००	₹,४,९२०,०००,०००
24	Driver	5	Other	₹१५०,०००,०००	₹,१२,३००,०००,०००
25	Employer	1	Administrative-Finance	₹२५०,०००,०००	₹,४,१००,०००,०००

26	IT Engineer	1	Other	٣٠٠,٠٠٠,٠٠٠	٤,٩٢٠,٠٠٠,٠٠٠
	Total	83	-	٧,٨٥٠,٠٠٠,٠٠٠	٢٧٧,٩٨٠,٠٠٠,٠٠٠

Table 10 - Summary of human resources required, number and cost

No.	Skill level	number	Salaries (wages) (Rials)
1	expert	8	450,000,000
2	skilled	25	350,000,000
3	non-skilled	50	150,000,000

- Number of skilled personnel required: **25**
- number of non- skilled personnel required: **50**
- number of expert personnel required: **8**

4- Ownership and legal permission:

4-1- ownership of land:

It is a suitable place for the implementation of the plan of the industrial town of Javanrood. The right to exploit the land in the mentioned industrial town is equal to 10000000 Rials for each square meter and the related costs are considered in the plan. Land ownership is subject to legal terms and conditions and will be available to investors after exploitation. In order to acquire industrial land in this town, it is necessary for investors to obtain legal permits and purchase it.

4-2- Intellectual property and incentives:

It is suggested that solar panel production be under the brand registered in the Trademarks, Patents and Industrial Property Registration Office and branding and advertising activities should be considered.

- Registering the company in the country's property and documents registration organization
- Registering the company's brand(s) in the country's property and document registration organization
- Registering the company's logo(s) in the country's document and real estate registration organization
- Buying technical knowledge of the products in the company's production plan
- Purchase of brand privilege with the aim of producing part of the products in the production plan under licenses

4-3-legal permission:

The process of obtaining permits:

Establishing a solar panel production factory in Iran requires compliance with a set of regulations, permits and certificates. These include industrial permits, environmental permits, safety standards, and quality certificates. It is very important to comply with the requirements of the Ministry of Industry, Mining and Trade of Iran to start production operations.

The process of obtaining permits includes several steps:

- Industrial license: submitting an application to obtain an industrial license to the Ministry of Industry, Mining and Trade. This plan usually includes details about the proposed factory location, technical specifications and desired production capacity.
- Environmental assessments: assessment of the environmental effects of the production process and its potential consequences. This often involves conducting an Environmental Impact Assessment (EIA) and obtaining approval from the Environmental Protection Agency.
- Safety and quality standards: compliance with the safety and quality standards set by the relevant authorities to ensure worker safety, product quality and consumer protection.
- Customs and commercial regulations: complying with import and export regulations of raw materials, components and finished products.

In the table below, the required permissions are listed.

Table 11- Legal permits

	License name	Main exporting organization	License type
1	Land ownership document	Organization of Registration of Documents and Real Estate of the country	optional
2	Construction permit	Municipality, Industry and Mining (Industrial Towns Company) and Engineering System	Mandatory
3	Environmental assessment permit	Environmental Protection Organization	Mandatory
4	Establishment license (consent in principle)	The organization of silence	Mandatory
5	Certificate of industrial activity	The organization of silence	Mandatory
6	High voltage branch license	Local electricity department and electricity distribution company	Mandatory
7	Gas distribution license	Local gas company	Mandatory
8	Water distribution permit	Water and Sewer Organization	Mandatory
9	Phone subscription license	Department of Telecommunications	Mandatory
10	Product license (by products)	The organization of silence	Mandatory
11	Get the product standard mark	Standards Organization	Mandatory
12	Obtaining a commercial activity license	The organization of silence	Mandatory

5- Market study and Competition:

The share of renewable energy in Iran's electricity production is less than 1% and its share in the nominal capacity of Iran's electricity production is about 1%. According to statistical data, the nominal capacity of Iran's renewable electricity production reached 1241 megawatts at the end of August 1403,

which has a share of about 1.3% against the country's nominal capacity of 93,452 megawatts. A review of the country's electricity production statistics in the first 5 months of 1403 shows that the share of renewable electricity production in the total electricity production during this period is less than 1%. In addition to having many capacities in the field of access to fossil fuel resources, Iran also has significant capacities in the field of primary sources of renewable energy production. Whatever has been done in the field of developing the use of fossil fuels in the country, the development of renewable energies has been neglected and neglected. Currently, 75% of the country's primary energy supply portfolio is natural gas, and in the field of electricity production, more than 90% of the country's electricity production is provided by thermal power plants that depend on fossil fuels. This is despite the fact that more than two decades ago, the discussion of the development of renewable energy, especially in the field of wind and solar power plants, was raised in Iran, but the pace of development of this type of energy in different governments has been very slow. It is noteworthy that Iran has very significant capacities in the development of renewable energies. In Iran, the amount of solar radiation is 40% more than in European countries, and it has more suitable conditions for the development of solar and wind power plants than neighboring countries, especially the Persian Gulf countries, due to cooler temperatures and favorable winds. A fact that some experts believe has theoretically provided a potential capacity of up to 100,000 megawatts of electricity for the country. Statistics related to the installed capacity of renewable and clean power plants in the country are given in the figure below (Tjarat News).

