

Plan: solar cells manufacturing

Introduction to product:

Based on the growing demand by customers and consumers worldwide, so increases the electricity generation needs. While, increase of the natural gas costs and emphasis by regulations on limitation of the greenhouse gases emission, the costs of electricity generation with fossil fuels increased. For this reason, making use of other energy sources for electricity generation such as solar electricity generation using the photovoltaic systems grew. The main objective of this plan is to construct the solar cells manufacturing factory in Lorestan Province. The ISIC code of the product is 3210512323 from manufacturing subgroup of the TV, radio and communication devices (32) and manufacturing subgroup of tube and valve electrical lamps and other electron components (3210).

Solar cells are exported and imported under the chapters of tariff 8541 of the Iran Custom regulation entitled diodes, transistors and semiconductors such as photo-sensitive semiconductors, optical battery provided as modules or prepared as panels, photo emitting diodes, piezoelectric crystals mounted, under the tariff 85414010 entitled solar panels (converting solar energy to electricity).

The main conditions on their importing is to take the permission from the department of commerce and ministry of industries and mines, paying 15% of the importing fees in 2016 (custom fee is 4% and commercial profit is 11%).

Introducing the product's application:

The solar cells system applications as energy source are classified as:

A. Off-grid solar cells

1. Applications:

- In-door applications
- Electronics and electrical devices
- Out-door applications
- Urban parks and passages lighting, automobile air conditioning system, small boats energy provision and so forth

2. Industrial applications

- Telecommunication, traffic signs, data processing mediator in remote cross-sections, industrial screens, cathode protection, remote monitoring, medical material cooling (e.g. vaccines and blood products and so on)

3. Remote applications

- Household electricity and rural equipment, refineries and water refinery small equipment, remote passages lighting and etc.

B. Gridded solar cells

1. Decentralized networks

- Private roads (for energy supply), research and educational centers (schools and so on), residential and official towers and so forth

2. Centralized networks

- Power generation in solar power station, industrial offices and plants electricity supply, sound insulating walls

At present, most of the applications for solar cells are in power generation in remote sites and the gridded systems and household applications follow.

Plan suggested sites

Based on the advantages of the establishment in industrial parks and zones, the Lorestan province industrial parks are suggested for implementing the plan.

Raw, auxiliary materials and consumables

The unit's raw materials include silicon wafer and metallization batter which are supplied through importation. Majority of the raw materials importations are from China. The standard dimensions of the silicon wafer used in photovoltaic systems are 156×156 mm and 125×125 mm. providing the silicon wafer price is based on Watt and it is 9300 Rials per Watt, approximately.

Sales plan and target market

The products price as the factory price for sale is as follow based on the products importing size

Table1. Sales plan

#	<i>Descriptio n</i>	practical capacity (watt)	nominal capacity(watt)	unit price	Annual Sale
1	solar cells	10800000	9720000	26,902	290,539
	Total	10,800,000	9,720,000		290,539

Annual nominal and practical capacity

Investigation into diverse units' capacity as well as the economic studies confirm that this unit's manufacturing capacity should not be less than 10.8 MW annually. Accordingly, the annual manufacturing capacity in 3 working shift each with 8 working hours daily and 300 days per year is 10.8 MW selected annually. Considering unpredicted and unexpected factors of process stop as well as maintaining and repairing processes, the plan practical capacity for this unit is 90% of the nominal one equivalent to 9.72 MW annually.

Manufacturing procedure and technology

Based on the screen print used with a little difference in manufacturing companies, Solar cells manufacturing and production process is as follow:

1. Raw materials: the main raw material for this process is Cz-Si single- or multiple-crystal wafer of the solar grid. These parts are usually supplied in rectangular and circle form with diameter of 10-15 cm and thickness of 200-350 μm . impurity of these chips is of type P and have electrical resistance of 1 Ohm.cm^{-1} .
2. Superficial defects elimination: silicon wafers introduced to the production line have some roughness and excrements on their surface due to cutting process in manufacturing factory. In this phase, about 10 μm of the surface layer of raw wafer is removed using acid or alkaline solutions.
3. Surface carving: in this phase, the surface of wafers has to be carved based on a certain pattern. The surface texture would be in form of pyramid and NaOH etching.
4. Phosphorous diffusion: as a type P impurity, phosphorous is used in solar grid silicon. Phosphorous diffusion is done at very high temperature. This is necessary due to the fact that carved wafers have to be cleaned of any alkaline residues and metal impurities before diffusion through acid etching.
5. Connections isolation: type P edges can cause shunt in on-surface connections and beneath impure wafers. In order to control this phenomenon, dry etching at lower temperature is used.
6. Anti-reflect cover: in order to reduce the reflectivity, the solar cells surface is covered titanium oxide.
7. On-cell connections print: in order to provide connections in on-cell surface, the paste containing silver powder is used.
8. Back-cell connections print: in this phase, the previous similar operation is done. Difference in connections print pattern paste type also is different on and back of the cells.
9. Simultaneous combustion: in this phase, a thermal operation type is done at high temperature. The main goal of this operation is to burn the paste organic impurities, sintering of particles and paste metal grains are in order to increase the conduction capacity increase as well as improve the cover electrical connections quality with silicon infrastructure.

