Final Semester Project Report

EXPLORING BUSINESS OPPORTUNITIES IN GRID-CONNECTED SOLAR PV SECTOR IN INDIA

Under the kind guidance of:

Prof. Zillur Rehman,

Associate Professor

Department of Management Studies

Indian Institute of Technology, Roorkee

&

Mr. Madhavan Nampoothiri

Founder, RESolve Energy Consultants

Submitted By:

Varun Mittal

MBA Class of 2012

Department of Management Studies

Indian Institute of Technology, Roorkee

DECLARATION

I, **Varun Mittal**, hereby declare that this report has been indigenously developed by me as a report of my Final Semester Project (which is a part of our MBA course curriculum at Department of Management Studies, IIT Roorkee), at the Department of Management Studies, IIT Roorkee.

The facts and findings contained in this report are totally based on my research work during the project. Also, neither any data has been sourced from any unauthorized source nor the data has been copied from any copyrighted/protected material. All the stated facts are true to the best of my knowledge.

I also declare that the contents of this project report would not be shared with any external entity that is unauthorized to access the same.

Varun Mittal

ACKNOWLEDGEMENT

I would like to take this opportunity to thank all those who helped me in completion of my final semester project and gave me insight into the Grid connected Solar PV Energy Sector in India.

I am highly grateful to my mentor Prof. Zillur Rehman (Professor, DoMs, IIT Roorkee) who has gave me this wonderful opportunity to pursue my final semester project in the area of my interest. His guidance on academic aspects i.e. methodology, market research framework and models, has been really beneficial in doing meaningful work in realistic time frame.

I would like to thank Mr. Madhavan Nampoothiri (Founder, RESolve Energy Consultants) who agreed to guide me for this project and spend his time from his busy schedule in guiding me. He helped me in building upon the idea for this project, defining the scope of study, understanding the practical aspects related to this sector and shared valuable knowledge with me being an industry expert. His critical appraisal, comments and suggestions have helped in maintaining the right direction of my study.

I would also like to thank Mr. Harsha (Co-founder, EfficientCarbon) who is a friend, a partner and a mentor and has always been supportive of my work.

Also, I would like to thank Dr. Srikant Panigrahi (Advisor to Prime Minister Office on sustainable solutions, Director General, CMI) who has been a constant source of guidance and motivation to me.

I would like to extend my sincerest thanks to various professionals and organizations in the Solar Sector who helped me in my research work with their valuable inputs and made it possible for me to come out with realistic findings.

INDEX

Contents

INTRODUCTION

OBJECTIVE: The objective of the thesis is to give stakeholders a holistic picture of Grid-connected solar PV sector in India, help them in exploring various aspects related to this sector and understand opportunities and threats thrown by this sector on the business they are involved in across the solar value chain system. Further, "key" industries related the solar PV sector i.e. solar PV EPC and PV manufacturing are analysed to provide business players (belonging to these two industries) with strategic inputs which can help them in making informed business decisions.

DESCRIPTION: The thesis work is divided into two parts. In first part, various aspects of this sector i.e. Social, Political, Legal, Technological, Economical and Environmental are explored to understand the opportunities and threats thrown by this sector to stakeholders representing solar PV value chain system. Industry attractiveness is evaluated based on above mentioned aspects which could give a realistic scenario of the industry's anticipated growth. Also, the market potential of the industry is seen from the eyes of a marketer such that business drivers are assessed and market segments are explored across various industries. Major challenges for the industry are also touched upon to highlight the areas of attention before policy makers and other associated stakeholders. The current solar PV scenario is presented to give an idea about the progress made in this sector so far and the growth in this sector in terms of projected solar PV installation is made using the targets set by the govt. under various National and State solar policies.

The second part is divided into 2 sections. In second part, analysis is done specifically for the focused "key" solar business players i.e. solar PV EPC and PV manufacturing based on to access competition across various dimensions. In first section of second part, Solar PV EPC industry is analysed by employing Porter's competitive forces model to give strategic inputs to the business players which can help them in formulating effective business strategies.

In second section of second part, aspects of Solar PV manufacturing industry at Global and Domestic levels are analysed using 5 parameters (Profitability, Technology, Infrastructure, Finance, and Policy & Regulatory to give a realistic picture of key developments taking place in this industry. Analysis is done on the observed conditions to reach at proposed solutions

and recommendations which could help business players in this industry formulate effective marketing strategies.

AUDIENCE OF REPORT: Local and Foreign players under following categories-

Bankers and Venture Capitalists

Solar PV cell/module manufacturers

EPC players

Industry Analysts and Regulatory Bodies of Solar Sector

Trade Associations and companies

Other industry Professionals

MODELS/ FRAMEWORK:

PART A: PESTEL model is used during the analysis

PART B:

In Section 1, Porter's 5 forces Model is used to analyse Solar PV EPC industry

Section2: Analysis for solar PV manufacturing industry is done using following 5 parameters to explore various business opportunities and business challenges

- Demand & Supply
- Cost & Price
- Technology
- Finance
- Policy & Regulatory aspects

MARKET RESEARCH AND ANALYSIS METHODOLOGY:

A. Data Collection- Identify stakeholders. Making parallel primary as well as secondary research.

1. Primary Research-
    a. Face to face discussion

b. Calls
c. Email- Questionnaire
d. Social networking websites- Postings

2. Secondary Research-
   a. Literature-
   b. Market Reports-
3. Limitations

B. Data Analysis- Again going back if required

C. Inferences- Again going back if required

D. Limitations: Personal Bias while answering, motive, secondary data may not be appropriate

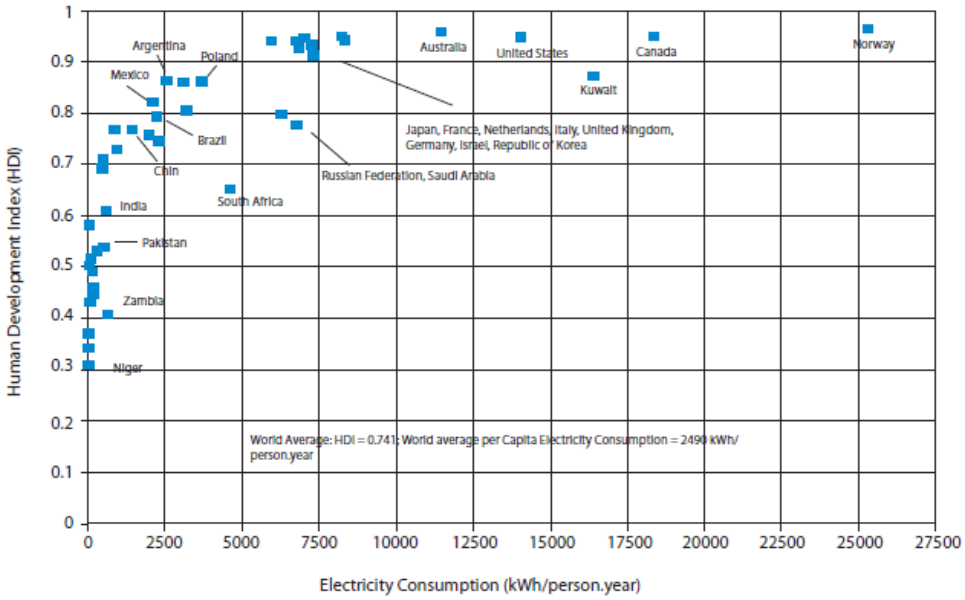
PART A

GRID CONNECTED SOLAR PV MARKET POTENTIAL

OPPORTUNITIES: MARKET DRIVERS

Energy Security for economic and social development

As per research by Prayas Group, In India per capita consumption of electricity per is around 481 units which is one-fifth of world average of 2596 units per year with 900 units per month consumption of electricity in US. Such a low electricity standard in India throws development challenge given the fact that HDI is directly related to the per capita consumption of electricity per year.



Narsimha, Girish, Sudhir(2009): An overview of Indian Energy Trends: Low Carbon Growth and Development Challenges" (Prayas Group Publication, Sep 2009)

Gap between supply and demand of power

LOADS	DEMAND	AVAILABILITY	DEFICIT
BASE LOAD	861,591 (MU)	788,355 MU	8.5%
PEAK LOAD	122 GW	110 GW	9.8%

Source: CEA report, 2011

In order to be energy secure, India needs to first match its supply of power with the demand and to add the capacity year on year with respect to the GDP growth rate, power being a primary ingredient in economic development. Based on these parameters, National Electricity policy objectives have been set as given below:

1. Power for all: To achieve this objective MOP has set aggressive plans to add more than 100,000 MW of conventional power capacity by 2012. However, India won't be able to achieve this target by 2012 since the targets set could not be achieved as expected though the capacity addition during 10th Plan was highest ever.
2. Rapid Economic growth: India is an aggressively growing economy: India needs to sustain an 8% to 10% economic growth rate, over the next 25 years, India needs, at the very least, to increase its primary energy supply.

Grid-Interactive power capacity scenario

Year	Plan	Projections for Installed Capacity Requirement in GW		Additional targeted/ projected capacity (conventional power in MW)	Actual capacity installed (conventional power in MW)	Grid- Interactive renewable power capacity			Cumulative capacity installed
		GDP Growth Rate				Targeted	Installed	%age	
		8%	10%						
2002-2007	10th Plan	153	155	41,110	21,080	10258	6190.86	4.68%	1,32,329
2007-2012	11th Plan	220	233	78,577**	53,166*	22700	20,162.24*	10.86%*	1,85,496*
2012-2017	12th Plan	306	377	101700	-	41400	-	12.80%	-
2017-2022	13th Plan	425	488	130800	-	72400	-	15.90%	-

MNRE (2006): "Projections for Electricity Requirement, IEPR Renewable Energy in India" (MNRE publication, 2006)

Assumptions: Existing Projections for Capacity addition/ Generation from conventional power during 11th and 12th plan as per 11th Plan proposals of MoP since the ; Capacity addition during 13th plan broadly in line with IEPR projections, with pro-rata increase in Generation.

**As on 31-11-2011*

***Revised Target (62,347MW)*

RES=Renewable Energy Sources: RES don't include Solar (RES include SHP, BG, BP, U&I and Wind Energy SHP= Small Hydro Project , BG= Biomass Gasifier ,BP= Biomass Power,U & I=Urban & Industrial Waste Power)

In order to achieve the above given objectives one of the recommendations given by IEPR is to increase the renewable energy share in grid-connected power to 10% in India's energy mix and 15% in installed capacity by 2022.

Why solar power in renewable energy mix?

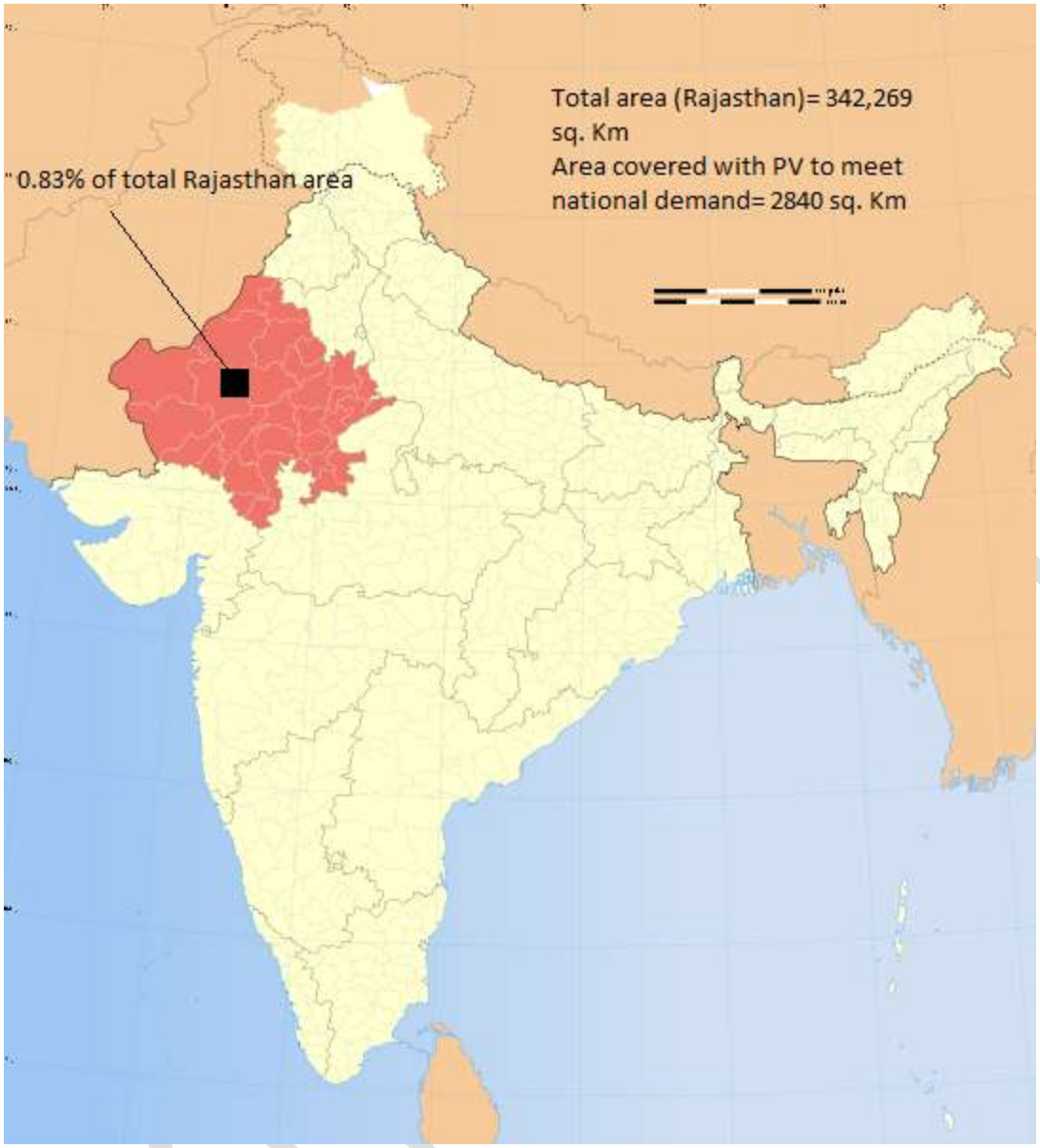
There is abundance of solar energy across India. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. The annual average global solar radiation on horizontal surface, incident over India is about 5.5 kWh per square meter per day or 1650 Kwh per sq. meter per year. There are about 300 clear sunny days in most parts of the country.

A glimpse of theoretical solar power potential in India

Solar radiation incident over Rajasthan area= 2000 Kwh per sq. m per year

Annual National Electricity demand= 568 billion Kwh (Year, 2010)

Assuming an efficiency of 10%, the area to be covered with PV required for meeting national electricity demand is approx. 2840 sq. km which is 0.83% of total area of Rajasthan.



Based on such promising solar energy potential across India, Govt. of India rolled out a central policy "Jawaharlal Nehru National Solar Mission: JNNSM" on 23rd Nov, 2009 to add 20,000 MW grid-connected solar power capacity which is 27.62% in grid-connected renewable power capacity by 2022. However, along with the central policy, 3 states i.e. Rajasthan, Gujarat, Karnataka have come up with their state solar policies which are independent or concurrent to central policy while other states are planning their solar policies such that the total contribution of solar will be much higher in renewable power mix thereby increasing the %age of renewable power (in power mix), cumulative grid-connected power capacity and the unit generation in India.

Economics-Rising Prices of electricity in India and Plummeting cost of solar power

*Sagar Gubbi(2010): Cost of generating power in India, Sagar Gubbi, 04 Oct 2010 viewed on Jan 2012 (*http://thealternative.in/blogs/green-mile/blog_entries/cost-of-generating-power-in-india)

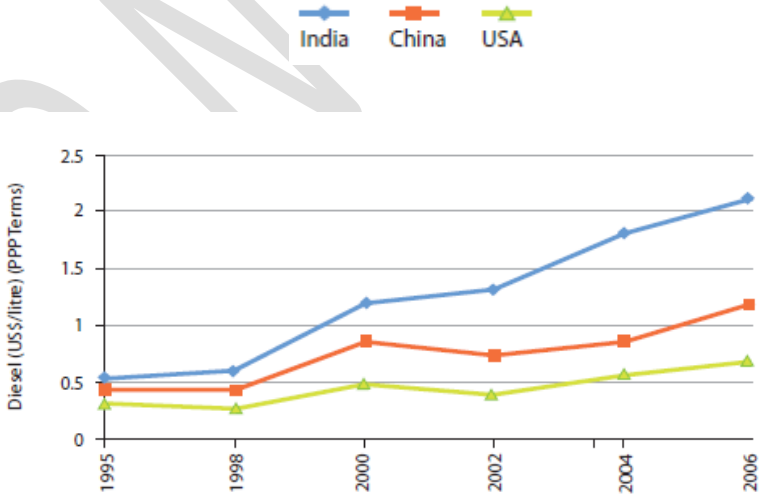
The graph given above tells about rising prices of electricity over the years in India. Thermal power constitutes around 66% of the total electricity requirement in India. Coal is expected to be the main stay in the thermal power generation in India at around 85% share in total thermal power generation with dependence on imports for remaining 11.5% of Coal requirements. Another thermal fuel is gas whose current availability is not sufficient to meet the requirement of even existing plants in India. The capacity addition of 82,200 MW for the 12th Plan is being targeted with around 60% capacity addition from thermal projects. The electricity prices are bound to increase further due to rising domestic and global prices of coal and natural gas as shown the graph below representing Global trend in coal prices.