Investigating the amount of capacity created in the renewable energy production sector (expansion turbine, small hydropower, solar, wind and biomass) during the last 5 years, indicates the slow and turtle development process of this sector.

The above graph shows the statistics of annual capacities in megawatts for the year 1403 from the beginning of the year to the end of August; It is noteworthy that in 1402, no new capacity was introduced into the circuit (according to Tasnim). Compared to these figures in Iran, developed countries such as America, Japan, England, Spain and France are the countries that have the largest share of renewable solar energy use in the world. 83% of the new electricity in America is supplied by solar energy. Compared to neighboring countries, in recent years, the United Arab Emirates has taken the first place in the use of renewable energy (solar and nuclear). For the first time in its history, this country has been able to provide more than 60% of its total energy needs through renewable and clean sources in 2023-2024. In other words, 5.5 gigawatts have been obtained through solar and nuclear power plants out of the production of about 8.6 gigawatts of the total required energy in the UAE. After the UAE, Egypt, Jordan and Qatar took the next positions in this field. Although Iran's share of solar energy in the region is small (450 megawatts), our country's capacity to invest and produce electricity in this area is very high. The amount of solar radiation in Iran is estimated between 1800 and 2200 kilowatt hours per square meter per year, which is higher than the world average. In Iran, more than 280 sunny days have been reported annually, which is very significant. According to the announcement of the Majlis Research Center, the share of solar power plants at the beginning of 1402 has

been more than 450 megawatts, which accounts for 53% of the capacity of renewable power plants (according to Tejarat newspaper).

- Domestic photovoltaic market

In Iran, after the agreement of the JCPOA in 2014 and therefore the beginning of removing banking restrictions and providing investment conditions, the efforts to build photovoltaic solar power plants saw a significant leap. In July 2014, we witnessed the occurrence of an important event in the field of renewable energy in Iran, in which the Ministry of Energy increased the tariffs for the purchase of electricity produced from renewable energy sources, and the period of purchase of electricity, which was limited to 2 years, was increased to 20 years. These conditions were parallel to the reduction of prices in the production and supply of solar panels and equipment in the world markets. Before the domestic manufacturers can make extensive plans to develop the production of panels and update their production line, the Iranian market will import solar power plant equipment from other countries, including China, due to the high prices and low volume of domestic production. And Europe turned. And the government, in order to improve energy efficiency and reduce losses in energy transmission, distribution and consumption, as well as using renewable electricity production methods, the bill for the merger of SANA and Saba to establish the Organization of Renewable Energy and Electricity Energy Efficiency (SATBA), on 24 9/1395 approved and notified to the Ministry of Energy on 10/30/1395 for implementation. From 2015 to today, many permits have been issued by SATBA for the construction of solar power plants (Jokar and Mohdpour, 1402).

In our country, there are several solar panel manufacturing companies that are supplying products to applicants for power plant design and construction, semi-automatic and fully automatic. Mana Energy Pak Company (as a private limited company and owned by Bakhtar Holding) has set up a photovoltaic cell and panel production line with a production capacity of 500 megawatts per year in two executive phases. German technology was implemented and the construction and operation of the factory began. Iranian Electricity Supply Company (Taban) is one of the companies that was built by Hekmat Bank (affiliated to the Islamic Republic of Iran Army) in Iran to build a photovoltaic panel production plant. The Taban panel is assembled from various parts imported from foreign countries, especially from China, and has a production capacity of 230 megawatts of solar panels per year. Taban factory has the most advanced solar panel assembly line in the country, the entire line is automatic. Sanat Firouze Solar Company started working as one of the largest photovoltaic panel producers in Iran and the first producer of power plant-sized panels, and the annual production capacity of this company is 60 megawatts. The production of solar panels in this company is done using the latest automatic and semi-automatic machines. At present, Pak Atiyeh factory is assembling solar panels by hand, and the highest solar panel capacity of this factory is 250 watts, and they are upgrading the production line and increasing the capacity of each panel. Horsa Solar company also operates with complete technology in the field of production of silicon photovoltaic panels in the range of 30 to 360 watts in two types of monocrystal and polycrystal. All the above companies import most of the parts needed to make the panel, which raises the cost of the solar panel compared to Chinese companies. By developing the solar panel value chain inside the country and localizing the required parts, the total cost can be reduced so that domestic products can be competitive with

Chinese products in terms of price. The fully automated panel manufacturing process in the factory increases the quality of the panel and the accuracy and safety of the panel. Production lines above ten or thirty megawatts are usually fully automatic, and the rest of the lines that are less than this amount are semi-automatic. Semi-automatic production lines have lower quality and the possibility of errors is higher in them. (barghnews.com).

