Chapter 6

Case Study of Rajasthan

6.1 Introduction

This chapter discusses the case study for Rajasthan. The objective of conducting this study is to find, how Rajasthan as a State has responded to the role of identified Barriers and Challenges for Mega Watt Scale Grid Connected Solar Photovoltaic Power Plants executed in the region.

This study is part of multiple case study design and is single holistic unit of analysis in nature. The fact, Rajasthan has been considered, is after Gujarat, it has the maximum installed capacity for grid connected solar PV power plants in the country, which is close to 500 MW[33].

Data was collected through various sources as mentioned in section 3.5.3 of chapter 3. The sources have been interviews, documents and observations. A visit to a 17 MW grid connected solar PV power plant in Phalodi in Rajasthan (observations) assisted the researcher in developing this case study. The interviews were conducted during the months of May and June 2013, details of interviews have been provided in the section 6.6. The documents consisted of State and Central policy documents, various regulation orders, State and company reports etc. Interviews were recorded and transcribed for data coding and analysis. The data was coded with the help of ATLAS.ti software.

Analysis of coded data was a three-step process, data selection and presentation, within-case analysis, and cross-case analysis. The codes have

[33] Accounts to 20% of the total installed capacity in the country.

been highlighted in [**bold**] during the discussions on all barrier and challenges. It helped in developing associative network diagram, presenting the relationship between responses given by the interviewees on each identified barrier and challenge. Further, last section of the chapter presents the results for within case analysis for the study, as it aided in creating a base for cross case analysis carried out in chapter 7.

6.2 State of Rajasthan

Rajasthan is located in north western part of the country sharing its boundary with Haryana, Punjab, Gujarat, Madhya Pradesh and Uttar Pradesh. It is one of the regions in country which shares international boundary with Pakistan. It was formed in April 1949 by assimilation of 19 princely states and a decade later Ajmer also became a part of this state. Rajasthan is divided into 7 divisions, 33 districts, 244 Tehsils, 249 Panchayat Samities, 9,166 Gram Panchayats, 39,753 inhabited villages and 188 urban local bodies (DISE, 2014).

Rajasthan has the largest boundary in terms of land area and as a state it shares 10.4% of area in the country. Rajasthan has no perennial rivers except Chambal and Mahi crossing through south-eastern region (Press Information Bureau, 2014). Topographically, the State constitutes a large chunk of land mass, which is arid and dessert in nature and scattered settlements (DISE, 2014) as shown in figure 6-1.

Rajasthan is a home to 5.7% of country's population and has second largest urban agglomeration in the World (India Brand Equity Foundation, 2013) while it has a quite low population density.

Figure 6-1 District map of Rajasthan ***Source*: Map of India**

This state has registered a Cumulative Annual Growth Rate (CAGR) of 8.3% from year 2009 to 2013 which contributes to around 4.7% of India's GDP. Economy of state is driven mainly by secondary (Industry) and tertiary (Service) sectors which together accounts for 80.1% of the state's Gross State Domestic Product (GSDP).

The important industries in Rajasthan include Tourism, Handicrafts, Minerals, Mining and Cement. The primary (Agriculture) sector contributes around 20% to the state's GSDP. The major agriculture products are oilseeds, cereals, groundnut, pulses and soya-bean (CARE, 2014). The table 6-1 shows facts file for the state Rajasthan.

Table 6-1 Rajasthan Fact File

S.No.	Parameters	Details
1	State Capital	Jaipur
2	Area (Sq. km)	3,42,239
3	Population(2011 Census)	6.86 Crores
4	Population Density(per Sq.Km)	201persons
5	Districts	33
6	Average GSDP growth rate (%)	17.9 %
7	Sex Ratio (2011 Census)	926 females per '000 males
8	Key Industries	Mineral Based Industries, Textiles, Tourism, Gem and Jewellery, Dimensional stones, Agro Processing
9	Fiscal Deficit to GSDP	-2.81 %
10	Literacy Rate	67.07 %

6.3 Power Sector Scenario in Rajasthan

Rajasthan has been making conscious efforts in area of infrastructure development for strengthening its economy. The reforms initiatives taken in power sector are some of the major steps taken in order to meet the growing demand of energy consumption.

In 1957 Government of Rajasthan formed Rajasthan State Electricity Board (REB) through a Notification No. F.11/OSD (PWD)/57 under the Electricity (Supply) Act 1948 (Government of Rajasthan, 2014). The objective of REB is to have co-ordinated development and rationalization of generation and supply of electricity on a regional basis in an efficient and economical way.

Government of Rajasthan on 19th July 2000 issued a gazette notification for unbundling Rajasthan State Electricity Board (RSEB). It was to unbundled into generation, transmission and three distribution companies

(Government of Rajasthan, 2014). The figure 6-2 shows the power sector companies in Rajasthan.

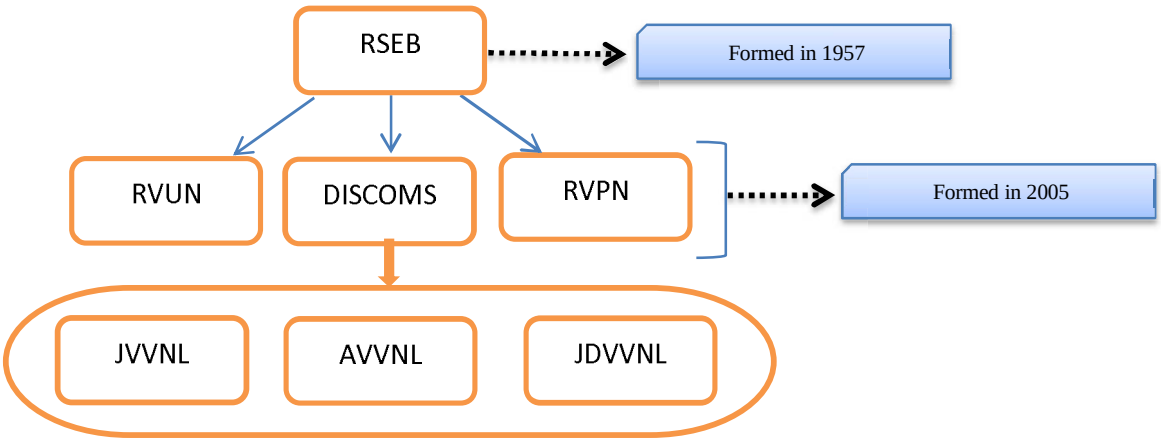

Figure 6-2 Rajasthan Power Sector Structure

The companies are as follows

- Generation
  - RVUN - Rajasthan Rajya Vidyut Utpadan Nigam Ltd. is engaged in the business of generation of electricity
- Transmission
  - RVPN - Rajasthan Rajya Vidyut Prasaran Nigam Ltd. is engaged in the business of transmission of electricity
- Distribution Companies – DISCOMS
  - JVVNL - Jaipur Vidyut Vitran Nigam Ltd.,
  - AVVNL - Ajmer Vidyut Vitran Nigam Ltd.
  - JdVVNL - Jodhpur Vidyut Vitran Nigam Ltd.

These DISCOM's are engaged in the business of distribution of electricity in these areas of Rajasthan.