Fuel Requirement in India (Tentative) during 2011-12

Fuel	Requirement (2011-12)	Availability (2011-2012)
Coal	545 MT	482 MT
Gas/LNG	89 MMSCMD	40 MMSCMD

*Matt Badiali (2011): If you like the Big trend in gold, you need to see the one in coal by, DailyWealth, July 2011 viewed on Jan 2012 (*http://www.dailywealth.com/1780/If-You-Like-the-Big-Trend-in-Gold-You-Need-to-See-This-One-Too)

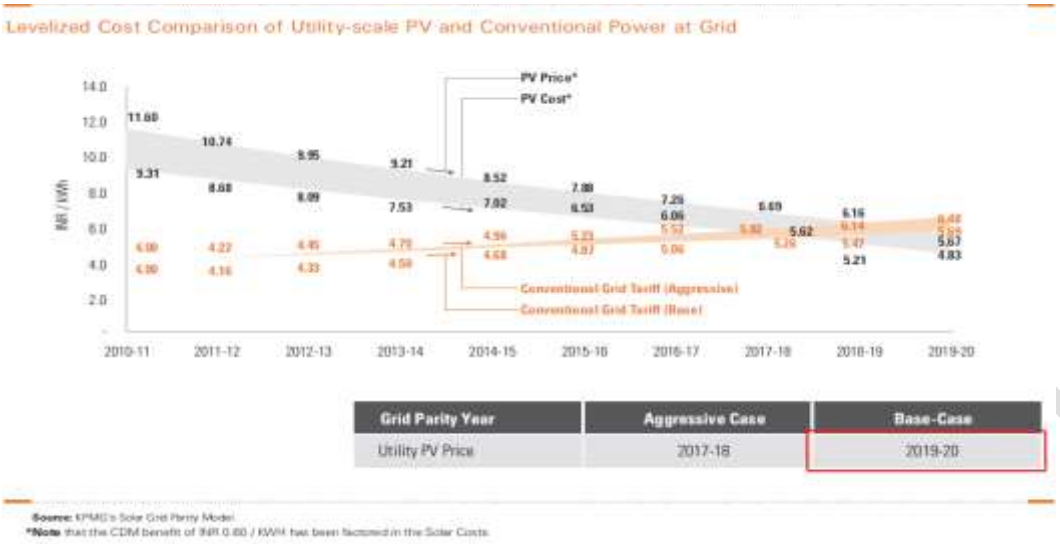
Power generation from diesel constitutes around 1% of total thermal power generation in India. At commercial as well as domestic level, Digital generators mainly used to generate power from diesel which along with polluting the atmosphere, are now quite expensive to operate with the rising cost of Diesel in India. The graph given below tells about the sharply rising prices of diesel in India w.r.t other countries.



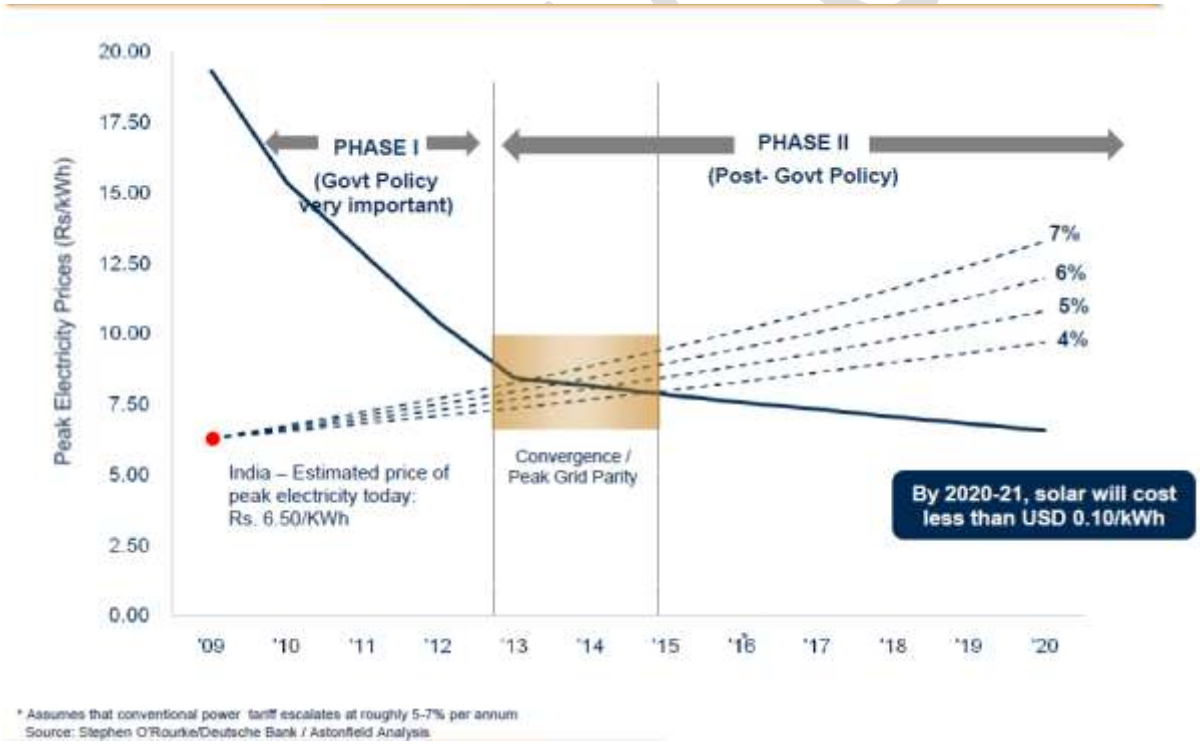
Narsimha, Girish, Sudhir(2009): An overview of Indian Energy Trends: Low Carbon Growth and Development Challenges" (Prayas Group Publication, Sep 2009)

The levelized cost of Utility-scale solar PV power prices at Grid have been plummeting sharply and on the other side the conventional power tariff is increasing rapidly like never

before such that KPMG has projected that solar PV power in India is expected to achieve grid-parity in 2017-2018.



KPMG(2011): "The Rising Sun"



TC Arora (2009): "Unleashing the Potential of Solar Energy in India" Presented to Govt. of West Bengal,July 2009

However, at when comparing with estimated price of peak electricity with the solar power cost, Peak Grid Parity is expected to be attained in 2013-2015 as per analysis done by *Stephen O'Rourke Deutsche Bank and Astonfield*. This shows that another driver for grid-

connected solar PV market is rising conventional power prices and decreasing solar PV prices because of improvement in technology and processes.

Environmental/ Ecological Security

There have been global initiatives to tackle Climate change issues resulting from industrial and other emissions of carbon dioxide and other greenhouse gases. UNFCCC was set up to provide an overall framework for intergovernmental efforts. India is not required to contain its GHG emissions, as a signatory to the UN Framework Convention on Climate Change though it has acceded to the Kyoto Protocol to undertake various steps taken in regard to climate mitigation and adaptation. Indian govt. launched NAPCC- National Action Plan for Climate Change on June 30, 2008, under which among 8 missions formed to promote understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation. One among 8 missions is Solar Mission named as "JNNSM" whose objective is *"to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible".*

CENTRAL, STATE AND CONCURRENT SOLAR POLICIES IN INDIA

JNNSM	Phase 1(2009-13)		Phase 2 (2013-17)	Phase 3 (2017-22)
	Batch 1 (FY 2010-11)	Batch 2 (FY 2011-12)		
Grid Connected Solar (PV + Thermal)(capacity >2 MW)	300 MW	700 MW	4000-10000	10000-20000
Grid Connected Solar PV (Capacity>5 MW)	150 MW (50%)	350 MW (50%)	Depends on percentage allocation	Depends on percentage allocation
Solar PV Rooftop and small solar plants (Capacity 100 KW-2MW)	100 MW	-	-	-

State Policies	Capacity/Specifications	Phase-Ending year	Cumulative Target
Gujarat State Policy,2009			
Grid Connected Solar (PV+Thermal)		Phase- 1, 2009-12	1000 MW
		Phase 2, 2012-15	3000 MW
State Policy, Gandhinagar (Solar) Photovoltaic Rooftop Programme		Phase 1	5 MW
Karnataka State Policy, 2011			
Grid connected solar PV and off Grid (PV+Thermal)		2016	1. 50 thermal 2. 200(SPV+CSP)= 40 per year 3. 100(REC) Aggregate=400
		2018	1000 MW
Rajasthan StatePolicy,2011			
Solar (PV+Thermal)Capacity Target (inclusive of JNNSM)	Aggregate	2021-23	10 GW- 12 GW
Under State Govt.	50 MW capacity with conventional bundling		Thermal : PV=(50:50)
		Phase-1 (2012- 13)	200 MW(50:50)
		Phase-2 (2013 -17)	400 MW (Additional)(50:50)
RPSSGP Scheme			As per guidelines of MNRE
Under State Govt.	Capacity= 1 MW		50 MW
Under REC Mechanism	Unlimited capacity		As per state policy
JNNSM			As per guidelines of JNNSM

Solar PV Plant	For promotion of manufacturing facilities	2013	200 MW
Captive use /direct sale to 3rd Party/States	Unlimited capacity		As per state policy
Solar Parks			3000 MW

Demand Forecast for Solar PV till 2018

Demand forecast* for Grid-connected and off-grid solar PV capacity (under above mentioned National and State Policies) to be installed till 2018 is 7.780 GW out of which 1.860 GW has been allocated , 848.5 MW capacity is under implementation and 176 MW capacity has been commissioned as on 31-12-2011. And 8.5 MW solar PV project has been implemented under REC mechanism as on 31-12-2011. The capacity target overall for Solar PV was 484 MW as on 31-12-2011 out of which only 178.5 MW was commissioned. The reasons which led to over shooting the deadlines are not discussed in this report since it lies outside the scope of this project. The table given below shows the picture of current solar PV installation in India.

* Since timeline for 3000 MW solar parks in Rajasthan is not given in the plan, it is not included in the estimate. Also, since specific proportion between grid and off-grid Solar PV projects is not given, demand projection for both types is given. The calculations are based on assumption of 50:50 ratios between solar PV and thermal capacity for the targets set. Secondly, state policies for other states not mentioned in the table given below, few states are in process of drafting their solar policies and others are expected to launch solar policies in future. The estimate doesn't include this possibility.

Grid connected solar PV projects scenario in India (As on 31-01-2011)																	
Grid connected projects (till 31st Dec)		**Gujarat**			**Rajasthan**			**Karnataka**			**Rest of the states**			**Total**			**Commissioning deadline for Solar PV**
	Phases/Years	**Total**	**PV**	**Thermal**	**Total**	**PV**	**Thermal**	**Total**	**PV**	**Thermal**	**Total**	**PV**	**Thermal**	**Total**	**PV**	**Thermal**	**PV**
JNNSM, PH-1, B-I(>5 MW)		20.0	0.0	20.0	505.0	105.0	400.0	10.0	10.0	0.0	85.0	35.0	50.0	620.0	150.0	470.0	Jan-End, 2012
JNNSM, PH-1, B-II		0.0	0.0	0.0	300.0	300.0	0.0	0.0	0.0	0.0	50.0	50.0	0.0	350.0	350.0	0.0	NA
Migrated under JNNSM		0.0	0.0	0.0	66.0	36.0	30.0	0.0	0.0	0.0	18.0	18.0	0.0	84.0	54.0	30.0	Nov-End 2010
RPSSGP(GBI)-IREDA		0.0	0.0	0.0	12.0	12.0	0.0	0.0	0.0	0.0	86.0	86.0	0.0	98.0	98.0	0.0	Oct-2011 to Dec-2011
GBI		0.0	0.0	0.0	11.0	11.0	0.0	6.0	6.0	0.0	0.0	0.0	0.0				
State Policy	Phase 1, 2009-2010	366.0	366.0	0.0	0.0	0.0	0.0	10.0	10.0	0.0	0.0	0.0	0.0	937.0	937.0	0.0	Dec- End, 2011 for Gujarat Dec, 2012 for Karnataka
	Phase 2, 2010-2011	561.0	561.0	0.0	0.0												
Direct RPO		0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	170.5	170.5	0.0	270.5	270.5	0.0	Depends on date assigned(2012)
Total Allocation	Till 31st Dec	927.0	927.0	0.0	894.0	464.0	430.0	26.0	26.0	0.0	409.5	359.5	50.0	2359.5	1859.5	500.0	
PPA Signed	Till 31st Dec	927.0	927.0	0.0	694.0	264.0	430.0	26.0	26.0	0.0	359.5	309.5	50.0	2006.5	1526.5	480.0	
Capacity Target	Till 31st Dec	300.0	300.0	0.0	59.0	59.0	0.0	16.0	16.0	0.0	109.0	109.0	0.0	484.0	484.0	0.0	
Under Implementation(achieved financial enclosure)	Till 31st Dec	420.0	400.0	20.0	592.0	162.0	430.0	10.0	10.0	0.0	326.5	276.5	50.0	1348.5	848.5	500.0	
Commissioned	Till 31st Dec	85.0	85.0	0.0	44.5	42.0	2.5	16.0	16.0	0.0	33.0	33.0	0.0	178.5	176.0	2.5	
To be allocated(capacity, month)		(200, In dec)	100	100	350(next month)	200	150	80,december	-	-	Depends on Policy	-	-	800	-	-	
REC Mechanism			-	-	-	-	-	-	-	-	8.5*	8.5*	-	8.5*	8.5*	-	

**in above table projects under REC is separately given and not included in calculations for aggregate (TOTAL) numbers*

Regulatory Framework: *RPO- A State Specific Obligation*

The renewable purchase obligation is mandated by the State Electricity Regulatory Commission (SERC) under the Electricity Act, for distribution companies and captive & open-access consumers to purchase a minimum level of renewable energy out of the total consumption in the area of a distribution licensee. Almost every state has set RPO such that special attention is given to solar by fixing a percentage of solar to be purchased. SERCs have directed the distribution companies as well as captive & open-access consumers to meet separate solar RPOs as per the tariff policy at least 0.25% of total consumption of electricity in their respective areas in 2011-12 and 2012-13. The solar power purchase may go up to 3% by 2022.

Solar RPO is met by buying bundled power (conventional + solar) from the generators in the state or by purchasing solar RECs. Under preferential tariff scheme (in case of JNNSM or state power policy) PPA is signed with NVVN and when NVVN supplies bundled power to State utilities at the "rates" determined as per CERC regulations, those State utilities will be entitled to use the solar part of the bundled power for meeting their Renewable Purchase Obligations (RPO). So, purchasing bundled power at the specified rates helps in RPO. REC mechanism enables Obligated Entities in any State to procure Solar RECs from solar power generator in any of the States in India and surrender the same to satisfy its solar RPO target.

Govt. support- Fiscal incentives and related enablers

To give a boost to solar manufacturing, various SEZ like incentives are given under JNNSM

a) Creating local demand for Indian makes by mandating that crystalline solar modules to be used have cells of Indian make for JNNSM- Phase 1 Batch 2 projects.
b) Fiscal:

   Zero import duty on capital equipment, raw materials and excise duty Exemption.

   Low interest rate loans, priority sector lending

   Incentives under Special Incentive Package (SIPs) policy to set up integrated manufacturing plants

c) create a single window clearance mechanism for all related permissions to provide ease of doing business

d) Infrastructure and ecosystem enablers- To create 2-3 large solar manufacturing tech parks consisting of manufacturing units (across the solar value chain), housing, offices, and research institutes.

Also, solar modules of foreign make could be imported duty-free to give project developers a choice among various technology options across the globe.

Capacity building

Capacity building on various fronts is being be pursued by the govt.

a) Research and Development
b) Human resource development
c) Institutional arrangements
d) International Collaborations

THREATS

Loss making Distribution Companies

Financial condition of distribution companies is very weak across India. According to report of High Level Panel on Financial Position of Distribution Utilities*, there are accumulated losses (period 2006-10) of Rs. 88,000crores resulting from operational and management issues coupled with regulatory shortcomings. Also, forecasting of financial position from April, 2010 to March, 2017 shows that losses decline from Rs. 27,000 (approx.) in 2009-10 to Rs. 22,000 in 2016-17 i.e. aggregate losses decline from 24% to 19% by March,2007 due to improvement in performance. Given such a disturbed present and projected futuristic financial condition of the Distribution companies, the RPO mandated by the govt. under which they need to buy much higher priced renewable energy or RECs seems almost impossible as banks will no longer in a position to finance RE PPA or RECs.

**In this report 15 states were covered which present 91% of the energy consumed*

Uncertainty in Regulation Enforcement

Enforcement of RPO and penalty on default is quite difficult such that state agency will be required to submit quarterly status to the Commission in respect of compliance of RPO by the obligated entities and impose a penalty on default given the fact that administrative system in various other departments in India has been quite inefficient in implementing the rules and regulation such that obligators bypass the obligations by illegal actions like manipulation and bribery.

MARKET SEGMENTS

Segments of Grid-connected Solar PV market

Based on capacity and installation type, 2 segments are there

a) Solar Farms- Grid connected solar farms supported by Govt. policies are of capacity above 1 MW. The market segments for solar power are obligated entities like distribution companies, captive consumers & open-access consumers.

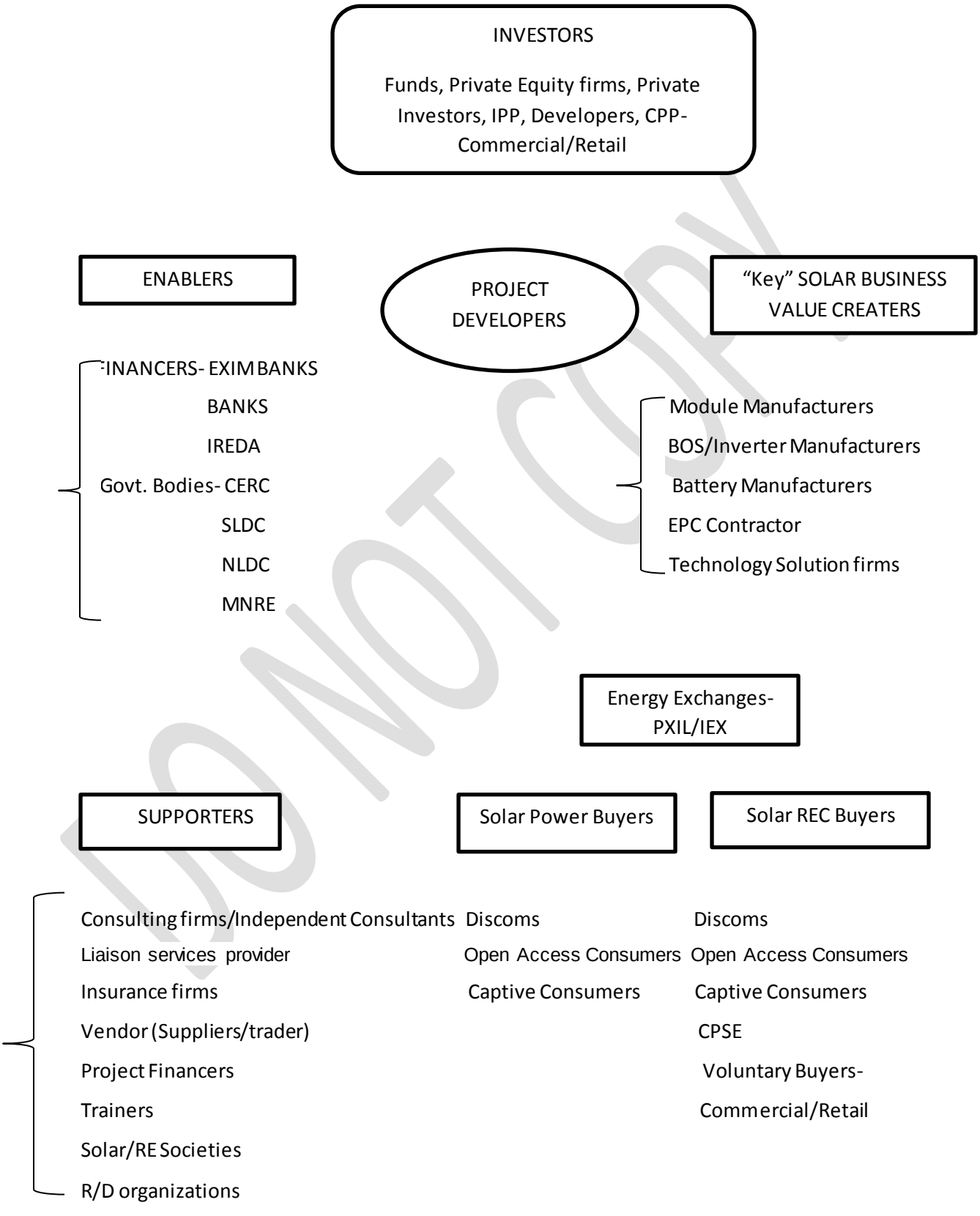
b) Solar Rooftops- Grid connected solar rooftops are of capacities from 100 KW up to 2 MW. It mainly consists of those segments which need solar power for captive consumption to be energy secure and cut down operational expenditure and/or meet their RPO at the same time.