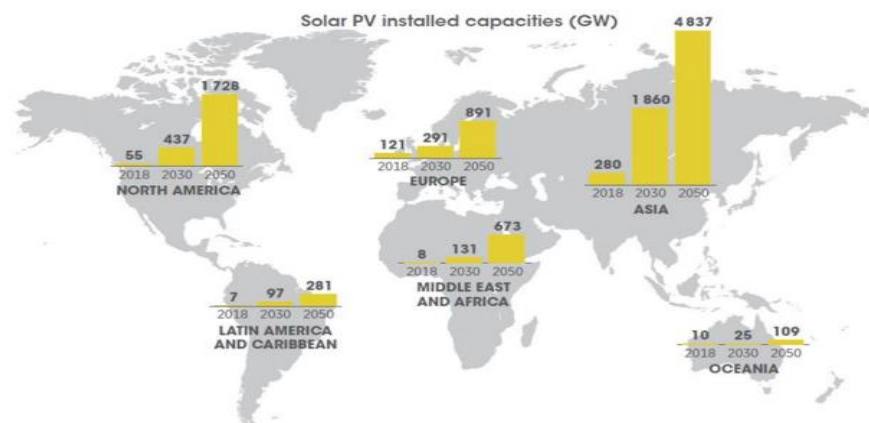
Table 12 - Iranian solar panel manufacturing plants

company	place of establishment	year of establishment	Capacity
Hedayat Nur Yazd Solar Power Company	Yazd	1371	30 MW
Semnan Electronic Manufacturers Company	Semnan	1384	10 MW
Clean Energy Production Industries Co	Mashhad	1391	10 to 250 MW
Pishgaman Novin Vahdat Technologies Company (Horsa Solar)	central	1393	25 MW
Solar Sanat Firuzeh Company	Khorasan Razavi	1395	60 MW
Iranian Taban Electricity Supply Company	Tehran	1395	230 MW
Mana energy	central	1397	2300 MW

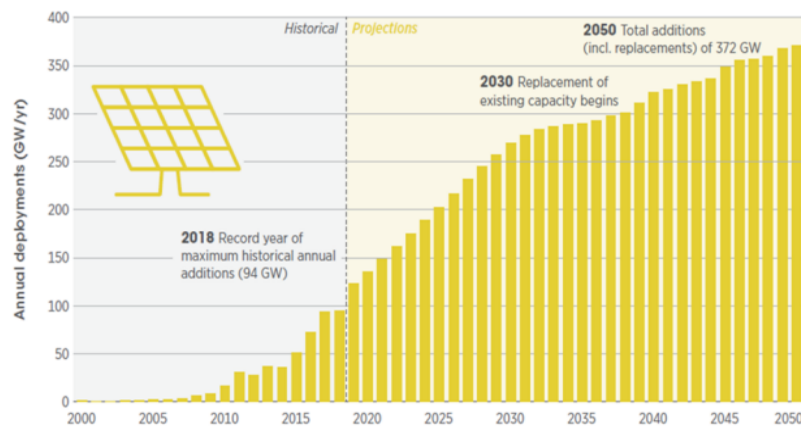
- Global photovoltaic market

With the advent of photovoltaic solar technology and then the commercialization of this technology, since the late 1970s, for three decades, the United States produced the majority of solar panels in the world. Between 2008 and 2013, the photovoltaic solar panel industry in China undercut global

prices by 80%, a stunning achievement in a high-tech and competitive market. The highest growth of the global solar market in 2018 was related to the Asian continent, which accounted for more than half of the world's solar capacity. The installed solar capacity of this region has reached 280 GWh at the end of 2018, which among the countries of this continent, China has the largest installed capacity with 175 GWh. The European Union was the world's second largest solar market last year. Germany has the highest installed capacity in this continent with 45 gigawatts of installed capacity. After these two regions, North America has the third active market with a capacity of 55 GW, and the United States has 90% of this capacity. According to the REmap scenario, the growing trend of installing photovoltaic solar systems in Asia continues and it is expected that the share of these systems in electricity supply will reach 65% by 2030.



The largest capacity of photovoltaic systems belongs to China, and it is predicted that this country will reach the capacity of 1412 gigawatts by 2030. North America has the second installed capacity. It is predicted that the capacity of this country will reach 437 gigawatts by 2030, more than 90% of this capacity will be in the United States of America. The capacity of photovoltaic systems in Europe will also reach 291 gigawatts by 2030 as the third world market.



The above shows the trend of installing the capacity of photovoltaic systems in the world, if it can be seen that this trend has decreased in growth in two times in 2012 and 2014, and in some years like 2018, it has seen a significant growth with an increase of 94 gigawatts of new capacity in It has been a year. One of the most important reasons for these ups and downs in the development process of these systems has been the improvement of technology, the implementation of effective incentive policies and appropriate financial support, and the improvement of financing methods. According to the forecasts made by the International Renewable Energy Agency, with the continuous advancement of technology and reduction of costs, it can be predicted that the solar photovoltaic market will grow rapidly during the next three decades. Along with the increase of new capacities, it seems necessary to replace the solar panels that are in the final stages of their useful life cycle. From new panels to replace old systems while having advanced technologies. As can be seen in the above diagram, these capacities should grow by 2030 with a double increase of the current capacity and nearly 270 GW, and by 2050 with a four-fold increase of the current capacity and with a figure of 372 GW. It should be mentioned that in the survey, the basis of the above figures is based

on the increase of the current annual capacity, which was around 94 gigawatts in 2018. At present, the major part of increasing the capacity of renewables is related to the installation of photovoltaic power plant systems in different countries, and this is while the systems disconnected from the grid or local systems also have a very high potential all over the world. Currently, Germany is the leader in installing home and separate systems compared to other countries in the world. Based on Remap's analysis, these systems can have a high growth capacity and be used in many regions of the world by 2030 (Satba report). Sunpower, LG, Taiwanese Winaico, Norwegian REC, QCells, and Chinese companies Trina Solar and Jinko Solar are known. are the most active companies in the field of producing solar panels in the world.