6.4 Power Generation Scenario

Rajasthan is the first State to hold a competitive bidding process for seeking private participation in power generation sector. (Press Information Bureau, 2014). Rajasthan had a total installed power generation capacity of 14,060 MW (as of September 2013).

The table 6-2 shows details of different sources generation as of March 2013 are:

Table 6-2 Sources of electricity generation

Fuel	Capacity MW	Percentage %
Hydro	1548	11
Lignite	251	1.79
Coal	7687	54.62
Atomic/Nuclear	573	4.1
Gas	775	5.51
Wind	2683	19.1
Biomass	106	0.8
Mini Hydel	-	-
Solar	443	3.2
Total	**14059**	**100%**

In the 12th plan the state plans to add a generation capacity of 4700 MW with help of private sector investments and State itself plans to add 7800 MW by the end of the plan (Government of Rajasthan, 2014).

The power sector includes different category of players who are involved in generation of electricity in the state. RUVN is responsible for 5430 MW of electricity generation through different sources, the private players contribute to 6259 MW of electricity generation and central government is

engaged in a total of 2370 MW of power generation. The figure 6-3 shows the total electricity generated as of September 2013.

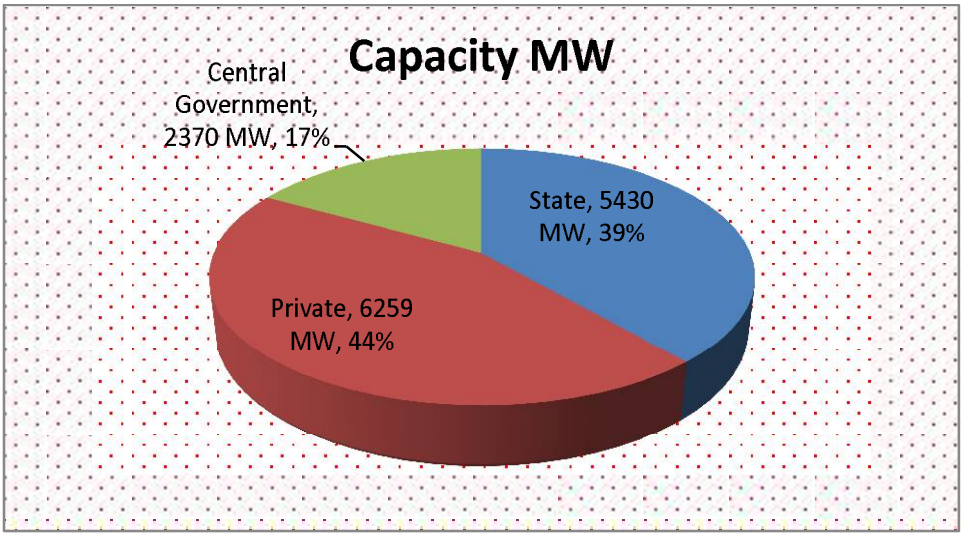

Figure 6-3 Contribution of different sectors in power generation ***Source*****:** CEA

6.5 Solar Energy Generation Scenario

On 19th April 2011 Rajasthan introduced its State specific Solar Policy, named as "Rajasthan Solar Energy Policy 2011" through a vide Notification No. F. 20 (6) Energy /2010 (Government of Rajasthan, 2011).

Rajasthan receives maximum solar radiation and has least rainfall in the country. It envisages of using these advantages to maximize its opportunities in power generation through solar energy. Government has put in an effort to identify land banks in various districts of the State for setting up of grid connected solar PV power plants in State. The State extended the identified land banks to Solar Power Developers (SPD's) for facilitating them in coming forward and investing in projects in the region.

Under the policy State plans to install solar plants in two phases. 1st phase will be upto 2013 and 2nd phase will be upto 2017. The figure 6-4 shows

the total capacity planned to be installed by 2017 by the state through SPV and CSP which is 200 MW and 400 MW respectively (Government of Rajasthan, 2011).

The nodal agency designated for developing solar energy sector is Rajasthan Renewable Energy Corporation Limited (RRECL). It was formed in August 2002 by merging former Rajasthan Energy Development Agency (REDA) and Rajasthan State Power Corporation Limited (RSPCL).

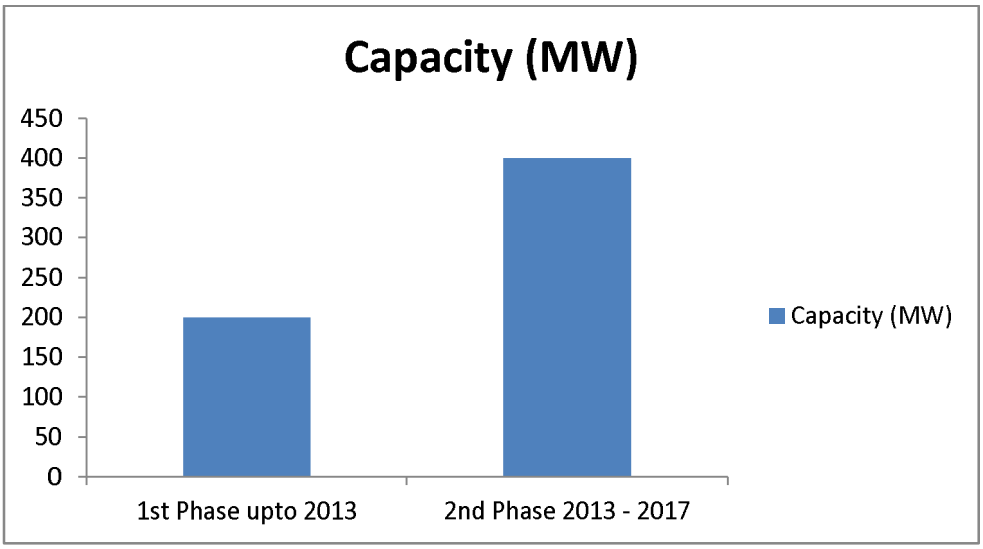

Figure 6-4 Capacity (MW) to be installed under Rajasthan Solar Policy

Some of the responsibilities to be undertaken by nodal agency are:

1. Registration of Projects
2. Approvals of Capacity for installation
3. Selection of Projects
4. Allotment of Revenue Land
5. Help in loans from Financial Institutes / Commercial banks
6. Allocation of power evacuation plans
7. Arranging statutory clearances

8. Execution of PPA
9. Accreditations of projects for REC mechanism

State government will select the projects through tariff based competitive bidding process.

State government plans to develop Solar Parks in near future of more than 1000 MW capacity in identified regions of Jodhpur, Jaisalmer, Bikaner and Barmer in various stages. The government will also act as a facilitator to attract player from across the world and will develop necessary infrastructure for promoting solar park. The government plans to attract investments across the value chain in solar sector ranging from manufacturing to R&D and Training centres. RRECL will be responsible for development of these solar parks. It will form a SPV in the form of a subsidiary company to facilitate activities related to development of infrastructure and management of Solar Park. This SPV will formulate policy and rules in respect of land allotment and sharing of development cost by Solar Power Producers and Manufacturers.

The table 6-3 shows the details of Rajasthan Solar Policy 2011.