   Market Segments for Rooftop solar power:

   - Industrial and manufacturing units
   - Retail business units (distribution centres, residential housing complexes etc)
   - Corporate Offices/Residential Buildings
   - Public Administration sites
   - Tourist Sites

PART B

SOLAR VALUE CHAIN SYSTEM



SECTION 1

Solar PV EPC players in India

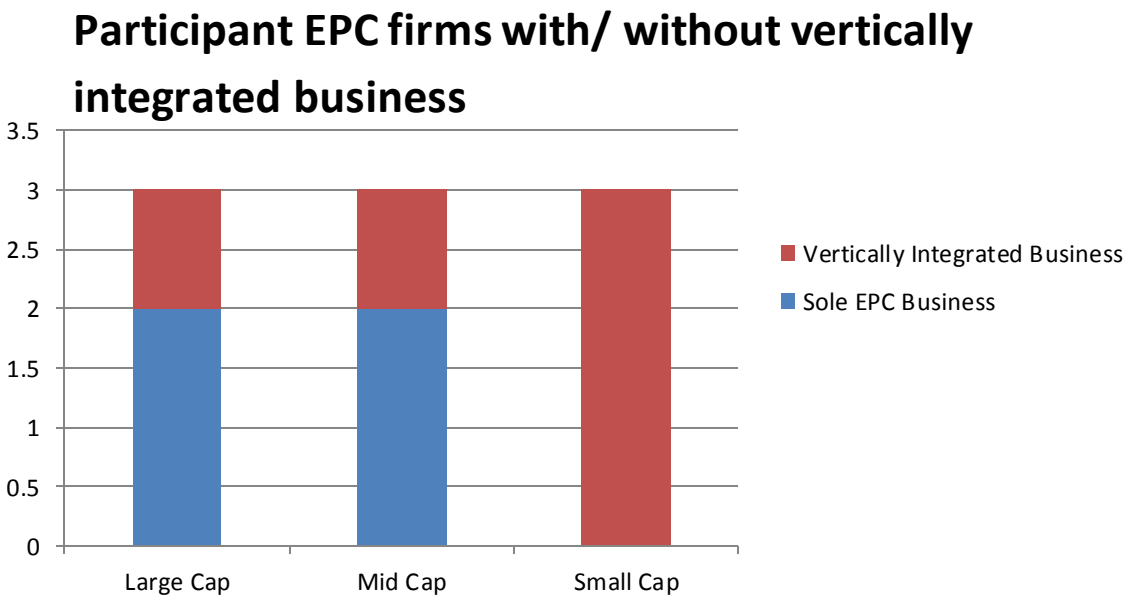
In Indian Solar PV market, there are pure domestic players like Mahindra Solar, L&T, Sterling & Wilson. There are foreign players like Juwi, MARTIFIER, Conergy. And finally there are JV EPC firms like Enfinity-Titan, Vikramsolar- PROENER, Greenforce-Gehrlicher solar. Over the period of time we have seen players in terms of market capitalization such that large cap firms undertake Rooftop projects as well as utility scale projects where as focus of small cap firms is only on rooftop projects.

Solar PV EPC industry is analysed by employing Porter's competitive forces model to study the market attractiveness of Solar PV EPC services business and give strategic inputs to the business players involved in this industry.

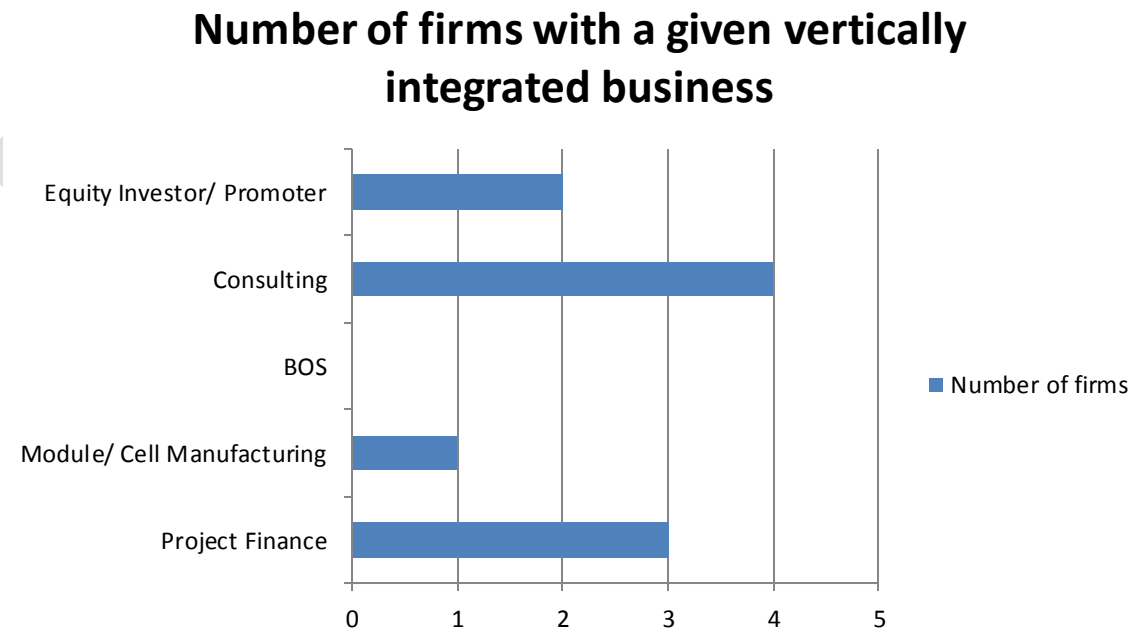
Survey is drafted based on the questions thrown by each force of Porter's 5 forces model such that the overall scope of this model has been covered.

SURVEY ANALYSIS & INFERENCES

EPC Participants in the survey

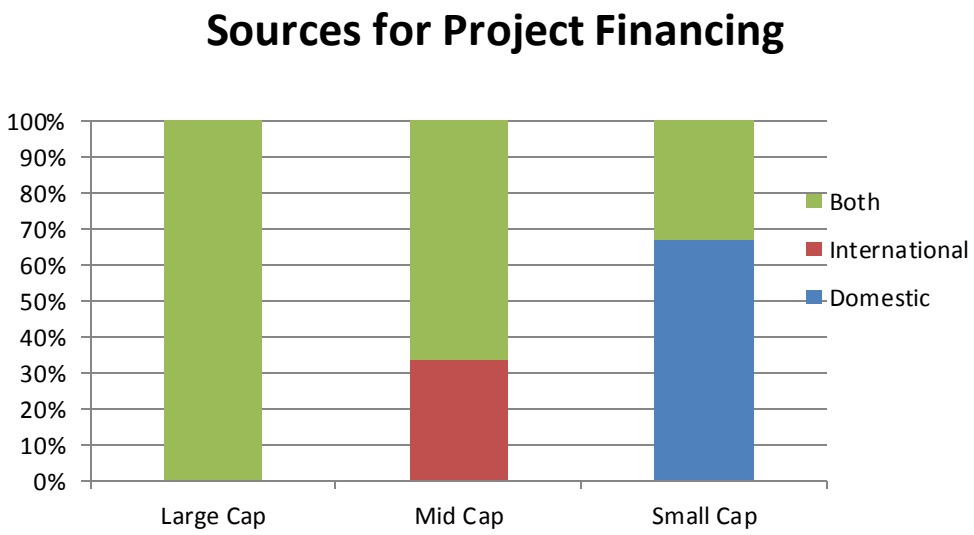


Total of 9 EPC players took part in the survey with 3 from each market capitalization category. Mostly Large Cap and Mid Cap segment EPC players were into core EPC business with no vertical integration in the business.



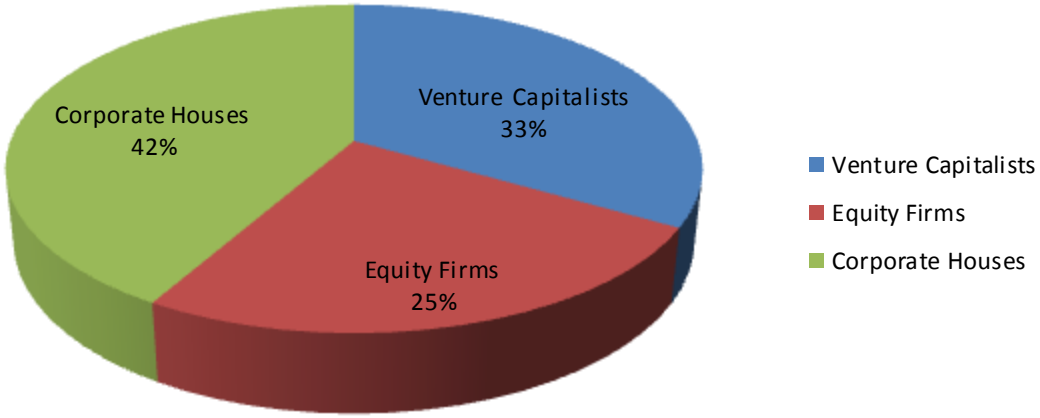
However, the players who are vertically integrated are mostly into consulting, BOS and project finance. Very few players are into Module/ Cell manufacturing business along with providing EPC services.

Project Finance



Large Cap & Mid Cap EPC players are approached by both international/ domestic sources for project financing. However, small cap EPC players mostly use domestic sources for project financing. This implies that domestic sources are more comfortable in financing small scale solar PV projects which is the main business segment of Small Cap EPC players.

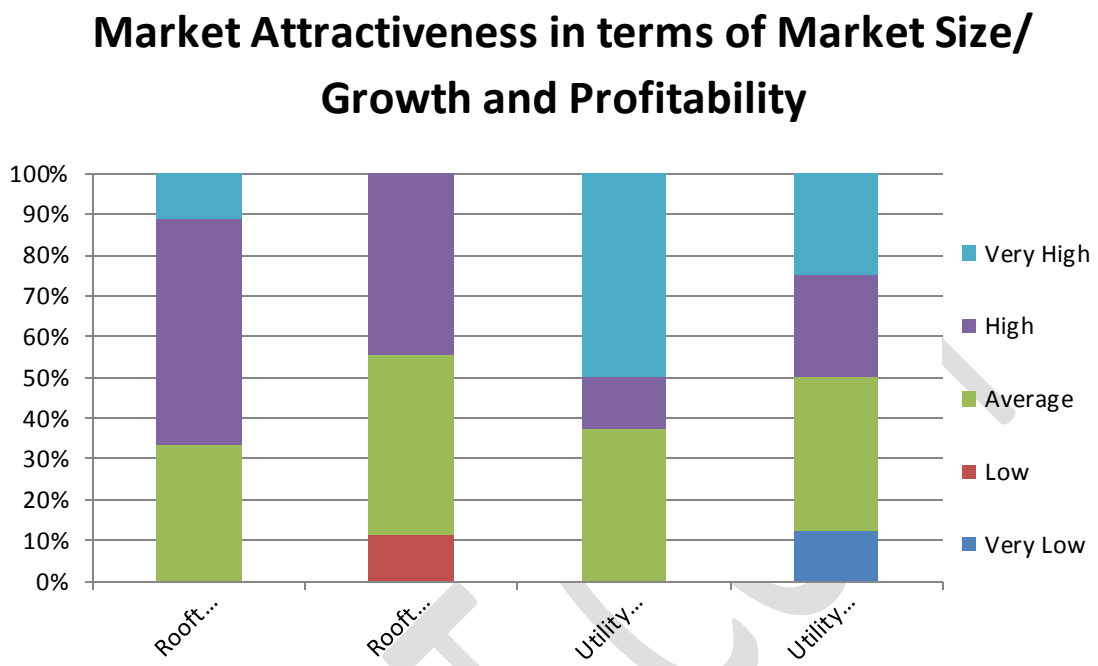
Equity Investors



Corporate Houses have been seen as investors in majority of the solar PV projects having 42% share in all the projects executed by participant EPC players. Second place has been captured by Venture Capitalists taking 33% share in the executed projects. Equity players share was 25% which is significant part of the whole equity investment sources.

Debt financing- 100% of the EPC players agree that their solar PV projects financed by Banks having Green/ Renewable Energy funds.

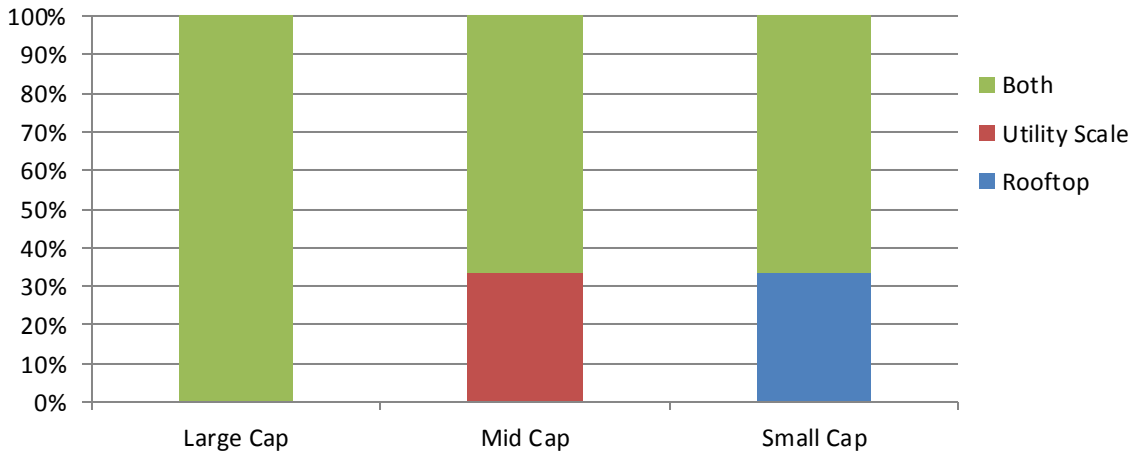
Threat of New Entrants



50% of the EPC players believe that Market size and growth for Utility scale projects is very high and 100% of them believe it is not below average. 90% of EPC players believe that profitability in execution of solar PV projects is not below average. Hence, overall we see that overall the market size/growth and profitability for utility scale solar PV projects for EPC players are highly favourable.

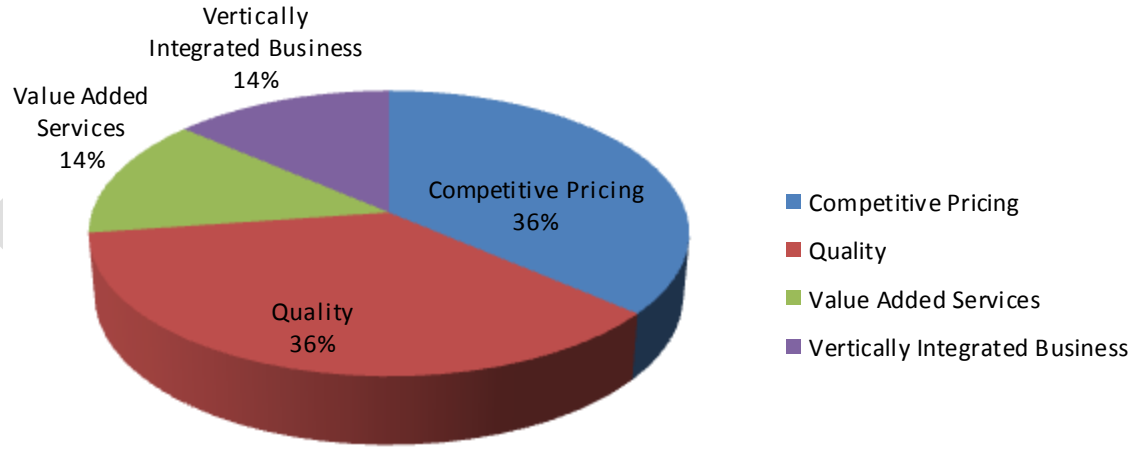
68% of the EPC players believe that Market size and growth for Rooftop projects is above average and 32% of them believe that it is average. Only 10% of them believe it is that profitability in execution of rooftop solar PV projects is low. Hence, overall we see that overall the market size/growth and profitability for rooftop solar PV projects for EPC players are quite favourable.

Execution of Projects by EPC firms under different Market Cap Categories



All Large Cap EPC participants target both Rooftop and Utility scale solar PV projects. Whereas 32% of Midcap EPC players execute only utility scale projects and 68% target both the segments. 32% small cap EPC players target only rooftop solar PV projects and 68% target both the segments.