- **Checking the demand trend**

- ✓ Market demand growth

The global market for solar panels has experienced significant growth in the last five years. The key statistics in this regard are:

- Market value: The market value of solar energy was approximately 59 billion dollars in 2020 and is expected to reach 230 billion dollars by 2028, growing at a compound annual growth rate of about 18%.

- Activated capacity: As of 2023, global solar activated capacity will surpass 1,000 GW, with countries such as China, the US, and India leading the way in installation and activation.

- ✓ Key drivers of demand

Several factors have contributed to the increase in demand for solar panels, including:

- Government policies and incentives: Many countries have implemented favorable policies, tax incentives and subsidies to encourage the adoption of renewable energy. For example, the European Union has set ambitious targets for renewable energy as part of its Green Deal.

- Falling costs: The cost of solar technology has fallen significantly, with prices dropping nearly 90 percent since 2010.

- Environmental Concerns: Growing awareness of climate change and environmental sustainability has led consumers and governments to seek cleaner energy solutions.

- Technological advances: Innovations in solar technology, such as bifacial panels and the development and improvement of energy storage solutions, have increased their efficiency and performance.

- ✓ Regional survey of demand

- Asia-Pacific: The Asia-Pacific region dominates the solar energy market, with China accounting for more than 50% of global installations. Considering the significant support of regional governments, it is expected that this region will continue to be a leader in this field.

- North America: In the North American region, the United States has grown significantly due to government support and investments by private sector companies in renewable energy.

- Europe: In the European continent, countries such as Germany and Spain are increasing their solar capacity as part of their commitment to reducing carbon emissions.

5-1- Introduce target market:

With the ever-increasing need for energy and the limitation of fossil resources, the increase in environmental pollution caused by the consumption

of these resources, the issue of warming, the effects of the greenhouse effect of acid rain and the need to balance the emission of carbon dioxide, the overall need to save fuel consumption Fossil and attention to the use of renewable energy sources makes it inevitable. In some countries, by using renewable energies in the electricity generation sector, they have been able to prevent the release of more than 100 million tons of carbon dioxide gas, which is very important in reducing environmental pollutants, which is a clear example of the use of technologies Such energies will be (Latfalipour et al., 2015). On the other hand, the ability to produce decentralized electricity from new energies has provided the opportunity for progress and development to remote parts of the country, which will strengthen the social and economic structure of rural areas and prevent their migration to cities. In the field of job creation, the use of renewable energies is also important. Due to their new nature, the job creation situation of these systems is more than the job creation caused by the development of the use of fossil fuels, so that the use of these systems is also possible locally. (Jokar and Mohdpour, 1402). The graph below shows the amount of job creation in the world by renewable energies. It is interesting that photovoltaic solar energy has the largest share.

During the last three decades, Iran's electricity production capacity has grown by an average of 2400 megawatts annually and the country's electricity production portfolio has become dependent on natural gas as the primary source of energy for about 85%. Considering the finiteness and limitation of fossil fuel supply, strong dependence on natural gas in electricity production can be a factor to threaten the country's energy supply security. In addition, the country is currently facing a deficit in electricity production and must increase its electricity production capacity. Therefore, diversifying the electricity production portfolio is a necessity for the country. Solar power

plants in the world are growing rapidly as one of the renewable sources, and due to its geographical location, Iran has a suitable radiation angle throughout the year, and the intensity of the sun's radiation in Iran is on average higher than the world average. By taking advantage of this capacity, Tovan took steps to increase the energy security and develop the oil and gas value chain by reducing the electricity industry's dependence on fossil resources (Evaluation report of new plans for the development of solar power plants, 1402). Iran is among the best countries in terms of receiving solar radiation, because in most parts of the country, due to dry climatic conditions and clear air without water, the amount of receiving radiation is relatively high. Total solar radiation is one of the most important climate parameters to identify areas prone to installing solar panels. To prepare this map, the average of 30 years of solar radiation data of stations in the region has been used. The average radiation of the entire province of Kermanshah is 2011.73 megajoules per second per square meter per year (Moghari and Heydari, 2016).