Table 6-3 Details of Rajasthan Solar Policy 2011

S.No	Parameters	Details
1	**Policy Name**	Rajasthan Solar Energy Policy 2011
2	**Operative Period**	2011-Till further announcement
3	**Capacity Planned**	200 MW- Phase 1 (Upto 2013)
		400 MW -Phase 2 (Upto 2017)
4	**Tariff (Rs/kWh)**	9.63 without AD 8.42 with AD Plant to be commissioned by 31 Mar 2014
5	**Category / Types of Projects**	Category 1 - Competitive Bidding
		Category 2 - Captive /Open Access
		Category 3 - REC

		Category 4 - JNNSM
		Category 5 - RPSSGP
6	**Current Installed Capacity**	443 MW
7	**Off Taker**	Rajasthan DISCOM
8	**Radiation kWh/m^2 / day**	6.5-7
9	**Nodal Agency**	RRECL
10	**Other Incentives**	Eligible for incentives under Industrial policy
		Electricity Duty Exemption

According to information on RRECL website a total number of seven solar projects have been allocated permission to install generation capacities under Rajasthan Solar policy. The cumulative capacity allocated is of 75 MW, but none of them has been commissioned as of March 2014. Till December 2013 the total installed capacity in the State through grid connected solar PV was 443 MW. But all projects that have been commissioned are under Jawaharlal Nehru National Solar Mission 2010.

The determination of tariff for procurement of power by Distribution Licensees and others from solar energy projects is determined by an independent body called Rajasthan Electricity Regulatory Commission (RERC). Commission has prescribed an obligation on distribution licensees to buy 50 MW of solar power which was later escalated to 100 MW through an order dated 25th May 2010 (RERC, 2008). Commission (RERC) through a vide notification number RERC/Secy./Regulation-85 dated 24th May 2011 announced the Renewable Purchase Obligation (RPO) to be achieved through solar power, expressed in terms of percentage of energy consumption (RERC, 2012). The commission declared the obligations for three years as shown in figure 6-5.

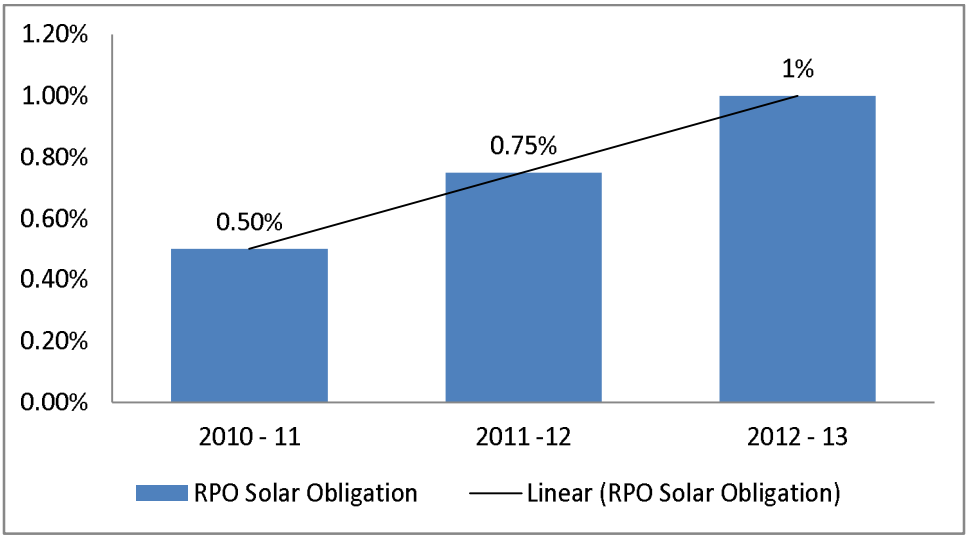

Figure 6-5 RPO Solar for Rajasthan for year 2011, 2012 and 2013

Commission also declared a generic tariff on 25th May 2010 which was applicable to grid connected solar PV power plants to be commissioned on or before 31st March 2012 (RERC, 2010). The Commission amended the tariff through its order dated 29th September 2010.

Table 6-4 shows the tariff for grid connected solar PV projects in Rajasthan

Table 6-4 Tariff for Solar PV power plants to be commissioned by 31.03.2012

Category	Tariff without AD benefit	Tariff with AD benefit
Solar (PV) commissioned by 31.3.2012	₹ 15.32 / kWh	₹ 13.19 / kWh

Further on 4th September 2013 RERC announced its latest revised generic tariff applicable to grid connected solar PV power plants to be commissioned by 31st March 2014 (RERC, 2013). These amendments were done because world has seen a declining trend in PV modules prices and related components as a result of which the Commission decided to

revise generic tariff from time to time basis. Tariffs for 2014 are shown in table 6-5.

Table 6-5 Tariff for Solar PV power plants to be commissioned by 31.03.2014

Category	Tariff without AD benefit	Tariff with AD benefit
Solar (PV) commissioned by 31.3.2014	₹ 9.63 / kWh	₹ 8.42 / kWh

In April 2013, nodal agency Rajasthan Renewable Energy Corporation (RRECL) declared the list of seven qualified bidders to install a capacity of 75 MW under the State solar policy in Phase 1. Initially the bids were called for 100 MW against which 23 applications were submitted.

The bids were called upon through a competitive bidding process and State followed L1 bidding process, which meant that all developers who were selected required meeting the lowest price discovered through this process. The lowest price discovered was ₹ 6.45 / kWh. According to the information available most of the bidders have not taken up projects only due to low tariff discovered (RE Solve, 2013) which according to them was not feasible. These projects are likely to be commissioned by 31st March 2014. The list of the qualified bidders has been given in the Annexure 10.

The maximum number of grid connected solar PV projects installed in Rajasthan is under JNNSM, which have come through competitive bidding. CERC is responsible for calculating the benchmark capital cost of solar PV and accordingly it announces the tariff. As per Regulation 5 of Renewable Energy (RE) Tariff Regulations, the Commission is to determine the Benchmark Capital Cost Norm for RETs, consequently which is applicable to SPV as specified under the regulation 57 (1). The

Commission may annually review the benchmark cost norm for all RETs. As mentioned above the determination of tariff for procurement of power from solar energy projects by Distribution Licensees and others is determined by the CERC. Since 2009 CERC has declared solar PV tariff for every fiscal year. The details have been listed out in table 6-6.