Competitve Advantages in EPC Business

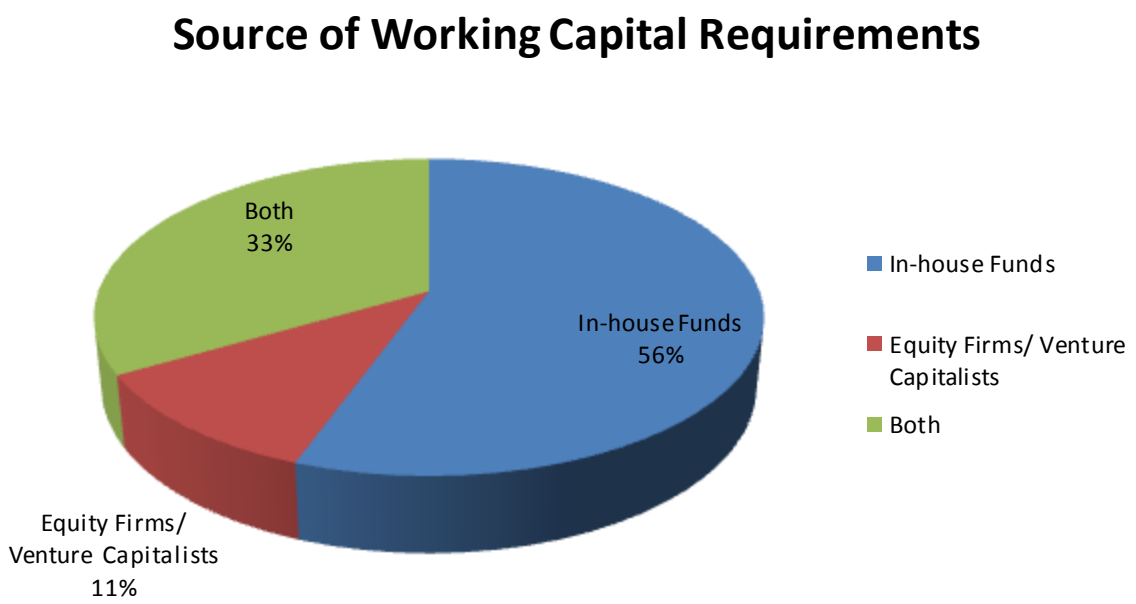


Competitive Advantage for EPC business among a no. of listed parameters, price competitiveness and quality have been regarded as the most sought after advantages of

their EPC services. While value added services and vertically integrated businesses comprise 14% each as the share of sought competitive advantage for the EPC services.

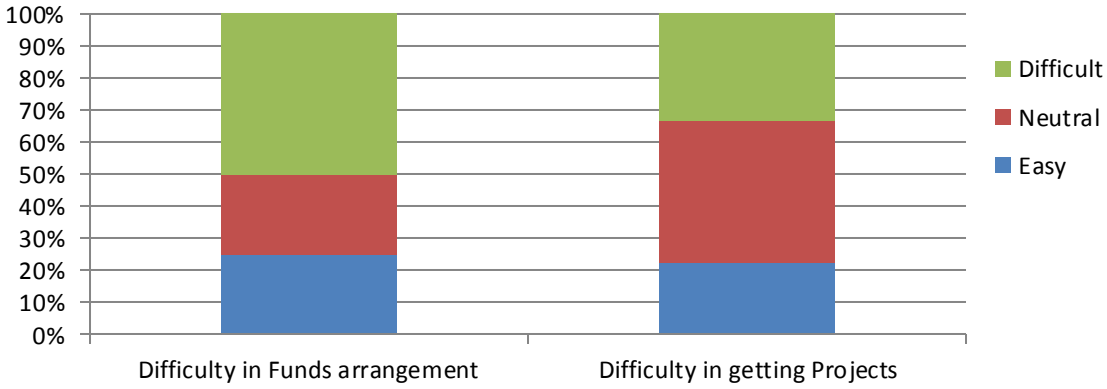
Getting Business from previous clients- 55.55% of the participant players get 10-25% of their projects from patrons and existing clients. 33.33% of the participant players get 25-50% of their projects from patrons and existing clients. Rest get all the projects from new clients.

Working Capital Requirements:

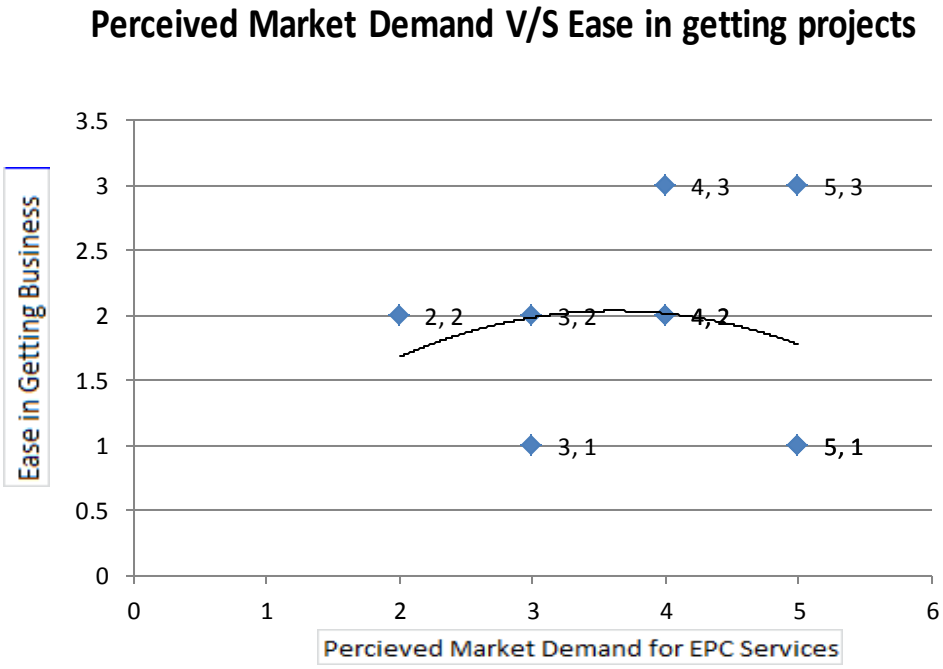


56% of the participant players' working capital requirements come from their In-house funds and 33% of players get funds from both Equity firms and Venture Capitalists. Only 11% get funds from Equity firms which is significant figure implying that venture capitalist find investment in solar PV EPC business quite lucrative.

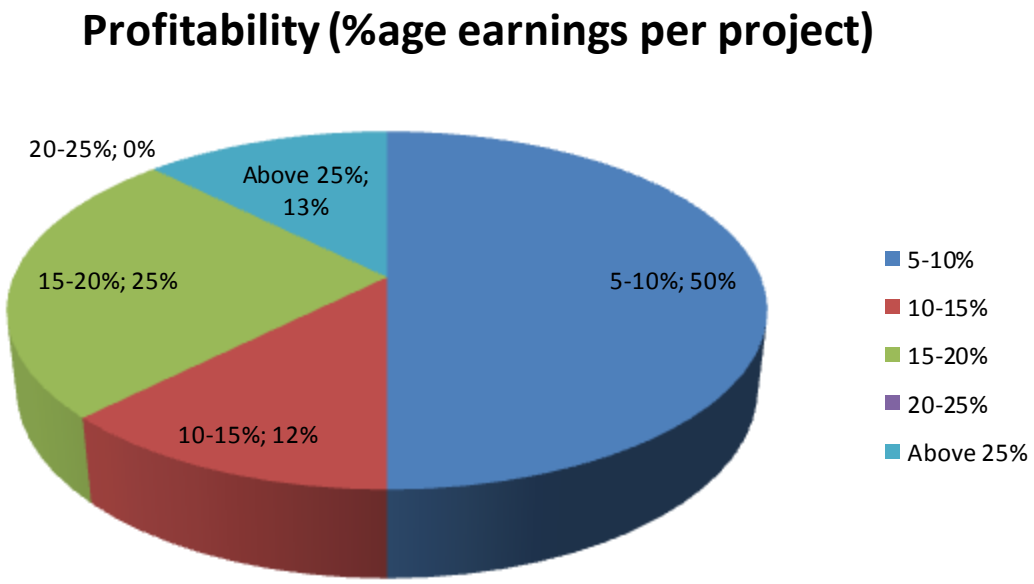
Difficulty in Funds arrangement/ Getting Projects



50% participants face difficulty in arranging funds to run their business. 24% find it easy to arrange funds and 36% said it is moderately difficult to arrange funds from the market. Overall, we can say that arranging funds with in the firm gets easy as compared to arranging the same from external sources. 35% of the participants find it difficult to get projects whereas 22% say it is easy to get projects and 43% say it is moderately difficult to get projects in the market.



When the perceived market demand is plotted against the ease in getting projects, the peak point of the trend line obtained shows that perceived market demand is above average and the ease of getting projects is average. This implies a favourable business conditions for an EPC players in the market.

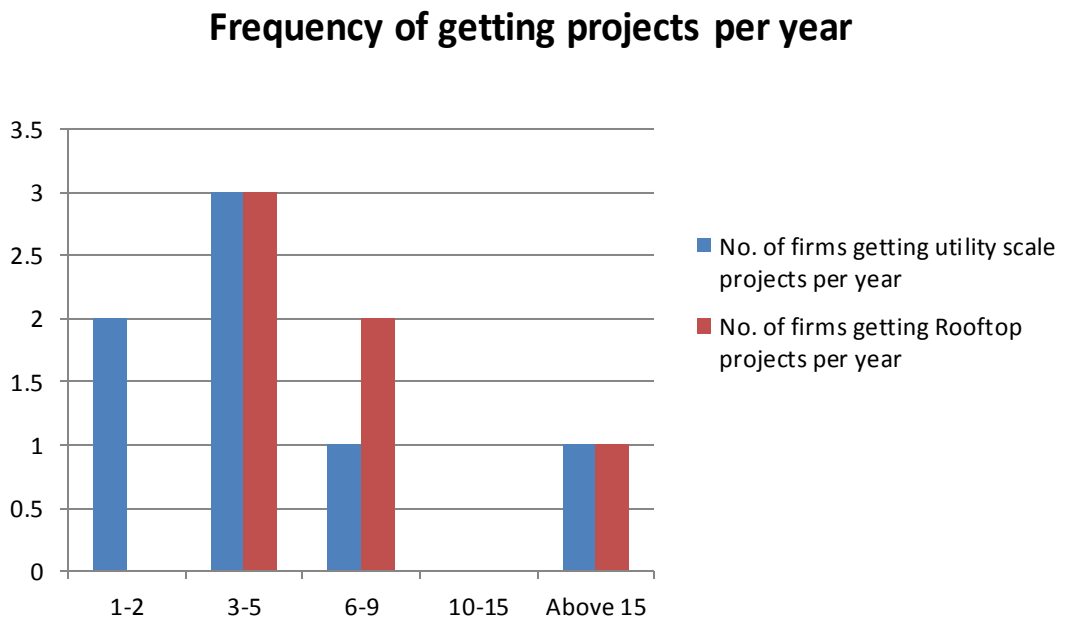


Majority of the players (50%) have profitability in the range of 5-10% for each project which shows viable business proposition for any new player planning to enter in this market.

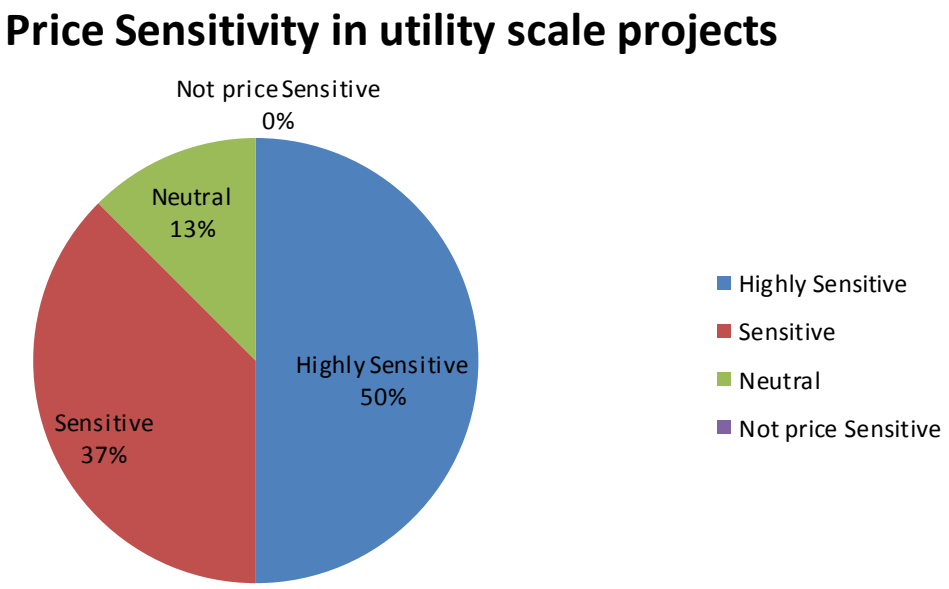
Threat of new entrants can be rated as MEDIUM under the conditions:

- Market size and profitability is highly favourable for EPC players in both the segments
- Price competitiveness and Quality are main competitive advantages for EPC players such that players with high economies of scale i.e. capacity to execute a high number of projects will be viable for business with high quality of services.
- Also, existing EPC players get significant business from existing clients/ patrons; it will be difficult for a new EPC player to get business if its brand is not established in the market.
- Most of the firms get funds for working capital requirements from in-house. And it is difficult to arrange funds from the market. So, new entrants with no significant in-house capital will find it difficult to arrange funds from the market.
- Perceived market demand is above average and the ease of getting projects is average; showing above average business opportunities in the market.

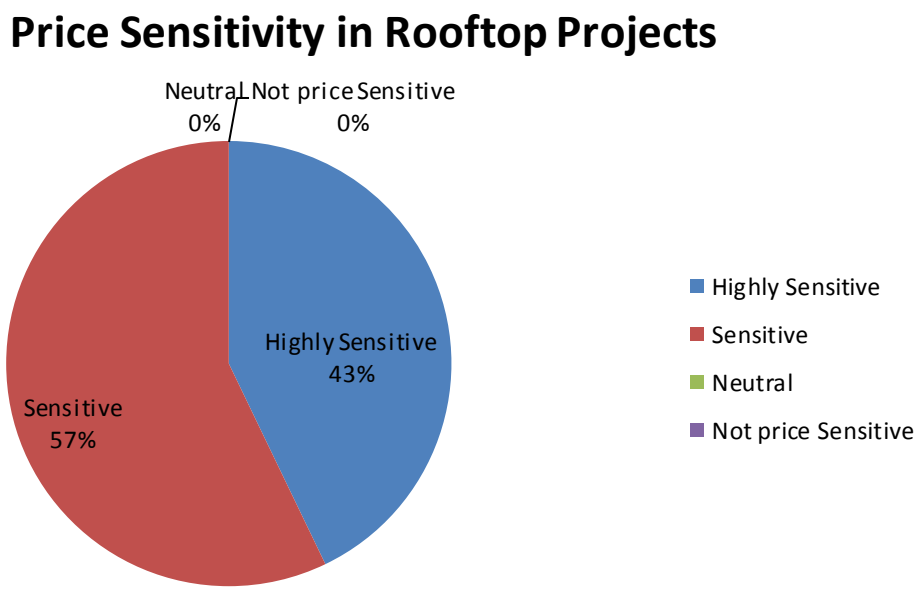
Threat of Buyers



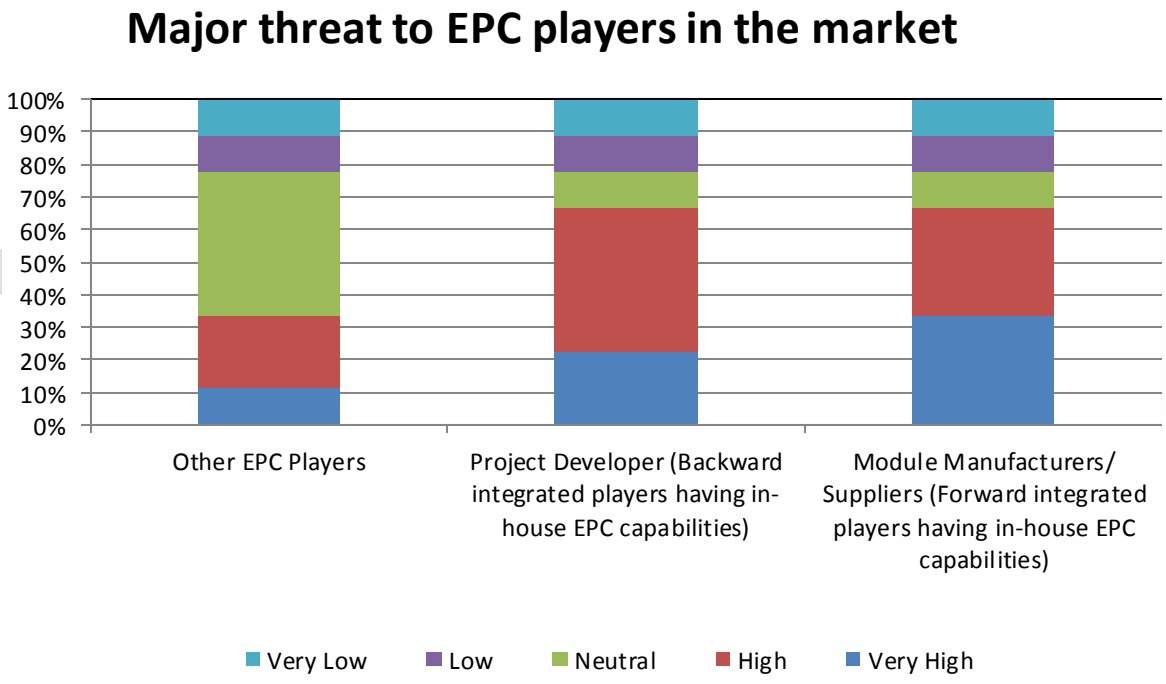
The frequency of getting projects is 3-5 for both the segments for majority of the participants. However, only 1 participant in each segment gets projects above 15 in one year. This shows that a handful firms have captured major market share.



50% of EPC participants say that there is high price sensitivity among project developers whereas 37% of EPC participants say that the buyers of their EPC services are sensitive regarding prices. Only 13% say that their clients are neutral regarding prices for EPC services.



In case of Rooftop solar PV projects, 43% of EPC participants say that their clients are highly sensitive regarding prices where as 57% say that their clients are sensitive regarding prices. This implies that overall there is a high sensitivity with respect to prices charged by EPC players for solar PV rooftop as well as utility scale projects.