10. Testing and classifying: solar cells are tested using virtual optical resource (simulated sun) at temperature 25°C. inconsistent cells are rejected and other cells are classified based on efficiency and output.

Investment costs

Description	Total Cost(m.Rial)	%
Land purchase	7,000	6%
Site preparation and development	1,916	2%
Civil works, structures and buildings	47,288	38%
Machinery and equipment	38,781	31%
Branches And Installation	9,437	8%
Vehicles	800	1%
Service equipment	87	0%
official equipment	387	0%
Other and unpredicted costs (5% of above costs)	5,285	4%
Total FIXED ASSETS	110,980.44	89%
pre-production expenditures	2,618.31	2%
TOTAL FIXED INVESTMENT COSTS	113,598.76	91%
Working capital in 100% of capacity	11,076.84	9%
Other assets	0	0%
TOTAL INVESTMENT COSTS	124,675.59	100%

Production costs

#	Description	Total Cost(m.Rial)
1	Raw and packing material	147612
2	Personnel's salary	11529.2
3	Energy	3997.87
4	Building and livestock insurance	202.77
5	Repair, maintenance and spare parts	3686.42
6	Marketing and Advertising	1452.7
7	Unpredicted	168.48
8	Depreciation	8434.42
Total operational and non-operational production costs		177083.87

Economic indices

Summary of the pre-feasibility studies of the solar cells manufacturing plan

<i>Description</i>	<i>Amount-measurement scale</i>
<i>NPV</i>	<i>281742 m Rial</i>
<i>IRR</i>	<i>63.95%</i>
<i>PBP</i>	<i>1.19 years</i>

Plan and Budget Organization of Lorestan province



PROJECT PROFILE – SUMMARY SHEET

Project Introduction

1. Project title: **solar cells manufacturing**

2. Sector: **manufacturing subgroup of the TV, radio and communication devices**

Sub sector: **and manufacturing subgroup of tube and valve electrical lamps and other electron components**

3. Products/Services: solar cells

4. Location: ... Free zone Economic special zone Industrial Estate Main Land

5. Project description:

Based on the growing demand by customers and consumers worldwide, so increases the electricity generation needs. While, increase of the natural gas costs and emphasis by regulations on limitation of the greenhouse gases emission, the costs of electricity generation with fossil fuels increased. For this reason, making use of other energy sources for electricity generation such as solar electricity generation using the photovoltaic systems grew. The main objective of this plan is to construct the solar cells manufacturing factory in Lorestan Province.

6. Annual capacity: 10.8 MW/year

Project Status

7. Local / internal raw material access 100 %

8. Sale: 100% locally

- Anticipated export market 0 %

9. Construction Period 24 month

Beginning of activity

In-site beginning of activity:

End of project:

Commercial activity beginning:

Project Status

10. Project Status:

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

Financial Structure

11. Financial Table

Description	Local Currency Required			Foreign Currency Required Million Dollar	Total Million Dollar
	Million Rials	Rate	Equivalent in Million Dollar		
Fix Capital	74817.76	31000	2.41	1.251	3.661
Working Capital	11076.84	R for each Dollar	0.36	0	0.35
Total Investment	85894.59		2.77	1.251	4.021

- Value of foreign equipment/machinery 1.251 million dollar
- Value of local equipment/machinery million dollar
- Value of foreign technical know- how million dollar
- Value of local technical knows- how million dollar
- Net Present Value (NPV): 281742 Million Rial for 10 Year, discount rate: 20%
- Internal Rate of Return (IRR) 63.95%
- Payback Period (PP) 52.63%

General Information

12. Project Type : Establishment Expansion and completion

13. Company Profile:

-Name (legal /natural persons):

-Company Name:

-Address:

-Tel:

Fax:

-E-mail:

Web site:

-Local entrepreneur : private sector public sector other

Please attach follow documents if available

- Pre-feasibility study
- Feasibility study
- Legal permissions (establishment license, foreign currency quota, environment, etc)

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