Table 6-6 Summary of Benchmark Capital Cost and Generic Tariff announced by CERC till 2015

Date of Announcement	Petition No.	Applicable for the projects to be commissioned in	Benchmark Capital Cost (Lakh / MW)	Generic Tariff	
				Without Accelerated Depreciation (₹)	Availing Accelerated Depreciation (₹)
3-12-2009	248/2009	FY 2009-10	1700	18.44	17.14
26-4-2010	53/2010	FY 2010-11	1690	17.91	14.95
The below tariff was applicable for the Solar PV Projects whose PPA was signed on or before 31-03-2011					
9-11-2010	255/2010	FY 2011-12	1690	17.91	14.95
The below tariff was applicable for the Solar PV Projects whose PPA was signed after 31-03-2011					
9-11-2010	255/2010	FY 2011-12	1442	15.39	12.94
27-3-2012	35/2012	FY 2012-13	1000	10.39	9.35
28-2-2013	243/SM/ 2013	FY 2013-14	800	8.75	7.87
7-1-2014	SM/353/ 2014	FY 2014-15	612	6.99	6.33

Source: **CERC**

The solar power plant developers (SPD's) who wished to install grid connected solar PV power plants under JNNSM policy shall entered into a contract called Power Purchase Agreement (PPA) with NTPC Vidyut Vyapar Nigam (NVVN) which is designated nodal agency under JNNSM. NVVN is a subsidiary to NTPC Limited formerly known as National

Thermal Power Corporation (NTPC). The power from solar is sold to NVVN, is to be bundled with unallocated quota of power from central power stations under bundling scheme[34]. This was done to reduce down the overall cost of power from solar. The bundled power is then sold to DISCOM's at CERC determined prices.

The grid connected solar PV power projects were to be selected on a developer's ability to share a percentage of CERC guaranteed tariff with NVVN as specified under JNNSM 2010 policy.

NVVN asked the developers to share a percentage of CERC determined tariff and (MNRE, 2010) hence it requested developers to submit the bids offering the maximum discount for getting preference to sign PPA.

6.6 Information and Data collected

During the course of study there were hardly any developers who had installed solar projects under Rajasthan State Solar policy 2011. With this limitation researcher consulted developers who had installed solar power projects under JNNSM policy 2010. These interviews assisted the researcher to gain insight in the role played by Rajasthan in addressing the identified barriers and challenges discussed earlier in study in chapter 4.

The respondents were interviewed during the months of May to June 2013. Respondents refused to disclose their names, name of the company, name of the projects which are mostly SPV's (special purpose vehicle), neither they allowed to mention their bankers name who financed their

[34] *Bundling Scheme: relatively expensive solar power with power from the unallocated quota of the Government of India (Ministry of Power) generated at NTPC coal based stations, which is relatively cheaper, has been proposed by the Mission. This "bundled power" would be sold to the Distribution Utilities at the Central Electricity Regulatory Commission (CERC) determined prices* (NVVN, 2013).

project. During every interview researcher had to signed a Confidentiality Agreement with the interviewees to adhere to the limitations.

The table 6-7 shows the details of the interviews conducted in Rajasthan. The table specifies the code used for the interviewee, date and time of interview conducted and limitation posed by respondents.

Table 6-7 Interview and data collection details

Codes	Interviewee	Date of Interview	Time of Interview	Comments
R1	1st respondent from Rajasthan	2 – May – 2013	11:00 am –12:50 pm	Do not disclose any necessary information that are important to organization, project or any related individual
R2	2nd respondent from Rajasthan	4 – May – 2013	9:00 am – 10:35 am	
R3	3rd respondent from Rajasthan	10 – May – 2013	3:00 pm – 4:10 pm	
R4	4th respondent from Rajasthan	20 – May – 2013	10:00 am – 12:30 pm	
R5	5th respondent from Rajasthan	2 – June – 2013	4:30 pm – 5:20 pm	
R6	6th respondent from Rajasthan	7 – June – 2013	10:40 am – 11:15 am	
R7	7th respondent from Rajasthan	15 – June – 2013	7: 15 pm – 8:30 pm	

The following sub sections present the respondent's experiences as shared during the interviews for various Barriers and Challenges identified in chapter 3. The researcher has tried to discuss the overall response of the different respondents for each category of barriers and challenges and then supported it with interview statements.

6.6.1 Discussions on Financial Barrier

The respondents expressed their views on how grid connected solar PV power plants were funded. It was understood from the information shared by them that, financing of grid connected solar PV projects was difficult as banks were hesitant in funding such projects. Banks usually claimed higher interest rates for lending money. In most cases banks did lend the money but it was only after they were assured of the revenues are being

realized by project. Banks mostly provided syndicate loan to mitigate the risk that persisted in sector.

Due to these limitations developers had to arrange funds from different sources for their respective projects. In spite of the fact, projects were self-financed in most cases, nevertheless, developers still looked for equity investors who could lend money. The short term loan (or bridge loan) was arranged through banks. Some developers even opted to avail Buyers' Credit to purchase modules and related equipment for the projects.

The respondents expressed their discomfort of bearing high investment on their own. In order to optimize the overall cost of the project, developer even used self-manufactured modules.

The respondent **R1** has shared his experience for executing the grid connected solar PV project in Rajasthan. He stated that their banker took time but did fund the project. This is evident from responses below.

> [**Banks lend money after the projects commissioned**]
> *"(…) lenders took time but did finance the projects."*

R1 mentions that they arranged their funds through availing short term loan from bank and apart from self-finance some funds were arranged through other sources.

> *"In our project the finance was managed by* [**short term loan**] *seed funding called the project development money. The long term financing was an issue. We infused our* [**Self-finance**] *own money* [**High investment borne by the developer itself**] *in our project and arranged through* [**Equity investors**] *different channels."*

Further **R1** expressed that bank funded the project only after, when they were assured of the successful operation of projects. He further stated that

after construction, which is 6-12 months, it is easy to convince banks as compared to initial stages.

> [**Funding only after plant started generating**] *"(…) when a project is commissioned then financial closure is not difficult because there is* [**Gestation Period of 6-12 months**] *no construction risk, the approvals and the clearances are also in place* [**revenue inflow, payment security**]*."*

It was further learnt that, developer went for Buyer's Credit for buying modules and equipment for the power plants.

> *"There were companies which gave* [**Buyers' credit**] *one year credit to the developers on* [**Gestation Period off 6-12 months**] *construction material and may be on the modules also (…) well normally nobody discloses these details of financing."*

The banks funded the project through syndicate / consortium lending. This helped banks to reduce their exposure to risk in the sector. The banks lend the money at higher interest rate as risk associated to sector was high.

Whenever banks are investing money in an infrastructure project they preform Due Diligence[35] process which is done to assure the feasibility of project.

R1 shares his experience related to financing of project.

> *"Every bank has its own criteria of* [**project appraisal**] *rating project before it finances it. The first thing they'll check is promoter's background, which should be good. The banks lend the*

[35] *It is the process of evaluating the a prospective business decision by getting information about the financial, legal and other material (important) state of the party.* (Biztaxlaw, 2014)

money on [**Higher interest rate at 12% - 15%**] *higher interest rates which ranged between 12%-13%. Our* [**Syndicate loaning**] *lead bank formed a group of banks to fund our project. This type of funding is called as consortium lending or financing. Lead bank does the* [**due diligence**] *due diligence on behalf of other banks though they are also liable to do the same at their individual level."* **[Respondent R1]**

R3 says that they had to arrange their fund by themselves through different sources.

"(…) projects are [**Equity funded**] *equity financed.***"**

[Respondent R3]

The respondent **R4** mentions that, banks were least interested in financing the projects during construction period even though the power purchase agreement was signed with concerned authorities. As a result of which projects had to be funded through self-finance or through equity investors. The banks lend money once they were convinced that revenues are being realized by power plants.