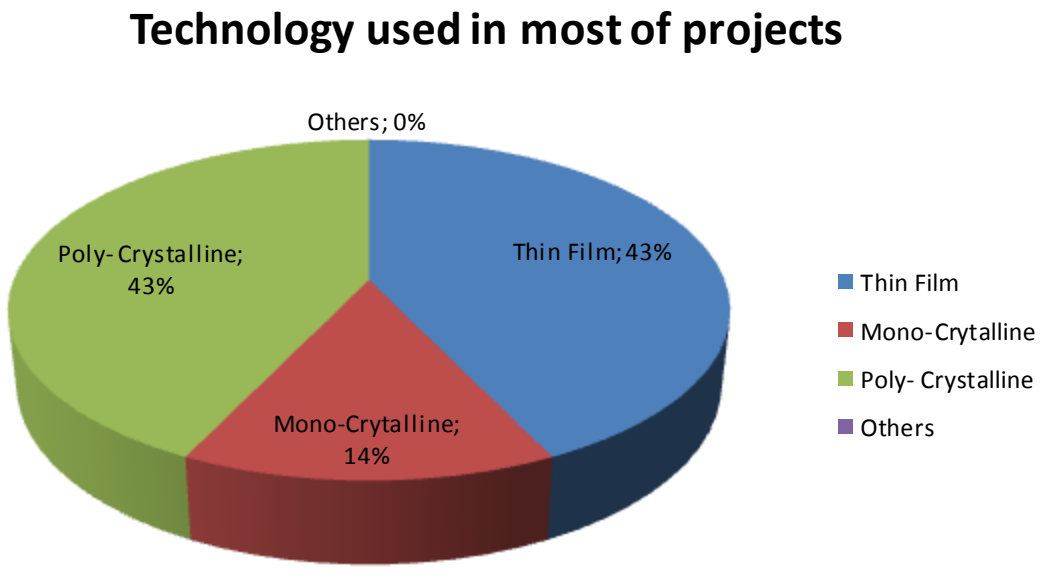
Overall, there is a business threat to EPC players from all the players in the market i.e. other EPC players, Project Developers and Module Manufacturers. However, the intensity of competition is higher from the side of Module Manufacturers (having forward integrated business line of EPC services). Secondly, project developers pose a greater business threat to an EPC player as compared to its counter-part EPC players in the market.

The observations made above can be listed below:

- Since a number of EPC players have captured majority of the market, the buyers are mostly inclined towards established EPC players in the market who have established their brands in the market.
- Price Sensitivity of clients is quite high for both the segments.
- All types of business players including the clients (project developers) pose a threat to business of EPC players

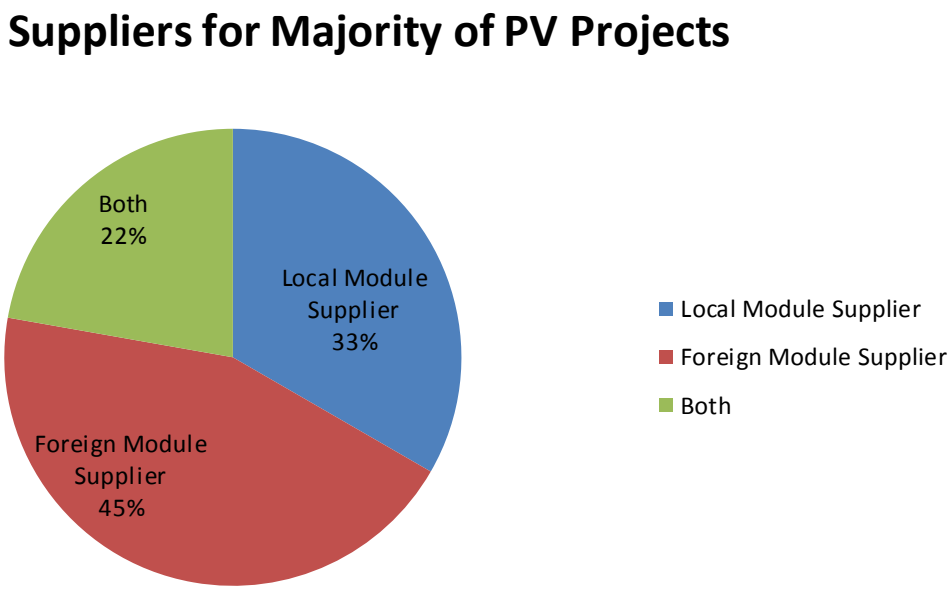
Taking all the factors into consideration, we can say that threat of buyers is HIGH to EPC players

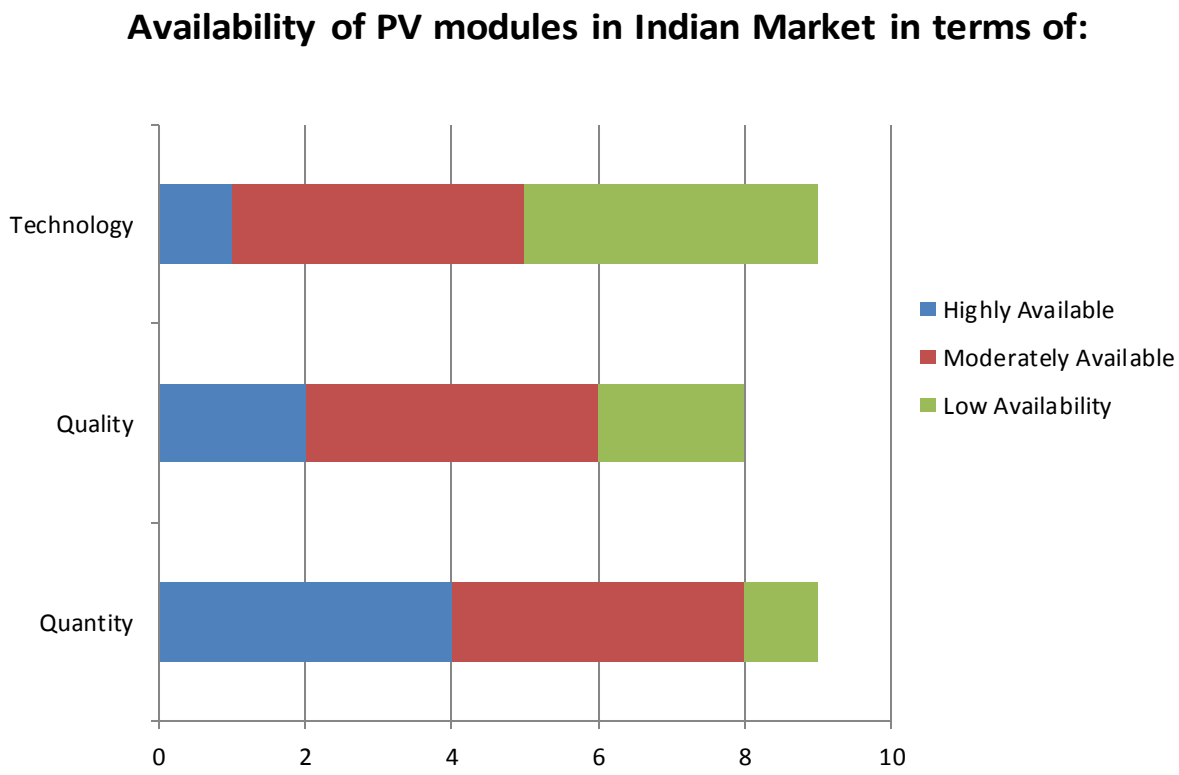
Threat of Suppliers



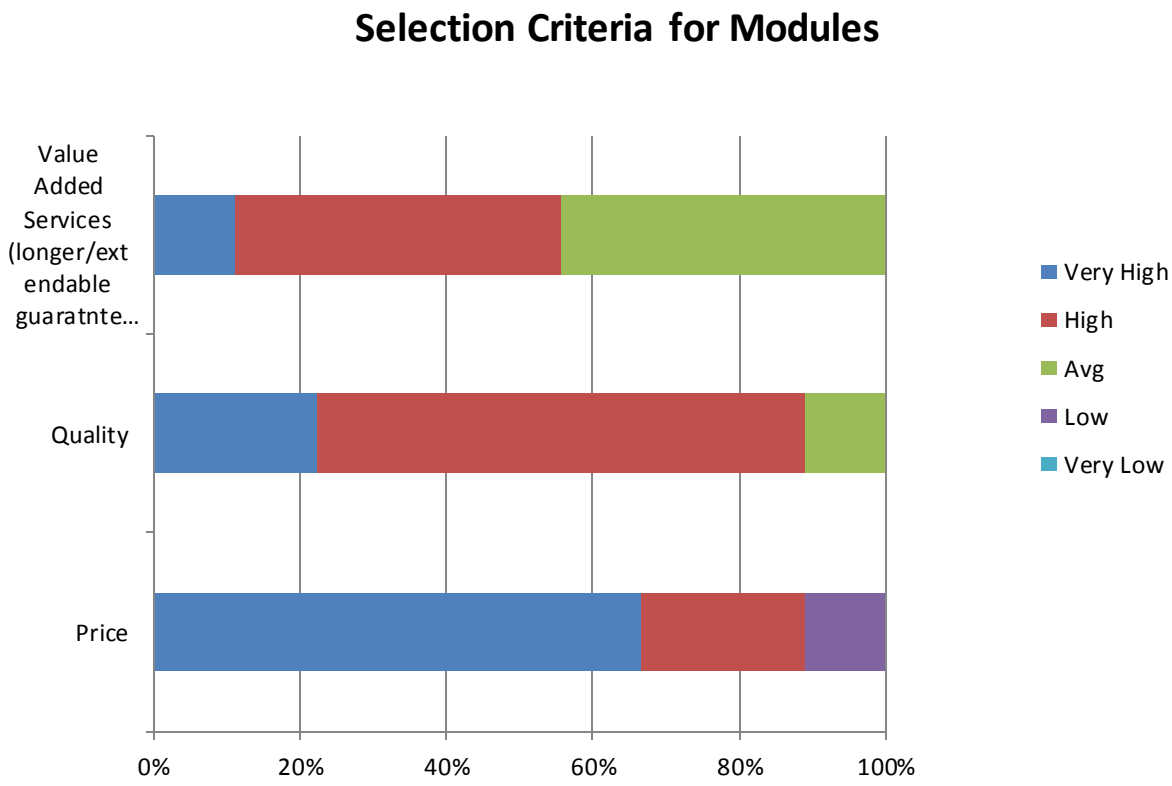
(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

The two technologies which are mainly used by the participant EPC players are Poly-Crystalline and Thin film. Since in India, indigenous production for thin film is almost negligible, most of the modules based on thin film technology are imported from abroad which is as per the observation made in the pie-chart given below which shows 47% of EPC players import modules from foreign suppliers. Poly-silicon requirement is mostly fulfilled by domestic manufacturers given the observation that 33% of modules are supplied from suppliers (of Poly Si and Mono-Si) within India.



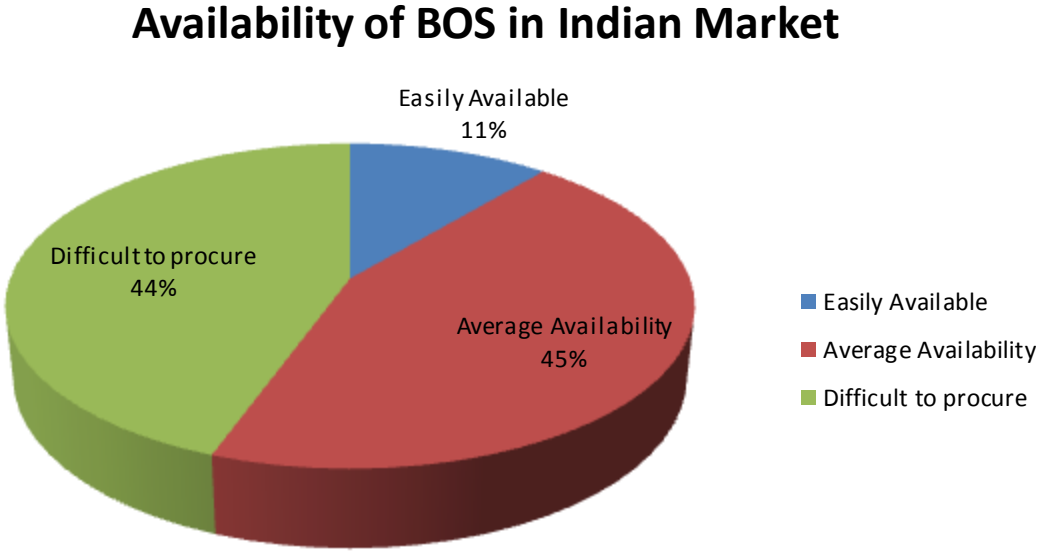


The availability of PV modules in Indian market in terms of supply is above average. However, PV modules with good quality are moderately available. And the PV modules with different technology options have quite low availability in domestic market.

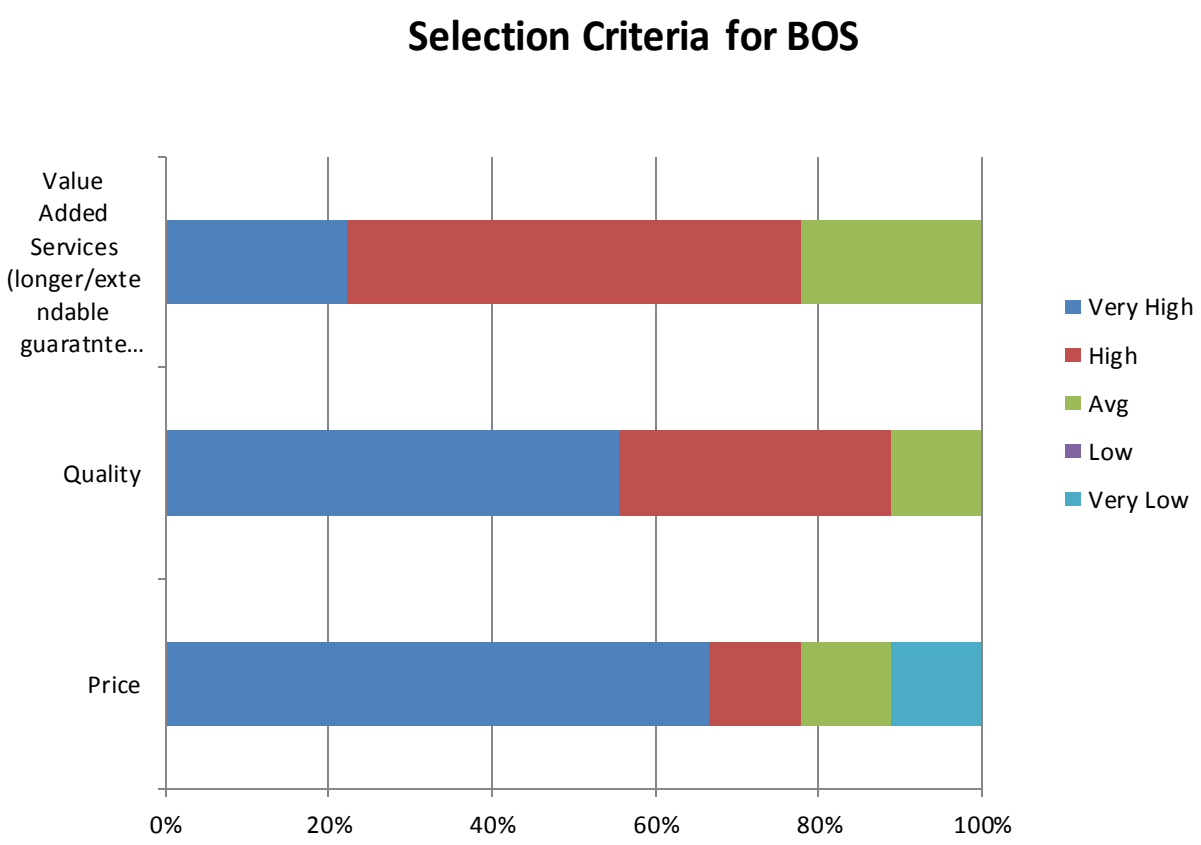


(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

The main selection criteria for majority of the module manufacturers is Price as 65% of the EPC participants said very high importance is given to price. Secondly, quality of PV modules stands at second position as important criteria for selection since more than 60% say they give a high consideration to quality. Value added services for modules ranks at the last position among the three criterions discussed.



Availability of BOS in Indian market is below average taking the observations made above into consideration. 44% participants find it difficult to procure BOS and 45% say there is an average availability of BOS in the market.



(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

The selection criteria for EPC players are same as that observed for PV modules. However, even though value added services ranks last, EPC players give high consideration to value added services for BOS as compared to PV modules.

Existing Channel of Module/BOS procurement: All the participants get the supply of BOS from Suppliers/ Vendors.

Scope of Negotiations with Module/ BOS Suppliers: All EPC players find BOS players concerned about both the price margin and order size for the supply of BOS. This implies that BOS stand a higher ground in terms of negotiation with EPC players.

Availability of experienced technical workforce: All the EPC players have expressed the problem of low availability of experienced workforce.

The observations made from the survey in the above mentioned area can be enlisted as below:

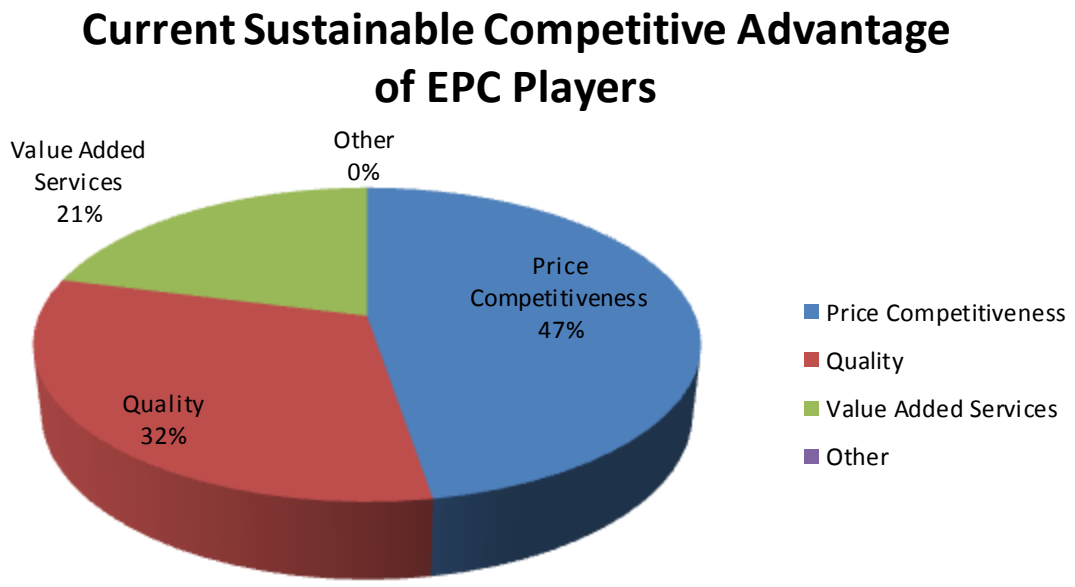
- EPC players use Poly C-Si and Thin film in most of their projects. Mostly, modules are imported from foreign suppliers in thin firm category and modules based on Poly C-Si technology are procured from local manufacturers. In Indian market, there is high availability of modules in term of quantity. There is moderate availability in terms of quality and low availability in terms of technology. Correspondingly, the selection criteria of EPC players is mainly based on price, secondly on quality and least on basis of value added services.