In Kermanshah province, there are 250 sunny days out of 365 days of the year, and this has prepared the conditions for absorbing solar energy in the province. In this regard, more than 200 5 kW solar panels have been installed in the province. According to reports, 75 solar power plants have been installed in the cities of the province this year (Irsa Online Report). Also, based on the national clean energy plan, which aims to produce more than four thousand megawatts of capacity in the solar and renewable power plant sector, two solar power plants and a solar energy town are also under construction in Kermanshah province with a total capacity of 180 megawatts. . The two mentioned solar power plants, one with a capacity of 60 megawatts in Sarpol Zahab and the other with a capacity of about 20 megawatts in Mahidasht (Investment Opportunities of Kermanshah Province, 1402).

Kermanshah Solar Energy Town with a capacity of 100 megawatts is implemented by Imidor state company in Kermanshah city in several phases, the capacity of the first phase is 40 megawatts. Also, in Mehr 1403, it was announced that 400 portable 100 watt solar panels are being handed over to the tribes of Kermanshah, which will be used to provide lighting and charge mobile phones.

It is noteworthy that the increase of solar power plants in the country has created an unprecedented growth in the import of all kinds of solar panels, especially Chinese panels. The production of solar panels in the country can eliminate this dependence and increase the efficiency of solar power plants. In addition to being widely used in power plants, solar panels are used to provide lighting for parks, lighting traffic signs, charging all types of batteries, small water treatment plants, etc. The demand for solar panels in Iran has witnessed a steady rise, which is caused by the growing awareness of the environmental and economic benefits of renewable energy. This demand is evident in both residential and commercial sectors. In the residential realm, homeowners and small businesses are increasingly embracing solar panels to lower energy costs and help with sustainability. In the commercial sector, industries, office complexes and institutions recognize the value of solar energy in achieving efficiency, reducing costs and fulfilling social responsibility. The growth of the solar energy market in Iran is ready. Forecasts show that the demand for electricity in Iran will continue to increase due to industrialization, urbanization and population growth. To meet this demand, the government has set ambitious targets for renewable energy capacity, including solar energy. Such targets signal a clear intention to transition to cleaner energy sources, thus creating a favorable environment for solar panel manufacturers.

In addition, the evolving global focus on reducing carbon emissions is aligned with country plans for a clean energy landscape. As international pressure to combat climate change mounts, the solar energy market is likely to see increased investor interest, both domestically and internationally. This attention, along with favorable government policies, positions the solar panel manufacturing plant to strategically enter the growing market. The growth potential of the solar energy market is based on the alignment of policy support, environmental requirements, and increasing demand for energy. By participating in this growth path, the solar panel manufacturing plant in question can both meet the growing domestic demand for solar panels and potentially explore export opportunities, thereby establishing itself as an important player in Iran's clean energy future. Therefore, the target market of the desired factory includes people and organizations who are looking to use solar energy. This includes household consumers, businesses, industries and organizations, governments and public organizations.

- **Market size**

- ✓ Planned capacity: Iran plans to build fifteen gigawatts of solar energy production capacity by 2030, for which the annual value of solar panels required is estimated at 1.3 billion dollars.
- ✓ Current potential production capacity: The solar panel production line can increase Iran's production capacity to 2.3 GW per year according to the level of infrastructure development.
- ✓ Cumulative installed capacity: According to recent reports, Iran has a cumulative installed capacity of approximately 539 megawatts produced by photovoltaic (PV) systems.

▪ **Market growth rate**

It is predicted that Iran's solar energy market will grow at a compound annual growth rate (CAGR) of 9 percent in the next five years. This growth rate can be strengthened by the support and incentive policies of the government, the increase in electricity demand and the shift towards renewable energy sources.

▪ **Market segmentation**

A - residential sector

- ✓ Target market: Home owners are looking to reduce electricity costs and increase energy independence.
- ✓ Market Size: With rising electricity prices and government incentives for rooftop solar installations, this segment has significant growth potential. Although currently the size of the market in this sector is very limited.
- ✓ Growth drivers: increasing awareness of the benefits of renewable energy and government financial incentives.

B- commercial sector

- ✓ Target Market: Businesses looking to reduce operating costs through sustainable energy solutions.
- ✓ Market size: With the increase of industrial energy in Iran, the demand for solar installations in the commercial sector is expected to increase.
- ✓ Growth Drivers: Sustainable development plans of the company and potential cost savings on energy bills.

C- Industry sector

- ✓ Target Market: Manufacturers and large-scale industrial facilities looking for reliable energy sources.
- ✓ Market size: The industrial sector's need for sustainable and affordable electricity makes it a lucrative market for solar solutions.
- ✓ Growth drivers: Government policies to promote the adoption of renewable energy in heavy industries.

T- Government and public sector

- ✓ Target market: government projects aimed at increasing the production capacity of renewable energy.
- ✓ Market Size: Significant investments are currently planned for public infrastructure projects that incorporate solar technology.
- ✓ Growth drivers: National strategies focusing on reducing dependence on fossil fuels and increasing energy security and addressing passive defense issues.

D- Export market

- ✓ Target market: neighboring countries with growing needs to supply renewable energy.
- ✓ Market Size: As Iran develops its solar power generation capabilities, panel exports can penetrate regional markets.
- ✓ Growth Drivers: Increasing international demand for renewable technologies and potential trade agreements.
- ✓ Determining the target market

Based on the analysis of the market size and its growth rate, the target markets can be defined as follows:

- ✓ The residential sector appears to be a secondary target due to its rapid growth potential driven by government incentives and increasing consumer awareness.