"(…) at construction stage also bank refrained from funding although the PPA was signed. Most of our projects are [**Self-finance**] *self-finance and equity was raised through different sources* [**Equity investors**] *and short term loan* [**short term loan**] *was arranged through our banker. Once the plant was commissioned the* [**revenue inflows**] *payment receipts were shown to the bankers which they* [**payment security**] *verified along with other documents related to PPA and* [**Funding only plant started generating**] *then they showed interest. (…) financing institute had*

[**project appraisal**] *strict parameters to approve a long term loan."*

As communicated by **R4,** initially their project deployed self-manufactured modules, in attempt to reduce the overall cost of project. But that proved to be non-effective. Whereas in other plants, imported modules were used to attain the overall feasibility for project. The modules were imported from different countries. Crystalline modules were sourced from China and Thinfilm were sourced from USA.

"In order to optimize our total cost of the plant we used [**Self Manufactured Panel**] *our own* [**Indian Manufactured Modules**] *manufactured modules in some projects but switched on to the Thinfilm technology which we sourced from USA. We have plants running on Crystalline which were sourced from china and Thinfilm PV modules."*

"(…) we switched to imported modules because it was becoming difficult to attain [**Project Feasibility**] *project feasibility with* [**Indian Manufactured Modules**] *Indian manufactured modules."*

[Respondent R4]

The associative network diagram in figure 6-6 shows the relationship between the responses given by the interviewees on Financial Barrier.

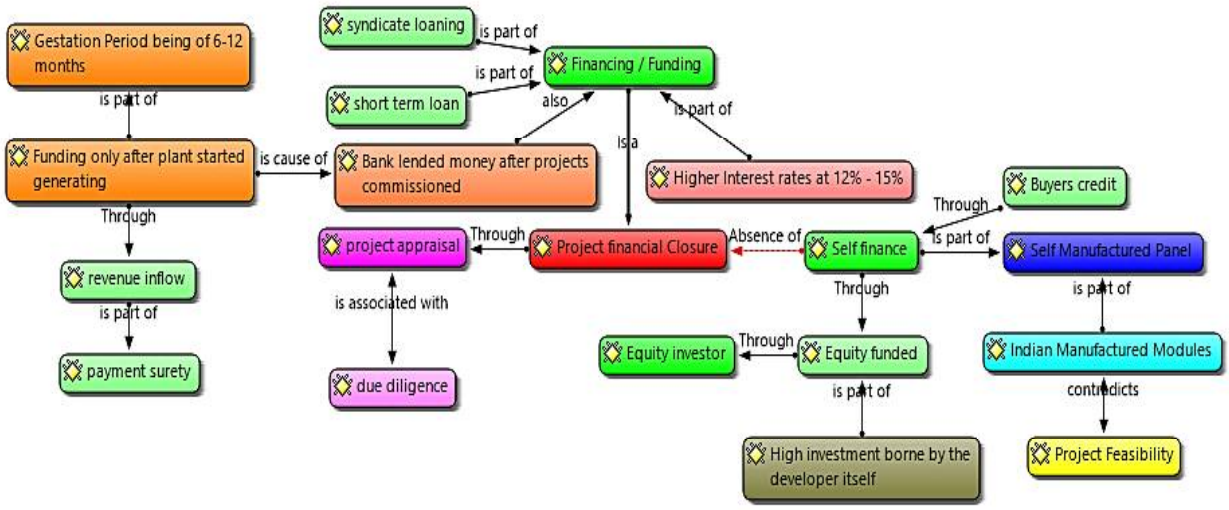

Figure 6-6 Associative network of outcomes on Financial Barrier in State of Rajasthan

Thus from the experiences shared by different respondents, it is evident that Rajasthan had no significant response to the role of Financial Barrier.

6.6.2 Discussions on Policy and Political Barrier

The respondents informed that Central Government promoted the solar PV sector in State of Rajasthan along with Government of Rajasthan. The State's own Solar policy, declared in 2011, lacked clarity and merit to attract developers. The Central Government announced JNNSM 2010 and chose Rajasthan to promote solar energy as they were sure of high radiation level and luckily Rajasthan had large government land banks which was barren and not suitable for agriculture.

The Government of Rajasthan assisted the developers with land banks at cheaper prices for developing grid connected solar PV power plants in State.

The Power Purchase Agreement (PPA) was signed with NTPC Vidyut Vyapar Nigam (NVVN) which is a working arm of central government organization called NTPC Limited. The developer was sure of successful execution of PPA because NVVN had good credibility in power sector, moreover Central Government announced a Payment Security Mechanism (PSM) to strongly back up the tariff discovered through competitive bidding. Ministry of New and Renewable Energy (MNRE) was responsible for implementation of PSM that was called Solar Payment Security Account (SPSA).

Further developers showed disquiet on clarity of JNNSM policy and Rajasthan Solar Policy, though respondents strongly communicated that developers went for high radiation in State.

As discussed Government of India chose and promoted Rajasthan for JNNSM, as they were sure of the land availability, which is best suited for solar power plants and they were assured of the radiation level as well, which is apparently highest in the country. On assessing these factors, GoI was sure that if developers commissioned their plants in Rajasthan, then they can be assured of higher generation of electricity. Consequently it will help the central government of making JNNSM a success.

In order to support developer in generating such an expensive power and have a reasonable rate of return on their investments. Ministry of New and Renewable Energy (MNRE), The Government of India, on 30th June 2011 under vide notification No.29-5-2010-11/JNNSM (ST) announced the implementation of Payment Security Scheme (PSS) for grid connected solar power projects under Phase 1 of JNNSM for the year 2011-12 (MNRE, 2011). The implementation of PSS is done by MNRE through a Solar Payment Security Account (SPSA) which is supported by national

Gross Budgetary Support (GBS) (MNRE, 2011). The funds deployment pattern under SPSA for the 1st Phase is shown in table 6-10.

Table 6-8 Funds to be provided under SPSA for 1st Phase of JNNSM

Fund Development Pattern	Incremental Fund Deployment (Cr)	Total Fund Capacity (Cr)
1 Jul 11	1.00	1.00
1 Jul 12	1.00	2.00
1 Jul 12	32.85	34.85
1 Jul 13	23.47	58.32
1 Jul 13	58.32	116.64
1 Jul 14	126.39	243.03
1 Jul 14	243.02	486.05

***Source*:** MNRE 2011

In continuation to the above statements the respondents **R2** and **R4** expressed their views as follows.

a) Political

> *"Rajasthan was chosen by* [**Central Government**] *Central Government because they were* [**Rajasthan because Central Government was sure of Radiation**] *sure of the radiations as well as the generation. They had* [**Large Barren Land Banks**] *large land banks which was barren and best suited for* [**Majority of plants**] *solar sector, either PV or Thermal. They felt that these are best conditions which can and will* [**Returns to the Developer**] *assure returns to developers / investors and help the country in portraying a perfect example in front of the World."*

R2 commented that, Central Government along with the assistance of Rajasthan government identified land banks with high solar radiation to facilitate Solar Power Developer (SPDs).