  Module Suppliers threat is LOW in the market.
- The picture is same for selection of BOS players as in case of module manufacturers i.e. there is high availability of BOS in term of quantity. There is moderate availability in terms of quality and low availability in terms of technology. However, there is significant percentage of participant EPC players say that BOS is difficult to procure in Indian market.

  BOS suppliers' threat is MEDIUM in Indian market.
- There is high threat from human resource in solar PV EPC industry based on the finding that 100% of participant players believe that the availability of experienced technical workforce is below average in the Indian market.

  Threat from human resource side is HIGH to EPC industry.

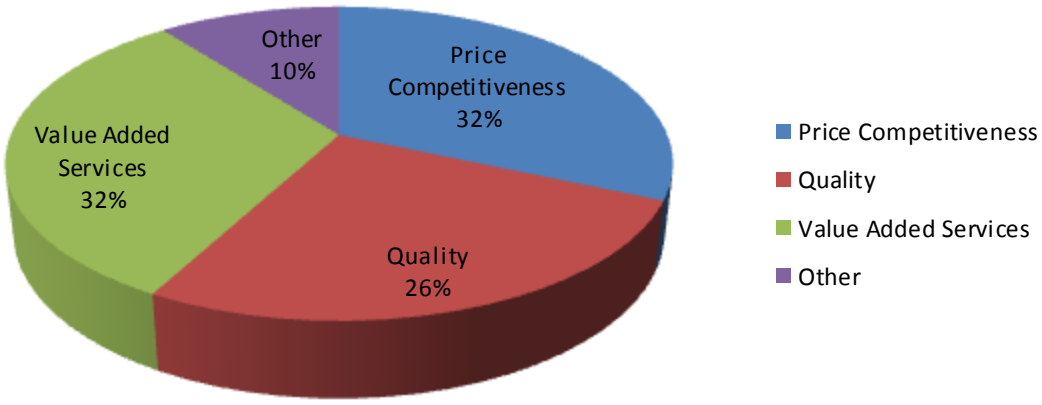
Intensity of Competitive Rivalry



(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

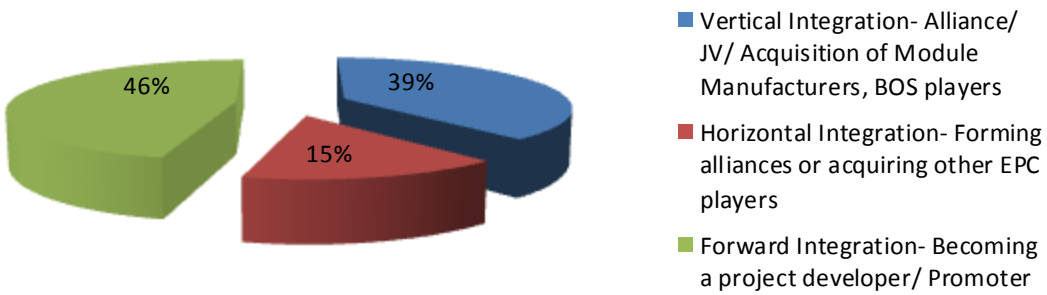
47% of the EPC players say that price competitiveness of their EPC services is the current sustainable advantage for their business. And 32% of the EPC players say that quality of their EPC services is the current sustainable advantage for their business. Only 21% EPC players say that value added services (insurance, O&M, warrantee, guarantee) is among sustainable competitive advantage of their business. However, when EPC players were asked about the sustainable competitive advantage they would like to incorporate in their business in future (see the pie-chart below) then price competitiveness as well as the value added services was proposed by 32% EPC players followed by quality of EPC services and 10% of players said that innovation in the EPC services on technology front which will increase the energy generation from designated capacity will make them winners in the market.

Anticipated Sustainable Competitive Advantages to be adopted by EPC Players



(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

Favourable Business Strategy



(Choices made by EPC players are mutually inclusive i.e. an EPC player might have selected 2 or more options at the same time)

Majority of EPC players (46%) say that Forward integration of their business i.e. becoming a project developer/ promoter will be a favourable business strategy for their business. 39% of EPC players favoured vertical integration of their business i.e. module/ BOS equipment manufacturing as a favourable business strategy. And 15% of the EPC players said that they will be looking to acquire other EPC players in the market.

Observations: Price competitiveness and quality are the main sources of competitive advantage for most of EPC players. For an existing player/ new entrant to compete in the market needs to understand that the business will be viable at higher economies of scale such the quality services are offered at highly competitive prices. This signifies very high competition in the market. Also, in future to sustain business EPC players will be required to incorporate value added services and other features in their services along with price competitiveness and quality services to be successful. Also, the EPC players are looking for moving in various directions of integration in order to attain competitive advantages as discussed above.

It can be implied that intensity of competition is HIGH in the EPC industry.

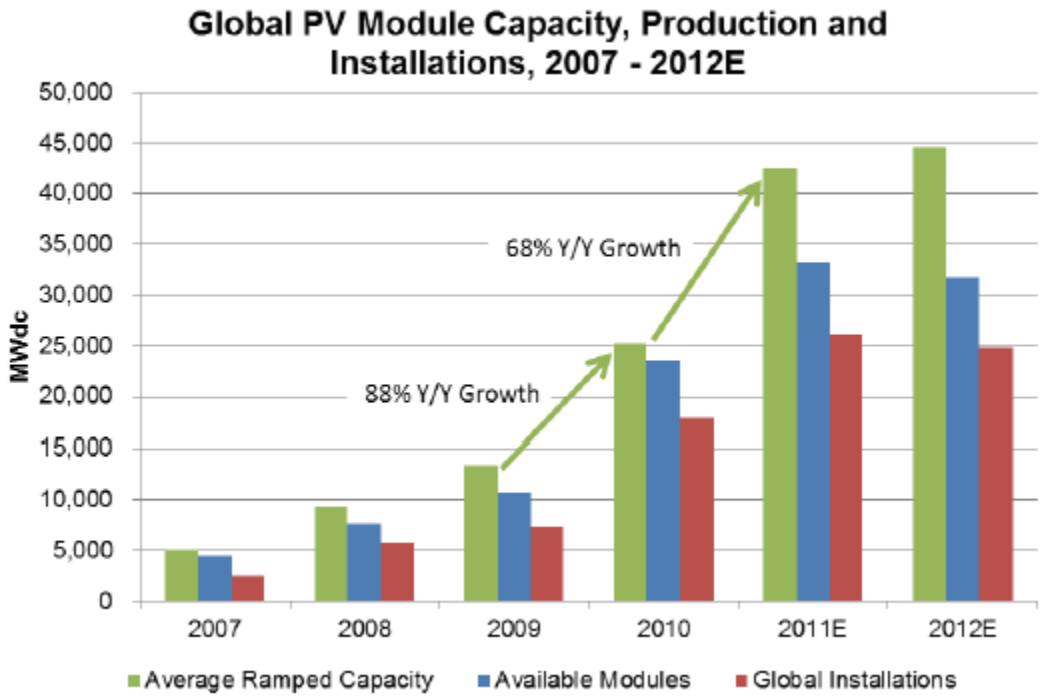
Threat of substitutes

Since, there is no substitute for EPC services for development of solar PV projects, there is no threat for substitutes. However, we can assess other renewable energy sources as a threat to solar PV services. Since the projected capacity of solar PV projects to be installed till 2018 because of no. of key drivers, we can infer that the threat of substitutes to be quite low.

PORTER'S FIVE FORCES ANALYSIS FOR SOLAR PV PROJETCS EPC INDUSTRY IN INDIA

SECTION 2

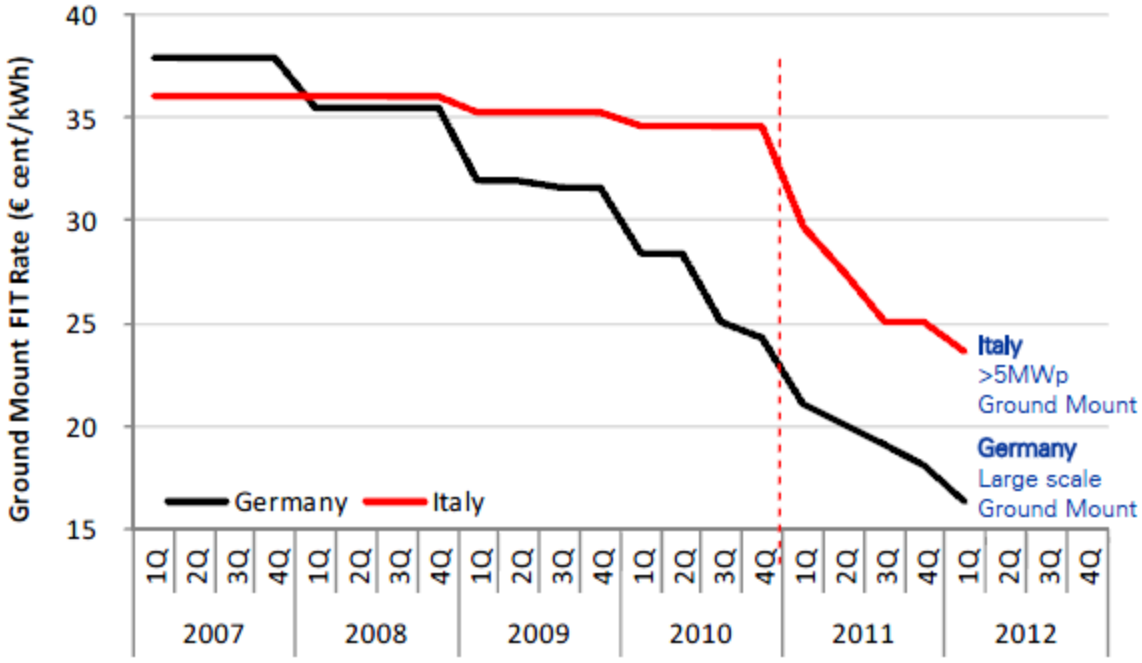
GLOBAL PV MANUFACTURING SCENARIO



Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

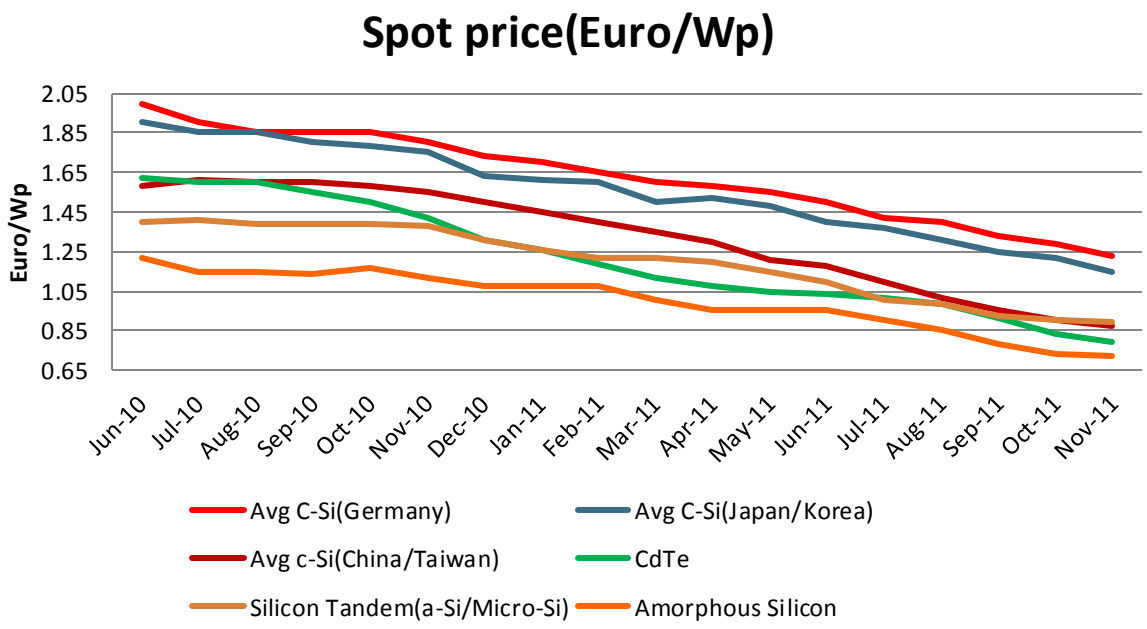
The Average Capacity for module production will reach to approximately 45 GW by 2012 end as per GTM research and there has been 55% Y/Y Growth since 2007. The gap between available module in the market and the average capacity has increased each year pointing towards a higher demand forecast in the future. Year 2012 will show the first drop in available modules in the market which perfectly corresponds to the first drop in global installation in 2012 due to unfavourable market conditions across the world. Cut in solar FIT lowers down ROI in solar PV projects making it a less attractive investment.

Feed-In Tariff (FIT) - Germany and Italy- Ground mount utility scale



Peter, Hari (2011): Solar PV Industry 2011 outlook (US: Deutsche Bank)

There is cut in solar FIT across key markets like Germany, Italy, France, UK, Czech Republic, Spain which will drive down the global installations this year given the fact that growth in US, India, China, Japan, Canada has not been substantial as of now to drive the solar PV market as compared to European countries' share in the PV installation market. The cut in FIT has been mainly due to two reasons: One is that most of European countries are in excess of energy supply from renewables or are about to reach that position. Another reason is that the funds on the clean energy promotion are drying up and it is getting difficult to plough in more money given the fact that Europe is facing economic crisis which is severe now. Global photovoltaic installations will be about 28.4 gigawatts this year (2012), while manufacturing capacity may reach 45 gigawatts, according to New Energy Finance.

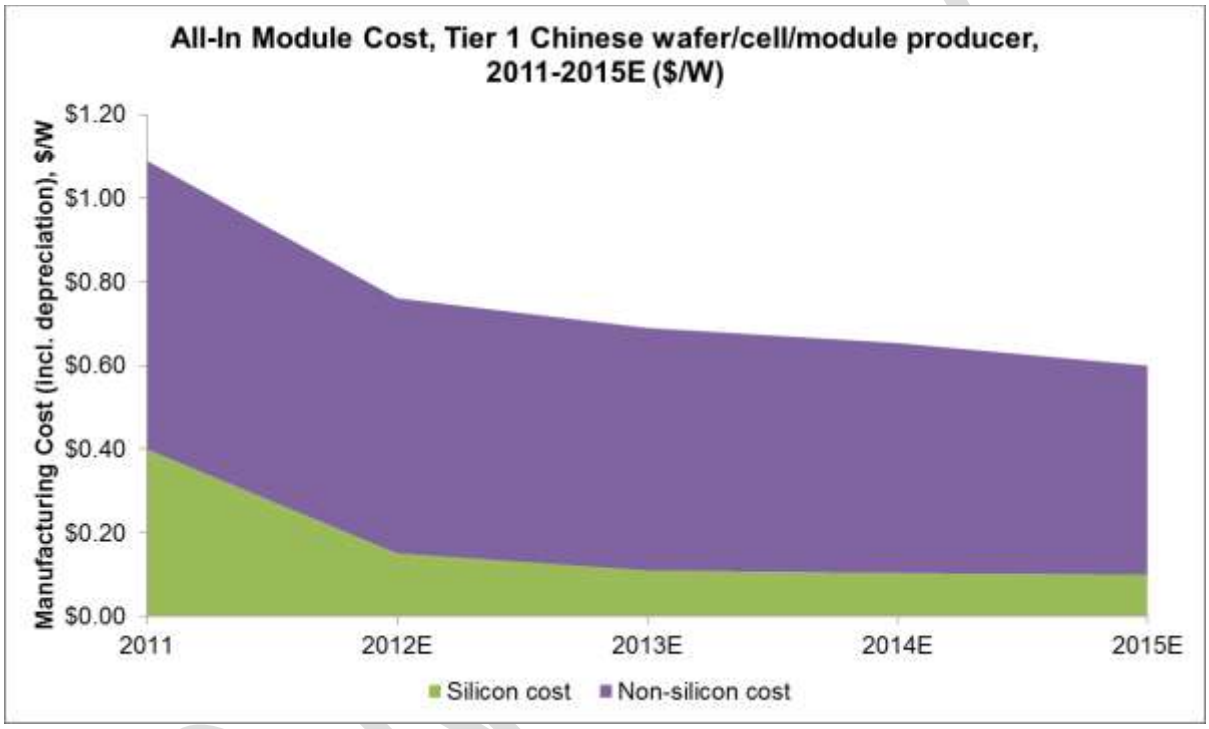


Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

The prices of PV modules have decreased sharply to almost half of the value a year before in Nov 2011 as can be seen from the above graph. There has been an on-going improvement in manufacturing process which is lowering the cost and subsequently price of the modules. Chinese counterparts in the market have come up with even highly competitive prices because of extensive support from the Chinese govt. in the form of loan at nominal rate of interest and subsidies to promote this industry in China.

Currently, market is struggling with over-supply of modules and decreasing demand in the limelight of reduced demand from key European markets such that many players who couldn't cope up with decreased prices vis-à-vis costs and reduced market demand have declared bankruptcy or in the verge of being bankrupt. Market leaders like Solyndra, Evergreen Solar, SpectraWatt, Calico Solar to name a few. LDK Solar is technically bankrupt without the financial support of Chinese govt. China has plans to reach 50,000 tons of annual production capacity of poly silicon and to reach 5 GW of annual capacity of solar cell and panel makers by 2015 despite of slow in global demand for PV. This will further worsen the condition of solar firms in US and UK who are currently struggling with margins amid reducing prices of PV modules due to lowering global demand as a result of economic slowdown.