- ✓ The commercial sector represents a significant opportunity as businesses increasingly seek sustainable solutions to manage costs.
- ✓ In the industrial sector, the creation of infrastructure should be considered for larger-scale installations so that the industrial sector considers the need for reliable electricity sources.

6- Physical Progress of project: yes ☐ No ☒

This is a creative and proposed plan and it is defined in order to cover the domestic needs of the country. There has been no progress in the implementation of this project so far.

7- Action plan and Implementation schedule:

The implementation of the project until its operation is planned for 24 months, and the operation of the project is expected from the beginning of 1405. The schedule of the project is presented in the table below.

Project implementation schedule

Activity/executive operations/year	1403				1404				1405			
Season	1	2	3	4	1	2	3	4	1	2	3	4
Conducting pre-investment studies	*											
Attracting investors and starting	*	*	*	*								
Obtaining the necessary permits and financing				*								

Providing engineering services				*								
Land purchase and preparation				*								
choosing the project manager (contractors)				*								
Workshop equipment				*	*	*	*	*				
Construction and landscaping operations					*	*	*					
Ordering, buying and transporting machines							*					
Installation of machinery						*	*					
Facilities								*				
Recruitment and training of employees									*			
Unforeseen delays									*			
Trial production									*			
Commercial production												

8- Financial projection:

8-1- The cost estimate:

The cost estimate

No.	subject	Costs (million Rials)
1	Fixed investments	5,495,951.6
2	Operating costs	643,870
3	Financial costs	6,139,821.6

Fixed investment

	Subject		Cost (Rials)
1	Land purchase cost		80,000,000,000
2	Land landscaping and land improvement		28,800,000,000
3	Civil operations and building construction		473,000,000,000
4	Machinery and production equipment		4,556,400,000,000
5	Service and ancillary equipment (office supplies and others)		9,460,000,000
6	Transportation vehicles		18,450,000,000.00
7	Overhead costs		-
8	Pre-production expenses	Pre-investment studies	-
		Project management and organization	-
		Technology education	-
9	Unforeseen expenses		-
10	Total		5,184,860,000,000

	subject			
Current expenses				
1	Raw materials		12,000,000,000	
2	Human resources		3,...,...	
3	Marketing (excluding human resources)		-	
4	Other ongoing expenses	Finished	93,490,344,220.89	
		Goods Inventory		
		Payroll - Other		180,000,000.00
		Receivables		504,000,000,000.00
Fix expenses				
5	Raw materials		20,300,635,200.00	

6	Human resources	10,899,000,000.00
7	Marketing (excluding human resources)	-
8	Depreciation expense	-
9	Other fixed costs	-
		-
		-
		-
	Total	643,869,979,420.89

8-2- Estimated revenues:

Project revenues

No.	subject	Season 1	Season 2	Season 3	Season 4	Year 1	year2	year3	year 4	year 5
1	Monocrystalline Solar Panels	1500000	1500000	1500000	1500000	6,000,000	7,000,000	8,000,000	10,000,000	10,000,000
2	Polycrystalline Solar Panels	1500000	1500000	1500000	1500000	6,000,000	7,000,000	8,000,000	10,000,000	10,000,000

Estimated product revenue (rials)

	Product or Service Name	Unit	Production rate	Price per piece (rials)	Total income
1	Monocrystalline Solar Panels	Watts per year	10,000,000	290.000	2.900.000.000.000
2	Polycrystalline Solar Panels	Watts per year	10,000,000	270.000	2.700.000.000.000
Total			20,000,000		5,600,000,000,000

8-3-Duration of project operation:

The construction period of the plan is 24 months and it is considered to start from April 1403. The duration of the project is considered to be 10 years.

8-4-Break- even analysis:

From an economic point of view, break-even point analysis is an important technique that is used to study the relationships between costs, income and profit, and according to the definition, the break-even point is the point where the exploitation of the plan creates neither profit nor loss. In other words, the break-even point analysis determines the point where the sales revenue is equal to the production costs, and thus it is used to analyze the effect of changing the volume of the product on the profit; The percentage of sales at the break-even point is 18.86%, which means that in this project, to reach a point where we have neither profit nor loss, we must use 18.86% of the nominal capacity.

8-5- Cost-benefit analysis:

The table of project efficiency indicators

total fixed investment Present value	77,200,755,435,440
total net revenue Present value	18,853,680,354,332
Net present value (NPV)	20,517,138,330,714
benefit - Cost ratio B/C	4/09
Internal rate of return (IIR)	% 78.76

Based on the calculations, the net present value of the project at a discount rate of 25% is 20,517,138,330,714 Rials, which shows the economic justification of the project. One of the other methods of checking and evaluating investment plans is the method of internal rate of return or internal rate of return. In fact, the

internal rate of return is the interest rate or discount rate in which the current value of all benefits of the plan is equal to the current value of its expenses. According to the calculations, the internal rate of return of the plan is estimated at 76.78% and it is favorable compared to the minimum expected profit (Minimum Attractive Rate of Return). Profitability Index shows how much economic profit will be obtained during the lifetime of the project for each unit of money invested in the project.