> *"In Rajasthan,* [**Government Land**] *government suggested the land."* **[Respondent R2]**

It is understood by the experience shared by respondent that NVVN signed PPA with SPDs under JNNSM. NNVN is working arm of NTPC which has a good credit rating as an organization in the country. The government supported developers through Solar Payment Security Account (SPSA). The MNRE was responsible for implementation of payment security mechanism.

a) Policy

> *"NTPC Vidyut Vyapar Nigam (NVVN) is the nodal agency to sign* [**project PPA sign**] *Power Purchase Agreement (PPA) with developers (generators) under* [**JNNSM**] *JNNSM. It has* [**NVVN had strong credential**] *strong credentials as well as a* [**Arm of NTPC which had good rating**] *good rating in power sector. Moreover* [**payment surety backed up by Government**] *central government backed by the payment through* [**Solar Payment Security Account**] *Solar Payment Security Account (SPSA) which was supported through* [**Gross Budgetary Support (GBS)**] *Gross Budgetary Support (GBS)."*

Government of India bundled purchased solar power with unallocated power generated through coal[36] to reduce the overall cost of power which was later sold to DISCOMs.

> *"The central government sold this power to* [**DISCOM**] *DISCOMs after* [**Power Bundling Scheme**] *bundling power from coal, this was done to average to out the cost of generation from solar"*

[36] *An example: (in optimistic scenario)*
Cost of 1 unit of power from Solar = 15/-
Cost of 1 unit if power from Coal = 5/-
So, from Solar (1unit x 15) + from Coal (10 unit x 5) = 15+50 = (65/11 units)
Cost of 1 unit of bundled power = 5.90/-

As per the information shared by **R4**, under central policy the maximum capacity that can be installed by a developer was capped to 5 MW (MNRE, 2010). Accordingly, transmission infrastructure of 33kV lines in the State were appropriate for a 5 MW, it is evident from following statement.

> *The plants were provided with* [**Rajasthan grid connectivity for most of the plant at 33kV line**] *33kV grid connectivity which is mostly available throughout the State. (…) it was not an issue for us apparently not for any of the developers because government allowed 5 MW per application and 33kV is adequate for a 5MW plant.* **[Respondent R4]**

The associative network diagram in figure 6-7 shows the relationship between responses given by the interviewees on Policy and Political Barrier.

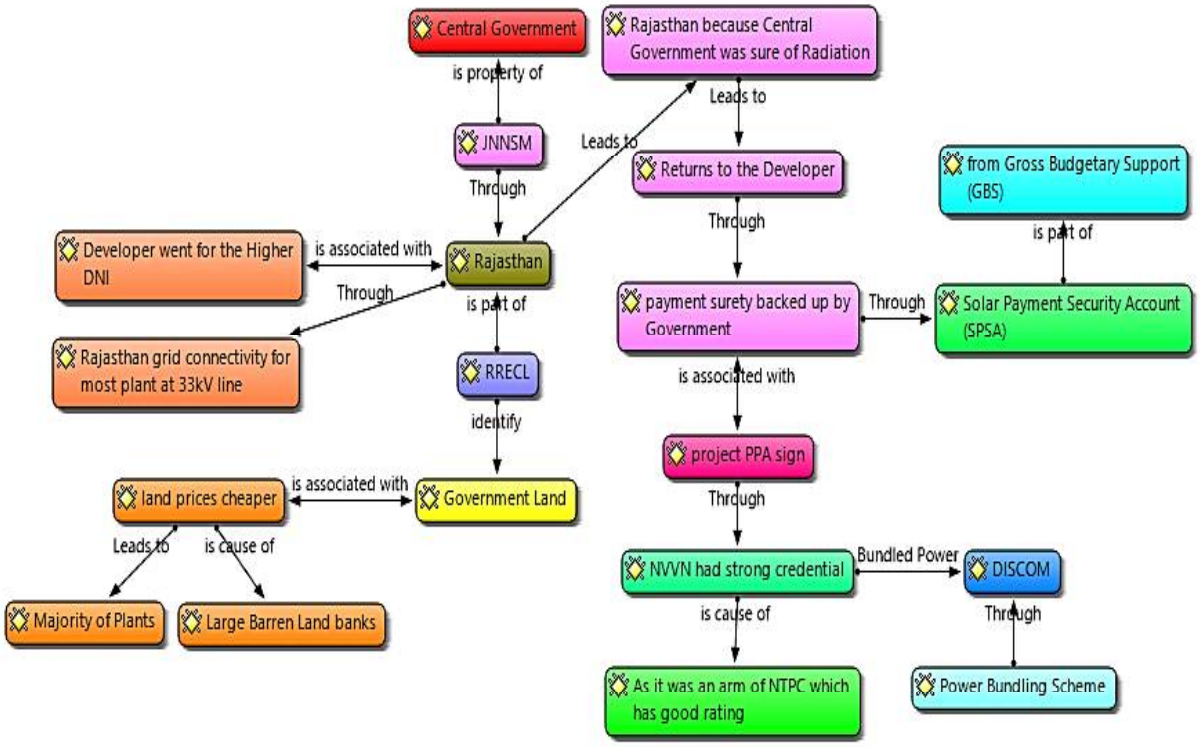

Figure 6-7 Associative network of outcomes on Policy and Political Barrier in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that, the government of Rajasthan helped the developers by suggesting them potential land banks for the projects. Hence it can be deduced that, Rajasthan had moderately significant response to the role of Policy and Political Barrier.

6.6.3 Discussions on Institutional Barrier

The respondents stated that they faced issues related to availability of reliable and accurate solar radiation data for a specific location. This situation persisted across the State. The DNI data was not dependable as a consequence of which developers had to be dependent on different

software namely Meteonorm, HOMER and PVsyst designed by international agencies. Further, developers referred the data provided by NREL but as they were not accurate and had to be double checked.

The Central Government along with Centre for Wind Energy Technology (CWET) installed 40 weather stations across the country but reliability issues still sustained.

Training institutes which are involved in capacity building, particularly for solar sector was an issue and industry faces challenge of limited workforce. As respondents stated, it was not that serious issue but apparently agreed that there is limited skilled workforce in the sector. The developers largely conducted two to three months of training along with self-training activities at project site.

Another issue faced by sector is the level of R&D activities and facility in country. The respondents agreed that there is very low level of R&D in country and has not assisted them in any manner.

Respondent **R4** states that, India as country lacks organizations / institutions which can provide accurate data on radiation levels for a specific location. The most preferred software by developers for calculating generation of a solar power plant was HOMER, PVsyst, NREL and Meteonorm.