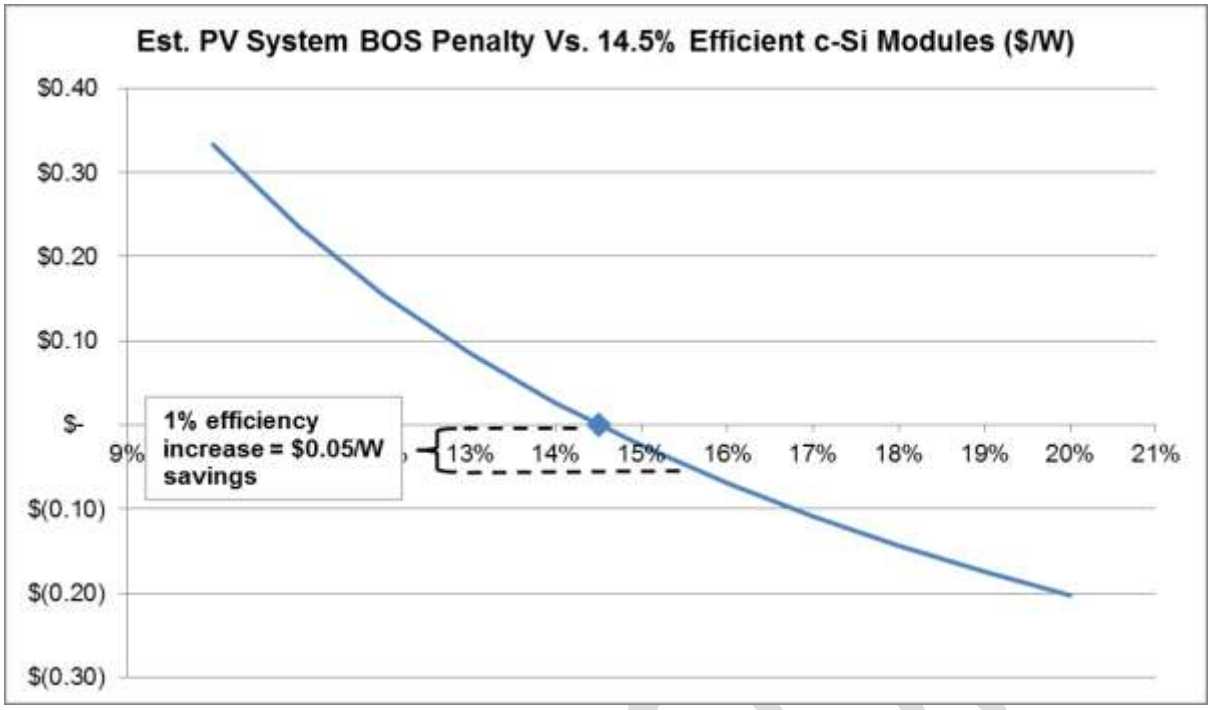
On the positive side, the costs for manufacturing solar cells and consequently modules is lowering down since the manufacturers have been inducing operational efficiencies which lowers down the wastage and usage of material. Also, the manufacturers have been successful enough to pressurise the material suppliers to sell poly silicon at reduced price per tonne in the spot market. However, the manufacturers having signed contract agreements for poly silicon supply will continue to bleed at previously agreed higher contract prices. The material costs may be bottoming out in the light of current scenario.



Madhavan (2011): "Will thin films win in India?"Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

Solutions:

To combat with current conditions, raising efficiency seems a plausible solution.



Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

As per Wang X, University of Delaware, (*Renew Sustain Energy Rev , 2011-The value of module efficiency in lowering the levelized cost of energy of photovoltaic systems*) 1% increase in efficiency of module results in 4% reduction in LCOE. There is 7% increase in Watts produced from 1% increase in efficiency, giving an advantage for the manufacturer in charging a premium of $0.05/W on the module price. Also, there is a reduction of $0.04/W in module manufacturing costs. Overall, for a 1GW-scale Module Manufacturer, increasing efficiency by 1% can add $50-70 Million of operating profit.

PV MANUFACTURING INDUSTRY IN INDIA

Mainly two players across the PV module value chain exist in India-

1. Cell Manufacturers
2. Module Manufacturers (primarily)

Indian PV manufacturing industry is mainly dependent on import of wafers and cells for the manufacturing of cells and modules respectively. Indian PV manufacturing sector lacks back-end players of the value chain like silicon material, ingots and wafer manufactures.

Year 2011

Component	Manufacturing Capacity (MW/year)
Cell Manufacturing (C-Si + Thin film Technology)	700
Module Manufacturing (C-Si + Thin film Technology)	1300

Amit Barve (2012): "Spotlight on Indian PV" Webinar organised PV Insider, Feb 2012

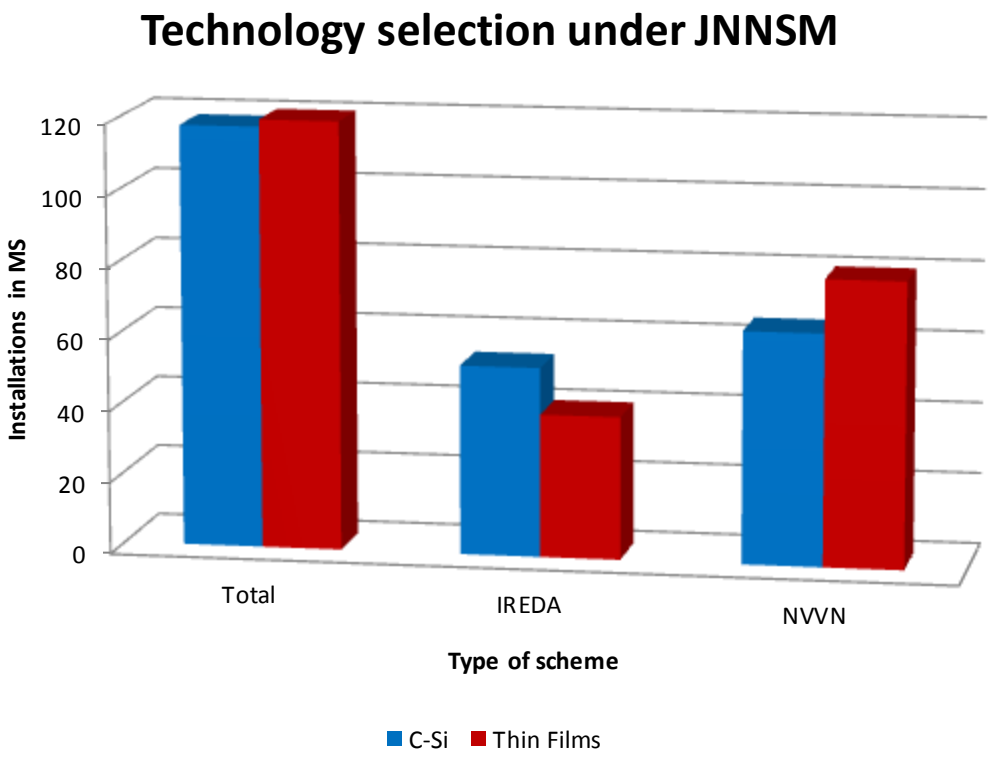
Export Market of Indian PV manufacturing Industry

Indian manufacturers have an advantage of lower labour costs giving them an edge in the international market in offering competitively priced yet high quality modules and cells. Majority of the solar PV production in India is exported to international market. As per ISA 2010 report, India has exported about 66% of its total PV production since 2002 which for China is around 90%. China poses a major threat to Indian manufacturers in the export market. Over last years, China has emerged as the major producer of solar PV cells and modules. The export market has been recently affected amid economic slowdown in Europe and subsequent cut in subsidies which has led to further lowering demand of PV modules and cells. As a result, manufacturers are even selling the modules at minimal margins. This has affected the Indian PV manufacturing market which was mainly thriving on export market.

A new ray of hope- High rising domestic requirement

Most the PV modules consumption is being used for off-grid solar applications but thanks to recently launched National Solar Mission and State Solar Policies which is being considered as push to domestic Solar PV manufacturing India. Under National Solar Mission, the target is to reach at 4 to 5 GW annual PV production capacity by 2022. Under Phase 1 of National Solar Mission, in order to give a boost to indigenous PV manufacturing industry, for the projects registered under batch 1 need to have locally manufactured modules based on C-Si technology and those under batch 2 are required to have locally manufactured cells in the

modules based on C-Si technology. However, there is no restriction for domestic content for thin film technology based modules used under JNNSM.



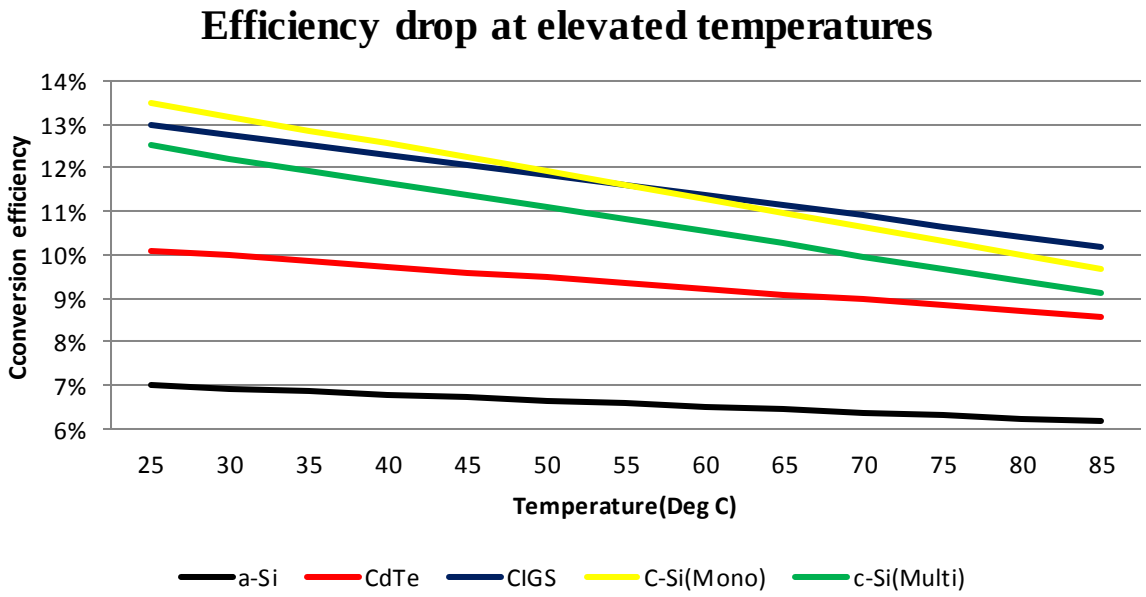
Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

We can see more that in more than 50% of the projects under JNNSM Phase 1, thin film is being used. The domestic consumption of domestic PV modules (C-Si) from projects under JNNSM Phase 1 can be estimated to be around 250 MW (at 50%) which is only around 17% of the current PV module (C-Si) manufacturing capacity. Also, the domestic consumption of domestic PV cells (C-Si) from projects under JNNSM Phase 1 Batch 2 can be estimated to be around 175 MW (at 50%) which is only around 29% of the current PV cell (C-Si) manufacturing capacity. Also, under Gujarat State Policy, in 60-70% of the projects thin films are being used. This situation points to the solar PV production capacity of India under-utilized and this certainly calls for strategy on the part of govt. and the stakeholders in PV manufacturing value chain. Thin film technology based module production is negligible in India and the projects in India mainly depend on imports for their requirement. Before coming onto the possible solutions for overall growth of PV manufacturing industry in India, we need to know the reasons which make project developers prefer think film technology over C-Si technology.

Drivers for thin film technology in India

1. Technology:

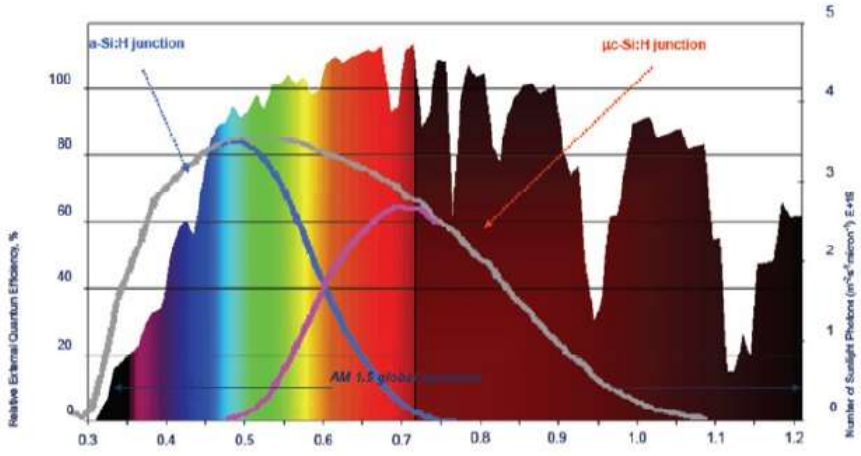
a) Temperature Co-efficient-



Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

Loses of C-Si in efficiencies is faster as compared to the same in thin film.

b) Better performance under diffuse light conditions-



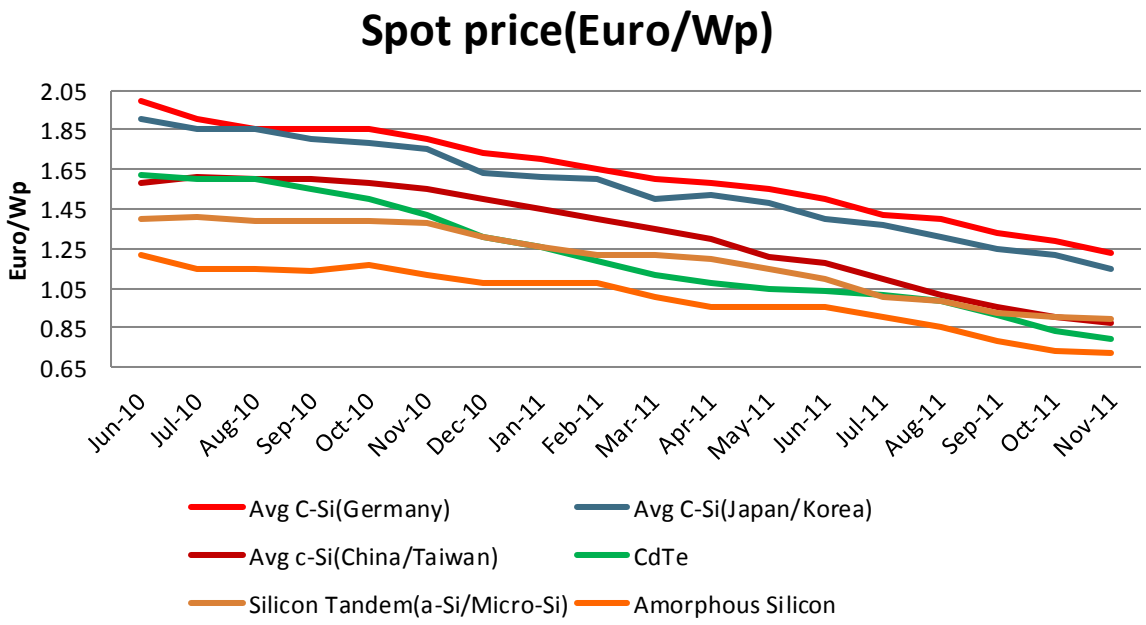
Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

Thin film modules absorb more light and show better performance under diffused light conditions due to shading effect.

As a result of above mentioned 2 technological advantages, TF generates more electricity in the environmental conditions in India where in summers the temperature rises to higher degrees.

2. Cost:

a) Module costs for TF is lower than C-Si module costs



Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011

b) Land and BOS costs for TF are higher. BOS required are more because of more area to be covered resulting in usage of more strings, fuses, cables and more workforce and time required. More Land is required to generate same power for TF as compared to C-Si. However, land costs in India are negligible which overcomes this drawback.

c) Operations and Maintenance Costs will be higher because of more exposed area resulting in more cleaning and breakdowns happening. However, in India labor charges are relatively cheap.

Overall, higher BOS and O&M costs are offset by lower module prices such that levelized costs of energy generated from TF is lower than that generated from C-Si.

3. Financing: In India project finance is still difficult to secure and banks are more comfortable with recourse or balance sheet financing around 12-16%. However, TF manufacturers abroad have tie-ups with EXIM banks for their native country which finance the projects at lower costs such that after hedging and insurance, the cost of capital hedges at 8-9%.

Overall, the picture for TF looks quite favourable for TF which seems to dominate PV market and TF market is mostly captured by foreign players. Any new investments in TF in domestic Indian market seem unfavourable given the fact that TF manufacturing business requires higher investments comparatively. Also, there is global excess production capacity.

Now, the focus in domestic market is highly on C-Si manufacturing over next 4-5 years. As Thin film is mostly used in Utility scale solar power plants due to number of reasons as discussed above, rooftop solar PV market will be equal or even greater significance to manufacturers.

PROPOSED MARKETING MIX

Target Markets/ Distribution Channels- Indian C-Si manufacturers need to focus on rooftop segment equally as utility segment since because of limited space requirements C-Si will be only prudent choice of customers. Manufacturers need to expand their distribution channels across the segments depending on their geographic reach.

Price: Indian c-Si manufacturers in India will be forced to reduce costs faster to remain competitive with foreign counterparts in C-Si as well as TF business. This can be done by achieving operational efficiencies and integrating business backward/forward.

Promotion: Indian module manufacturers need to focus more on marketing their products and should establish their products as a Brand in the market. We have seen that foreign manufacturers have been aggressively focussed on marketing their product in Indian market. First Solar can be taken up as sample case which has been successful in selling its TF technology based product in Indian market by using its established brand image.

Product: The module manufacturers must focus on benchmarking their products since one of the primary factors for any module to be successful in the market is Performance. Manufacturers need to make much required investments in testing facilities and certifications in order to attach tangible and intangible performance tags with their product.

CONCLUSION & RECOMMENDATIONS

BUSINESS OPPORTUNITIES IN GRID CONNECTED SOLAR PV SECTOR IN INDIA

There is a significant potential of business opportunities in Grid-connected solar PV sector in India due to no. of key drivers such as

- Energy security issue
- Abundance of solar energy
- Rising Prices of electricity
- Plummeting cost of solar Power
- Environmental/ Ecological Security

Govt. has identified this potential in solar sector and has initiated National Solar Mission and various other solar policies along with necessary regulatory framework i.e. RPO. Govt. has been in pursuit of developing the necessary eco-system by providing financial support (Subsidies, FIT), formulating regulations, setting targets, propelling R&D, developing technical workforce and lots more. Demand forecast* for Grid-connected and off-grid solar PV capacity (under above mentioned National and State Policies) to be installed till 2018 is 7.780 GW out of which 1.860 GW has been allocated , 848.5 MW capacity is under implementation and 176 MW capacity has been commissioned as on 31-12-2011. However, there are certain threats to this sector. PPA signed with loss making Distribution companies might get defaulted. Also, RPO enforcement is seen a major barrier to the success of solar policies and REC mechanism. Although the challenges are great in the success of this sector but we should not forget that drivers of this sector stand taller and will tend to force the conditions in favour with time.