The investment payback period (Period Payback Investment Project) is the period of time to acquire the initial capital of the project from the source of its income. In other words, the payback period indicates the time it takes to recover the initial investment. This measure shows the speed of money return and the power of protecting the project against risk. The return period (simple) of the plan is estimated to be equal to 25 months (equal to the year 1407) according to the calculations.

8-6- Sensitivity analysis of IRR:

In the sensitivity analysis of plans, the percentage of changes in the internal rate of return (IRR) of the plan is measured relative to the change in some parameters and basic variables of the plan. In this plan, the analysis is based on major variables such as sales revenue, fixed costs of the plan, and operational costs of the plan. The following table shows the results of sensitivity analysis regarding the variables of operating leverage DOL, financial leverage DFL and compound leverage DCL.

The amount of operating leverage and compound leverage (the overall risk of the company) has always been decreasing from the first year to the tenth year, which means that the risks have been decreasing.

Sensitivity of IRR

Leverage Title	1403	1404	1405	1406	1407	1408	1409	1410	1411	1412
Operating Leverage DOL	1.32	1.19	1.12	1.07	1.05	1.04	1.03	1.02	1.02	1.01
Financial Leverage DFL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Compound Leverage DCL	1.32	1.19	1.12	1.07	1.05	1.04	1.03	1.02	1.02	1.01

8-7- Summarize table:

Below is the management summary of the business plan for the production of solar panels related to Mrs./Mr. Mohammad Rasul Almasi Fard located in Javanrood Industrial Town. The findings of this study show that

The situation of supply and demand of products/services of this project is examined in the attachment. And appropriate marketing strategies have been set to respond to market needs and operate in a competitive environment. The business model of this project has also been set, which can be reviewed below.

For this project, 5,184,860,000,000 Rials will be invested as fixed capital in various items, and 311,091,600,000 Rials will be spent for obtaining permits, preparing maps, trial launch, etc., considering this figure, the total investment in This plan reaches 5,495,951,600,000 Rials. On the other hand, in the first year of operation of the project, the amount of working capital is 643,869,979,421 Rials, which is 757,817,942,877 Rials and 891,926,246,064 Rials for the second and third years, respectively. It should be noted that the utilization percentage of the nominal capacity in the first, second and third year is 60%, 70% and 80% respectively, also the estimates show that the total income of the project at 100% of the nominal capacity is 5,600,000,000,000 Rials.

In total, the project will create employment for 83 people who will work in different positions. Also, this plan requires 1 rial of bank facility, which includes 0% of the total required investment (fixed and revolving).

The profit of the first year of this project is 1,795,743,147,646 rials, which in the tenth year, taking into account the salvage value and inflation considered in the assumptions, reaches the amount of 41,540,564,601,715 rials; The following table provides a summary of the most important financial data:

"Summary of economic issues"

activity	International Standard Industrial Classification (ISIC Code)	product name	Nominal capacity (unit)
Industrial Production	---	Solar Panels	20000000
Period of Implementation	Total Fixed Investment	Annual Working Capital	Required manpower
24	(million Rials)	(Million Rials)	83
Internal Rate of Return IRR	5,495,951.6	643,870	Benefit/Cost Ratio B/C*
78/76	Net Present Value NPV	Applicant's Income (Million Rials)	4/09

In general, according to the expected rate of return and the net present value of the plan, it is recommended to invest in this plan. Also, with the calculations made, the internal rate of return (IRR) of this plan is 78.76%, which is compared to the expected rate of return of capital. transition (30 percent); This project is in a favorable condition; Therefore, from the point of view of this financial index, investment in this project is suggested.

8-8-Estimation of exchange rate changes during the project implementation:

The exchange rate at the time of evaluation is taken into account as shown in the table below. The purchase and sale prices are subject to market prices and are adjusted to a large extent by the increase in the exchange rate. If, during the construction and implementation phase, the project is financed through foreign currency sources, the amount of financial resources required will not

change much. An increase in the exchange rate will help the company develop exports and earn more foreign currency. Since in this project, the dependence of raw materials and production lines on foreign items is very low, exchange rate fluctuations and their increase will not have much impact on the company. In general, exchange rate fluctuations will have little impact on the evaluation results.

Currency	Unit price	Unit of measurement
Dollar (USD)	640000	Rial
Euro	700000	Rial

9- Capital needs, the supply and guarantees method:

9-1- Foreign currency needed:

Based on the calculations made in the section related to machinery, equipment, and required materials, the required capital value, including insurance costs, customs and clearance, as well as annual maintenance costs, can be predicted as shown in the table below.

No.	year	Amount of currency required
1	first	12 Million dollars
2	second	750 Thousand dollars
3	third	750 Thousand dollars
4	fourth	750 Thousand dollars
5	fifth	750 Thousand dollars

9-2- The Way of participation and finance method:

Participation in the present project and its financing is foreseen in the form of establishing a company inside the country. The total financial resources

required are predicted through the investor's contribution and have not been included in order to implement the facility plan of domestic banks.