Under JNNSM policy it is a mandate for developers to install Pyranometer. Centre for Wind Energy Technology (C-WET) along with the support of central government had setup 40 weather stations across the country to tap the radiation level at different locations.

a) DNI

"(…) [**HOMER, PVsyst, Meteonorm**] *HOMER, PVsyst and Meteonorm are available software in market mostly to all developers, but still the question remains on reliability of these data software.* [**CWET installed 30 whether station**] *C-WET installed 40 stations all over India. Also as per national solar policy the installation of* [**Pyronometer is compulsory installation at plant of 1 MW above**] *Pyronometer is mandatory at all plants above 1 MW."*

Further **R4** responded that, challenges related to training of workforce or Human Resource Development / Capacity Building is not that serious issue and can be handled by developer. The skilled workforce for solar sector is not a challenge as of today. This is evident from discussions below.

b) Training / Capacity Building

"Skilled workforce is not that big issue but yes, I agree to it that we [**Skilled workforce an issue, Workforce limited**] *lack skilled force in sector."* **[Respondent R4]**

Respondent **R6** also stated that availability of accurate DNI database is big challenge, therefore software were used to assess the radiations level for a location.

a) DNI

[**DNI priority**] *"DNI reliability was an* [**DNI data reliability is an issue**] *issue for a plant location. We took help of some software for calculating plant generation. We referred to* [**NREL, Meteonorm, PVsyst**] *NREL, Meteonorm and PVsyst."*

The respondents **R6** and **R2** mentioned that, Training/ Capacity building was not an issues, therefore it can be managed by developers.

b) Training / Capacity Building

"(…) today [**Self training**] *I'm training new engineers* [**On-site training of 2-3 months sufficient**] *on site itself and it is not that difficult, it is more of an ongoing process."* **[Respondent R6]**

a) Training / Capacity Building

[**Self-Training**] *"(…) this kind of skill develops in 2-3 weeks."*

"(…) even I'm putting up a 100 kW plant, I'm ready to go for MW scale installation" **[Respondent R2]**

The associative network diagram in figure 6-8 shows the relationship between the responses given by the interviewees on Institutional Barrier.

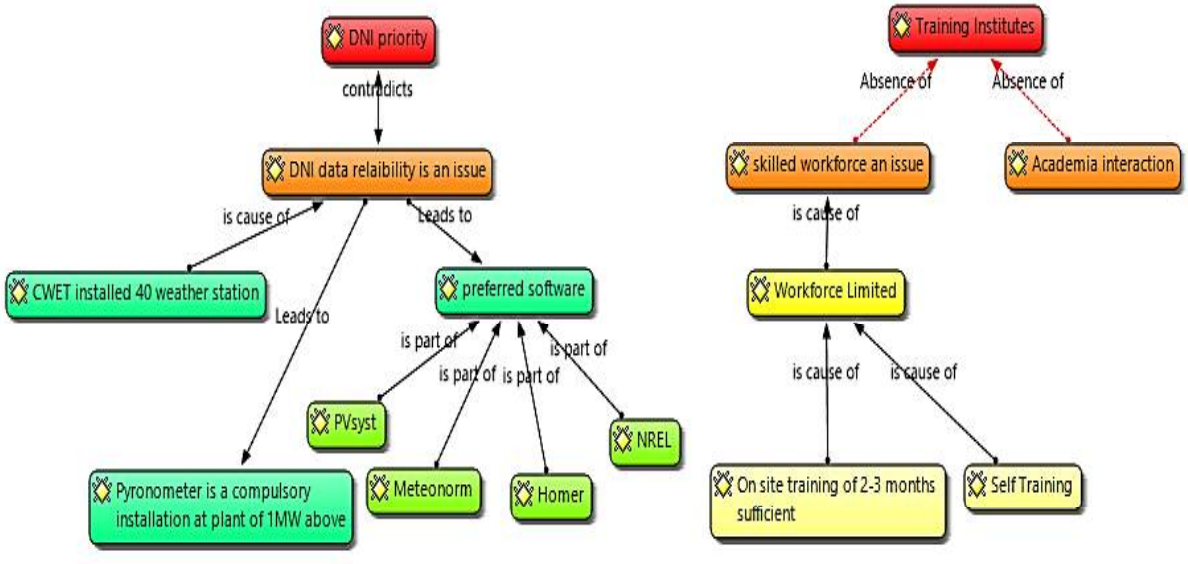

Figure 6-8 Associative network of outcomes on Institutional Barrier in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that Rajasthan had no significant response on the role of Institutional Barrier in the State.

6.6.4 Discussions on Land Information Challenges

The respondents shared their experience related to gaining necessary information for identifying potential land for grid connected solar PV power plants. The respondents communicated that, Government of Rajasthan had designated Rajasthan Renewable Energy Corporation Limited (RRECL) on behalf of Central Government to assist developers with identification of land and provide necessary information as required.

The developers mostly acquired government land with much assistance of RRECL. They further expressed that Village Accountant (Patwari) was much of help in identifying right piece of land.

Government of Rajasthan had identified land banks on behalf of developers. The developers were provided with land banks at on very economical price as compared to Gujarat government land price.

The respondent **R2** stated that, in Rajasthan government suggested land to developers on behalf of Central Government. The government had identified land banks in state which were having high radiations and barren in nature.

> *"In Rajasthan,* [**Government Land**] *government suggested the land. The most part of* [**Developer went for the higher DNI**] *Rajasthan receives high radiation and* [**Large barren Land Banks**] *the identified land banks which were barren in nature.*"
>
> **[Respondent R2]**

The respondent **R1** explained that modules are mounted on a steel structure hence it becomes important to go for soil testing. It is done in order to ensure the strength of soil. This test ensures safety of plant on windy days, wherein the wind speed can go upto 100 miles per hour. The importance and procedure for soil testing is stated below as per information shared by the **R1**.

> [**Soil Testing**] *"Soil testing is done at site to gain information on* [**Land soil strength**] *strength of the land. A minimum of 6 metres is dug and 2-3 kilograms of soils is excavated. It is normally done till we hit the hard surface. The plant design is based on soil testing results, because if this is not considered then it may result in adverse situations for the plant. These areas are mostly under* [**High wind at plant side**] *high wind speed zone where on a given day wind speeds can touch up to 80-90 miles an hour, which is enough to blow the plant off if strong piling is not done or strong mounting structures are not erected."*
>
> *"(…) soil testing results takes around 15-20 days. Accordingly land is leveled and construction is done."*

In the following statements **R1** informed that, in Rajasthan, government facilitated developers with identification of land for the project, which was acquired on lease basis at a very nominal rate.

> *"(…) government provided the land at very* [**Rajasthan land prices cheaper**] *nominal lease amount. Rajasthan had this benefit as compared to Gujarat government land.*

[**RRECL**] *"RRECL shared this database with developers, who submitted their application for* [**Government land**] *land identification in Rajasthan under JNNSM policy 2010."*

[Respondent R1]

R6 mentioned that, land was identified with the help of land arranger. He further commented that physical aspects considered for identification of land are, it should be continuous in nature, contour should good and grid connectivity in proximity. These factors are evident from following statement.

"The land is being identified through [**Patwari**] *land arrangers or local land brokers. The specific details which a developer looks in an* [**information of identified land**] *identified piece of land are:*

1. *Plant should be near the grid substation* [**Grid Proximity**]
2. *Contour should be good* [**Good Contour**]
3. *The strata should be good* [**Good Strata**]

[Respondent R6]

The associative network diagram in figure 6-9 shows the relationship between the responses given by the interviewees on Land Information Challenges.