**** refer (PART A: Demand Forecast for Solar PV till 2018)***

RECOMMENDATION TO EPC PLAYERS

(In reference to findings from Porter's 5 forces analysis)

Threat of new entrants: Given the fact that at this pint of time, market attractiveness for solar PV EPC industry is significant in terms of Market size/ Growth and profitability in both the segments which shows favourable business conditions. Players will be focussing keeping the

entry barriers high through competitive pricing and high quality. Also, the current accounts of patrons/ clients need to be maintained since they represent a significant share of their projects executed. The new players who are interested in making entry to this industry need to overcome the existing barriers of price competitiveness and quality. Also, new entrants with in-house working capital will make a quick entry in the market. However, they need to focus on establishing their brand in the market in order to grab the market share of existing players.

Threat of Buyers: Buyers which are Project Developers are mainly focussed towards the established brand image of the EPC players. They are highly sensitive towards price and pose of threat of backward integration such that they themselves develop in-house EPC capabilities. EPC players need to focus on establishing their brand image and highly reasonable on pricing of their EPC services. Also, there is EPC players can look out for possible partners in project development business to form a suitable type of alliance/ partnership to overcome this threat.

Threat of Suppliers: As there is a high availability of modules in term of quantity and moderate availability in terms of quality and low availability in terms of technology, EPC players need to establish required channels for procurement of modules/ BOS as per quantity, quality and technology requirements. EPC firms needs to highly focus on talent acquisition and human resource development given the fact that there is a stringent availability of experienced technical workforce in this area.

Threat of Substitutes: Since the threat of substitutes is negligible as discussed above since EPC services can't be replaced. However, when considering other renewable energy projects with solar projects, execution of solar projects seems a highly viable option in regards to various techno-commercial and environmental parameters as discussed above. So, Sun will shine brightly over solar sector in India.

Intensity of Competitive Rivalry: An existing player/ new entrant to compete in the market needs to understand that the business will be viable at higher economies of scale such the quality services are offered at highly competitive prices. Also, in future to sustain business EPC players will be required to incorporate value added services and other features in their services along with price competitiveness and quality services to be successful. Also, the EPC players need to look for moving in various directions of integration in order to attain competitive advantages as discussed above.

As we have observed that in India over next 4-5 years, the focus of indigenous PV manufacturing will be on C-Si Technology. Both Utility scale and Rooftop segment are equally important to manufacturers. To promote indigenous solar PV manufacturing in India, an eco-system needs to be developed.

RECOMMENDATION TO SOLAR PV MANUFACTURING INDUSTRY

Backward Integrated Business: Along with the manufacturing of panels and modules, the manufacturing of ingots and cells needs to be boosted in India. Since, locally made ingots and cells will help the module manufacturers to reduce the prices to greater extent and will help them compete with foreign counterparts since the price difference mainly comes from the import duty paid by local manufacturers on ingots and cell imports.

Banks: The role of Private and Public sector banks will be inevitable in the growth of this sector. However, we have not seen much required participation from the Indian banks. Since this industry is quite new and banks have limited information on this, Indian govt. should come forward and along with players in solar industry, it should inform and educate the banks about this sector so that they equally participate in funding. Other suggestion can be Priority sector lending scheme by RBI such that solar sector can be included in this scheme such that its mandatory for banks to invest certain percentage of adjusted bank credit in funding in this sector.

Govt. Support- Support is definitely required from the govt. in both utility scale and rooftop segments in the form of further more subsidies and/or custom duties in foreign duties on foreign imported modules or abolition of custom duties on raw material (silicon material) imported by local manufacturers. However, there needs to be a difference between support and protectionism since protectionism can affect this evolving industry in India as we know that majority of the modules are imported by project developers and much required import duties can affect the business of project developers.

Research & Development: Private players along with govt. should focus on R&D to attain increased quality since technology advancement will help establish the reputation of overall Indian PV manufacturing industry across the globe. Also, along with this technical and managerial workforce needs to be developed who would take forward this evolving sector to heights.

ANNEXURE- I

BIBLIOGRAPHY

Reference

1. Narsimha, Girish, Sudhir(2009): "An overview of Indian Energy Trends: Low Carbon Growth and Development Challenges" (Prayas Group Publication, Sep 2009)
2. MNRE (2006): "Projections for Electricity Requirement, IEPR Renewable Energy in India" (MNRE publication, 2006)
3. KPMG(2011): "The Rising Sun"
4. GTM Research (2011)
5. MNRE (2010): "Guidelines for SELECTION OF NEW GRID CONNECTED SOLAR PV POWER PROJECTS BATCH-I & BATCH-II"
6. CERC (2010, 2011): Annual Reports
7. High Level Panel (2010): Reports of High Level Panel on Financial Position of Distribution Utilities
8. GENI (2009): Overview of Renewable Energy Potential of India by GENI
9. Lakshman Rao R Sutrave (2010): "Future of Indian Solar PV Industry" (Frost and Sullivan publication)
10. SERC (2010, 2011): Reports/ Notifications
11. Shashank (2011): "Grid-Connected Solar power projects in India (commissioned by Nov 2011)"
12. Indian Semiconductor Association (2010): "Solar PV Industry 2010: Contemporary scenario and emerging trends"
13. National Electricity Policy (2006)
14. Dr. Tobias Engelmeier, Mohit Anand, Shishir Basant, Shivansh Tyagi (2011): "The India Solar Handbook (Bridge to India publication, 2011)
15. GTM Research and BRIDGE TO INDIA (2011): Indian Solar Market: Strategy, Players & Opportunities
16. Harjeet S. Kalsi (2004): "Power Distribution Reforms: Opportunities & Marketing Strategy for BHEL towards turnkey solutions for distribution of power"

1. Ashish Kulkarni, Ashish Khanna, Gevorg Sargsyan, Natalia Kulichenko, Chandrasekeren Subramaniam, Anjali Garg and Ruchi Soni, World Bank (2010): "REPORT ON BARRIERS FOR SOLAR POWER DEVELOPMENT IN INDIA" (World Bank publication)

Web links

1. Sagar Gubbi(2010): Cost of generating power in India, Sagar Gubbi, 04 Oct 2010 viewed on Jan 2012 (http://thealternative.in/blogs/green-mile/blog_entries/cost-of-generating-power-in-india)
2. Matt Badiali (2011): If you like the Big trend in gold, you need to see the one in coal by, DailyWealth, July 2011 viewed on Jan 2012 (http://www.dailywealth.com/1780/If-You-Like-the-Big-Trend-in-Gold-You-Need-to-See-This-One-Too)
3. Ministry of Power
4. MNRE
5. NVVN
6. CEA
7. EAI: Energy Alternatives India
8. Indian Planning Commission

Conference/ Webinars

1. TC Arora (2009): "Unleashing the Potential of Solar Energy in India" Presented to Govt. of West Bengal,July 2009
2. Madhavan (2011): "Will thin films win in India?" Presented at the Intersolar India 2011 Conference, Mumbai, India, 2011
3. Amit Barve (2012): "Spotlight on Indian PV" Webinar organised PV Insider, Feb 2012
4. Don Purka (2009): "ADB Support for India's National Solar Mission" presented at Solar Energy Conclave, 2009

ANNEXURE- II

Questionnaire

EPC Players

Survey for EPC players for academic project on "Business opportunities in Grid Connected Solar PV market in India".

Greetings!!!

I would like to introduce myself as Varun Mittal, a management student at DMS, IIT Roorkee.

I am writing my final semester project on "Business opportunities in Grid Connected Solar PV market in India" and I would really appreciate your help in the same. I have drafted survey for EPC players. It will be tremendous learning experience from this exercise since a no. of stakeholders across the value chain will be taking part in this and I will be sharing with you the results gathered over a period of time in the form of a report.

(Min Time 15 Min)
(Max time 22.5 Min)

Guidelines:

1. Project Developers needn't undertake this survey. Only EPC players are requested to answer the questionnaire.
2. Professionals who are involved in Strategy, Business Development, Marketing & Sales, Project Management, Business Management in the organization should undertake this survey. You may pass on the link to your colleague whom you find more appropriate to answer the survey.
3. Please use the organizational approach rather than individualistic approach while answering so that the objective of industry analysis doesn't get compromised.
4. Company information will not be disclosed in the report rather overall industry analysis will be shown.

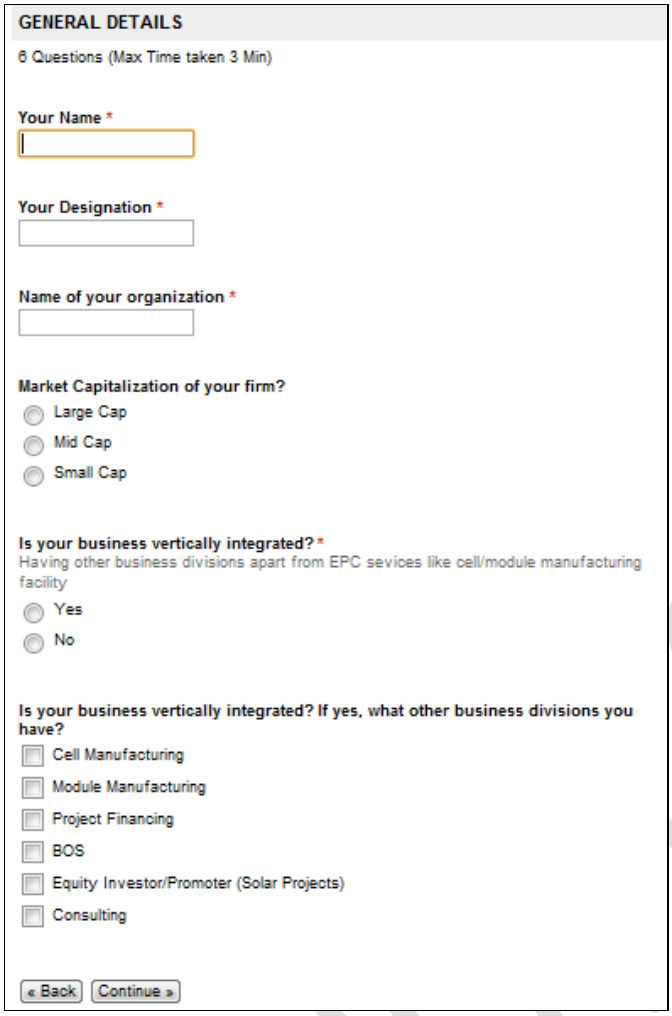
PART A

Page 2. General Details- 6 Questions (Max Time taken 3 Min)
Page 3. Project Finance- 7 questions (Time taken at max 4 min)

PART B

MICRO LEVEL ANALYSIS: Porter's 5 forces model is used for making Micro level analysis of Solar PV EPC market
Section 1: Threat of new entrants- 8 Questions (Time taken at max 4 minutes)
Section 2: BBargaining power of your business prospects- 8 Questions (Time taken at max 4 minutes)
Section 3: Bargaining power of suppliers- 10 Questions (Time taken at max 5 minutes)
Section 4:Intensity of competitive rivalry- 5 Questions (Time taken at max 2.5 minutes)

Continue »



GENERAL DETAILS

6 Questions (Max Time taken 3 Min)

Your Name *

Your Designation *

Name of your organization *

Market Capitalization of your firm?

- Large Cap
- Mid Cap
- Small Cap

Is your business vertically integrated? *

Having other business divisions apart from EPC sevices like cell/module manufacturing facility

- Yes
- No

Is your business vertically integrated? If yes, what other business divisions you have?

- Cell Manufacturing
- Module Manufacturing
- Project Financing
- BOS
- Equity Investor/Promoter (Solar Projects)
- Consulting

« Back | Continue »

PROJECT FINANCING

Specific issues/suggestions related to project financing

7 questions (Time taken at max 4 min)

Are you involved in project financing along with EPC?

- ◯ Yes
- ◯ No

Which are the type of institutions from which debt is raised for projects?

- ☐ Banks (having green/renewable energy funds)
- ☐ Insurance firms (having funds)
- ☐ Trust Funds

The institutions from which debt is raised for your projects are:

- ◯ domestic
- ◯ International
- ◯ Both

Which are the type of institutions from which equity is raised for projects?

- ☐ Venture Capitalists
- ☐ Equity Firms
- ☐ Corporate houses

The institutions from which equity is raised for your projects are:

- ◯ domestic
- ◯ International
- ◯ Both

Issues pertaining to Financial Closure and lead time for the same. Suggestions

EPC Players

MICRO LEVEL ANAYSIS
Threat of new entrants- 8 Questions (Time taken at max 4 minutes)
Bargaining power of your business prospects- 8 Questions (Time taken at max 4 minutes)
Bargaining power of suppliers- 10 Questions (Time taken at max 5 minutes)
Intensity of competitive rivalry- 5 Questions (Time taken at max 2.5 minutes)

Threat of new entrants

8 Questions (Time taken at max 4 minutes)

Which market segments do you target?

- ◯ Solar farms
- ◯ Solar Rooftops
- ◯ Both

How lucrative are following markets in terms of market size/growth for you?
Rate on scale of 5

	Very High	High	Avg	Low	Very Low
Solar farms	◯	◯	◯	◯	◯
Solar Rooftops	◯	◯	◯	◯	◯

How lucrative are following markets in terms of profitability for you?
Rate on scale of 5

	Very High	High	Avg	Low	Very Low
Solar farms	◯	◯	◯	◯	◯
Solar Rooftops	◯	◯	◯	◯	◯

How is your services offering different from the other players in the market which gives you a competitive advantage?

- ☐ Competitive Pricing
- ☐ Quality
- ☐ Value Added Services
- ☐ Vertically Integrated Business (JV/alliance with technology providers)

Are you getting the business from your patrons, old clients? If yes, what is the percentage of your previous clients in the total no. of solar business clients?

- 10%-25%
- 25%-50%
- 50%-75%
- 75-100%

How you support your working capital requirements for doing business? How are you funded?

- In-house funds
- Equity firms/venture capitalists
- Both

Answer on scale of 3

	Easy	Neutral	Difficult
Difficulty in arranging funds for your business			
Difficulty in getting business in the market			

How attractive is your industry profitability in terms of percentage earnings out of EPC cost per project?

% earnings out of EPC cost charged

- 5-10%
- 10-15%
- 15-20%
- 20-25%
- Above 25%

Bargaining power of your business prospects

8 Questions (Time taken at max 4 minutes)

What is market demand for solar PV EPC services in market?

- ◯ High
- ◯ Above Average
- ◯ Neutral
- ◯ Below Average
- ◯ Low

You get projects more in

- ◯ Number
- ◯ Size
- ◯ Both

What is the frequency of getting new Solar PV projects?
per year

	1-2	3-5	6-9	10-15	Above 15
Solar Farms	◯	◯	◯	◯	◯
Solar Rooftops	◯	◯	◯	◯	◯

Answer on the scale of 3

	Difficult / High	Average/ Neutral	Easy/ Low
Availability of prospects' information in the market	◯	◯	◯
EPC price bargain leverage available to clients	◯	◯	◯

What is your existing channel of project acquisition ?

- ◯ Alliance Partner
- ◯ Previous client
- ◯ New client
- ◯ Depends

How are your customers sensitive to prices charged by you?
to get an idea about level of negotiation for prices of your services

	Highly Sensitive	Sensitive	Neutral	Not price senstitive	Not at all concerned about prices (Only quality is the main concern)
Solar Farms	○	○	○	○	○
Solar rooftops	○	○	○	○	○

What is Differential advantage (uniqueness) of your services?
Superior Technology ; Value added services (if any)

Whom do you see following as a major threat to your business?

	Very High	High	Neutral	Low	Very Low
EPC Players	○	○	○	○	○
Project Developers (Backward integrated players having in-house EPC capabilities)	○	○	○	○	○
Module Manufacturers/Suppliers (Forward intergrated players having in-house EPC capabilities)	○	○	○	○	○

Bargaining power of suppliers

10 Questions (Time taken at max 5 minutes)

Solar PV cell Technology used in most of your projects

- [ ] Thin Film
- [ ] Mono crystalline
- [ ] Polycrystalline
- [ ] Other

Who is the manufacturer of solar cells of the panels purchased by you i.e. cell material?

- [ ] Local
- [ ] Foreign
- [ ] Don't know

Who are your suppliers/vendors of Solar panels purchased by you?

- [ ] Local
- [ ] Foreign

Availability of solar panels in the Indian market in terms of quantity, quality and technology requirements?

	Highly Available	Moderately Available	Low Availability
Quantity	○	○	○
Quality	○	○	○
Technology	○	○	○

Main criteria for selection of a supplier of Solar PV modules

	Very High	High	Neutral	Low	Very Low
Price	○	○	○	○	○
Quality	○	○	○	○	○
Value added services (longer guarantee periods, extendable guarantee periods)	○	○	○	○	○

Availability of associated BOS technology/equipment in the market?
BOS, trackers etc

- Easily Avaliable
- Neutral
- Difficult to procure

Main criteria for selection of a supplier of BOS

	Very High	High	Neutral	Low	Very Low
Price					
Quality					
Value added services (longer guarantee periods, extendable guarantee periods)					

What is your existing channel of procurement of equipment (Solar PV and BOS) ?

	Alliance Partner/JV	Supplier/Vendor	In-house
Solar PV modules			
BOS			

Availability of experienced technical workforce in Indian market
Any comparison

- Easily Available
- Moderately Available
- Low Availability

How are your suppliers sensitive to prices/order size offered by you?
to get an idea about level of negotiation for prices w.r.t order size

	Price (higher %age margin)	Order Size (higher revenue generation)	Both
Solar PV modules			
BOS			

Intensity of competitive rivalry

5 Questions (Time taken at max 2.5 minutes)

What is the number of solar PV EPC players of different market capitalization in the market?

	Very High	High	Average	Low	Very Low
Large Cap	○	○	○	○	○
Mid Cap	○	○	○	○	○
Small Cap	○	○	○	○	○
Overall	○	○	○	○	○

What is a Sustainable competitive advantage through innovation in solar PV EPC business for you?

- ☐ Price Competitiveness
- ☐ Quality
- ☐ Value added services
- ☐ Other: _____

What can be a new Sustainable competitive advantage through innovation in solar PV EPC business for you?

- ☐ Price Competitiveness
- ☐ Quality
- ☐ Value added services
- ☐ Other: _____

What is a powerful business strategy adopted by your company for solar PV EPC business?

- ☐ Forward Integration- Becoming a project developer/Promoter
- ☐ Vertical Integration- Alliances/JV/Acquisition of Module manufacturers, BOS players etc
- ☐ Horizontal Integration- Forming alliances or acquiring other EPC players
- ☐ Other: _____