9-3- Payback period:

The payback period is the period of time when the initial investment of the plan is compensated from the annual cash funds of the plan. The return period (simple) of the plan is estimated to be equal to 25 months (equal to the year 1407) according to the calculations.

10- Incentives, features and advantages of project:

Given that the feasibility study plan for the production of solar panels has been developed with the aim of attracting foreign investment in the province, significant incentives are available at the national level and specifically at the Kermanshah provincial level for this purpose;

- No restrictions on the volume and percentage of foreign investment participation
- Possibility of registering an Iranian company with 100% foreign capital
- Transfer of the capital principal, capital profits and benefits from the use of capital in the form of currency or goods
- Foreign investors enjoy similar and equal rights to domestic investors
- Possibility of investment by foreign natural and legal persons and Iranians residing abroad
- Possibility of investment in all permitted fields for the private sector
- Providing protective coverage to all foreign investment methods
- Short and fast application process (foreign investment registration system) and approval of foreign capital
- Issuance of three-year residence permits for investors, managers, foreign experts and their first-degree relatives and the possibility of entry

- 50% tax discount on declared income from the sale of goods by foreign joint ventures if at least 20% of the manufactured products are exported
- Discount up to 50% of the subject of foreign joint investment (for every 5% of participation, equivalent to a 10% exemption from the registered and paid-up capital
- Possibility of guaranteeing foreign capital against losses resulting from expropriation and nationalization by the Free Trade and Industrial Zones Organization from its assets or through contracts with banks, credit institutions and insurance companies with the approval of the Council of Ministers

In addition to the aforementioned incentives and benefits that are specifically available for foreign investment, other incentives that can be used in general can be mentioned;

- Exemption from commercial profits for the import of capital industrial machinery
- 20-year tax exemption for production and service units located in areas not prone to employment, as well as the possibility of the aforementioned production and service units enjoying tax facilities at rates lower than the standard bank facility rates
- No need to obtain separate permits from different departments and transfer of land in cash and interest-free installments in industrial towns
- Creating the necessary conditions for the synergy of industries located in towns and industrial areas

Resources

Expert report on the evaluation of new plans for the development of solar power plants, 1402, resistance economics think tank, energy group. Mett.ir

Famco Hyper Industries, www.famcocorp.com

J. Huang and F.S. Sun, (2007), “**Feasiability study of one axis three positions tracking solar PV with low concentration ratio reflector**,” *Energy Conversion and Management*, vol. 48, pp. 1273–1280.

Jokar, Mehdi and Mohdpour, Mehrdad. (1402), **Analysis and review of the use of solar panels in Iran's electricity industry**, *Environmental Sciences and Geography*, 8(1).

K.-H. Chao and C.-J. Li, (2010), “**An intellegent maximum power point tracker power point tracking method base on extension theory for the PV systems**,” *Expert Systems with Applications*, vol. 37, pp. 1050– 1055.

Moghari, Alireza and Heydari, Hassan, (2016), **Identification of climatically suitable areas for the construction of solar power plants in Kermanshah province using fuzzy logic model**, *Energy Planning and Policy Research Quarterly*, 3(9), 179-204.

Preliminary investigation of the creation of the production value chain of crystalline silicon photovoltaic module in Iran. (2017). Solar Energy Technology Development Center, Power Research Institute, version 7.

Rajaei, Seyyed Abbas; Badri, Seyyed Ali; Mansourian, Hossein; and Babaei, Mehdi. (1403). **Future research of settlement system in border areas** (case example: Kermanshah province). *Quarterly Journal of Regional Geography and Future Research*, 2(1), 1-19.

Rezaei, Shagaig; Yazdchi, Narjes; Dahami, Mohammad; Badakhshian, Milad; Lak, Mohammad (1400). **Solar panels in the modern building industry**. The 7th International Conference on Civil Engineering, Architecture and Urban Management.

Sajjadi, Noshin and Boqa, Shervin. (2018). **Investigating the environmental effects of different generations of solar cells.** Environmental Science Studies, 4(1), 1092-1099.

Salehi Shabestri, Ali, Khakzad Shahandashti, Arash and Pirmohammadi, Mohsen, (1402), **review of opportunities, future technologies and the need to develop solar energy in Iran**, the 31st annual international conference of the Iranian Mechanical Engineers Association and the 9th Iranian Power Plant Industry Conference.

Solar Panel Production Line, (2022), **Technical Economic Handbook**, Hamyarsolar.com

Sozen, T. Menlik and S. Unvar, (2008), “**Determination of efficiency of flatplate solar collectors using neural network approach**,” Expert Systems with Applications, vol. 35, pp. 1533–1539.

Taheri, Mehdi and Zare, Atefeh (2019), **ranking of factors affecting marketing and sales of solar panel products using AHP method** (case study of Fars Province Electricity Distribution Company), 4th International Conference on Management, Economics and Accounting.

Y.-P. Chang, (2009), “**Optimal design of discrete-value tilt angle of PV using sequential neural-network approximation and orthogonal array**,” Expert Systems with Applications, vol. 36, pp. 6010–6018.