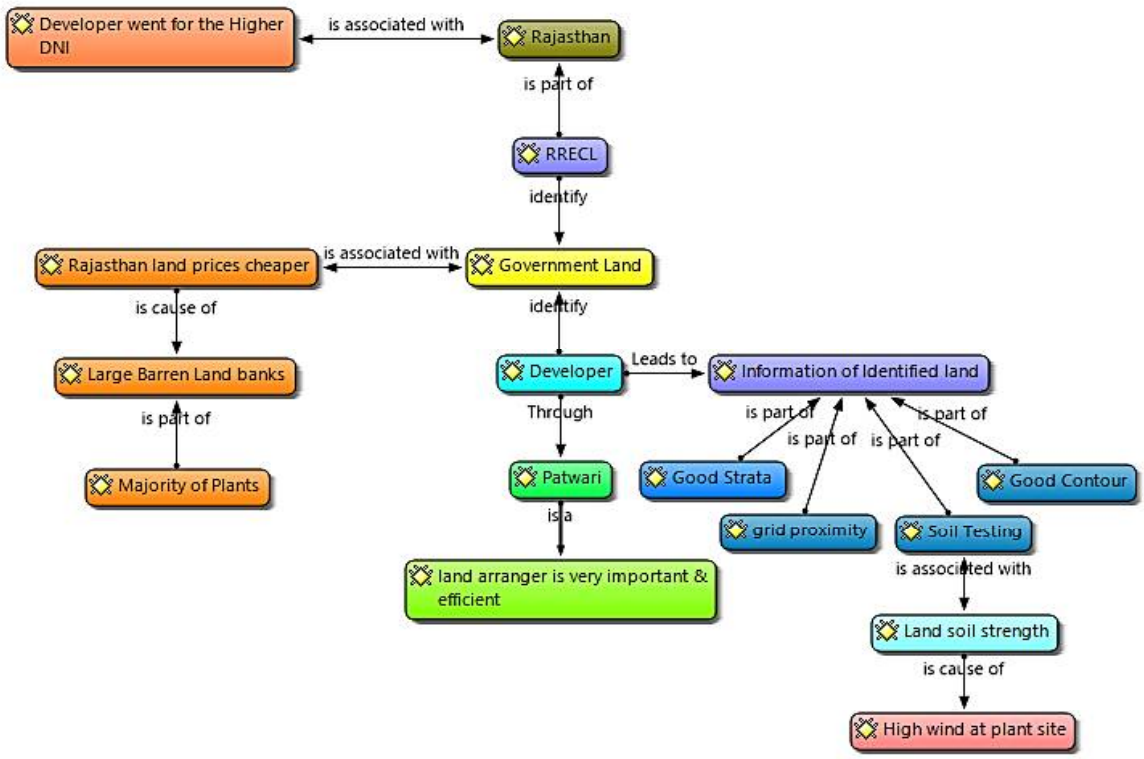

Figure 6-9 Associative network of outcomes on Land Information Challenges in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that Rajasthan had significant response to the role of Land Information Challenges in the State.

6.6.5 Discussions on Land Acquisition Challenges

The Government of Rajasthan had identified a land bank for developers. The nodal agency RRECL had a database which it shared with the potential developers for executing grid connected solar PV projects. The government provided land on lease basis for 30 years + 10 years. This lease was very nominal in value, which helped developer to reduce the overall cost of project.

Though very few projects came on private land, as a consequence the acquisition was tough due to local disturbances which caused delays in execution of project.

According to interviews conducted it was understood that majority of plants have come up on government land in Rajasthan.

Rajasthan has a large area covered by desert and little area covered under forest cover. The Thar Desert is the World's seventh largest desert. It spreads across 800 km in length and 490 km in width. The sand dunes in the southern regions are mapped as high as 152 m, whereas in northern region it is mapped around 16 m in height. Due to sparse rainfall agriculture activities are difficult to be carried out.

The weather of Rajasthan is dry and humid and receives very less rainfall which ranges between 5 mm in winters to 20 mm in summers to a maximum of 130 mm in monsoons. The temperatures are scorching high in summers which can go upto as high as 53°C to a minimum of 0°C in months of winters.

Rajasthan's

- Latitudinal Location: 26.57 N
- Longitudinal Location 73.83 E

The kind of land and climate the State has are paramount conditions for a solar power plant. It has large desert / arid land, it has less rainfall and above all most important it has high solar radiations. Government of India chose and promoted Rajasthan for JNNSM because they were sure of land availability which is best suited for solar power plants and they were sure of radiation level, which is apparently the highest in country.

R1 informed that, RRECL was responsible for identifying government land in State on behalf of central government under JNNSM policy. The developer acquired land on lease basis for 30 years. This was evident from interview given to researcher stated below.

> [**RRECL**] *"Rajasthan Renewable Energy Corporation Limited (RRECL) had* [**RRECL had identified land with good DNI**] *database which had details for some locations along with details of* [**Government Land**] *government land holdings. In late 2009 and early 2010* [**Clinton Foundation database**] *Clinton foundation had created their own database in which they had details of locations and area having high DNI in the State. The person who was working with Clinton foundation* [**Information sharing**] *shared this database on behalf of the company with RRECL for future business proposals in solar energy sector. After some time Clinton foundation dropped the idea of venturing into solar business in India and did not freeze any future plans."*
>
> [**Taluka office** (**Registrar office**)] *"(…) the SDM – registrar is single touch point for land allotment."*

R1 further mentioned that they were assisted by Village accountant who is called Patwari, he is the person who helped them to identify land as per their (developer) need. He further stated that, on identification of land, an application is filed to RRECL for acquisition of identified land. The land is acquired on 30 plus (+) 10 years lease. This lease rate is decided on basis of District Level Committee (DLC) rates plus (+) 10%, which is the prevailing circle rate for that district area. This is apparent from statements below.

"The investor goes to RRECL with an application to install a solar PV plant at a desired location, and then they are directed to respective [**Taluka office** (**Registrar office**)] *Taluka office (Registrar office). There developer seeks the help of* [**Patwari**] *Patwari who helps them to identifying land with desired specification and requirements. He has a map which shows the shape, size and location of land. The land belonging to government is* [**Rajasthan land prices cheaper**] *cheaper as compared to private land in Rajasthan. The* [**Developer**] *developers seek to take hold of a* [**Government Land very cheap**] *government land even if contour is not continuous, because if he has to go for a* [**Private Land**] *private land then it can be an expensive tradeoff for him."*

"(…) for a developer shape of land would be last thing even to compromise upon. The land categorizations are [**Katha**] *'Katha' and* [**Khasra**] *'Khasra'."*

"After the land was identified [**Developer informs RRECL about the identified land**] *we submitted an application to RRECL for allocation of that land. Then nodal agency (RRECL) forwards the application to concerned Taluka (Registrar office) for allotment of land."*

"Our power plant is on government land which is being leased for [**30 years**] *30 years plus (+) 10 years. The* [**Government Land on lease**] *land lease price is decided on the basis of* [**10% of prevailing circle rate + District level Committee Rates**] *District Level Committee rates plus (+) 10% which was the prevailing circle rate for the district area. Rajasthan had this advantage over other states and specially Gujarat that it had* [**Large Barren land**

Banks] *abundance of government land holdings that is under* [**Developer went for the higher DNI**] *high radiation areas.***"**

[Respondent R1]

R2 and **R3** also states that, they acquired government land for their project. RRECL facilitated them on behalf of State government under JNNSM policy.

> *"We had acquired* [**Government Land**] *government land for our projects in* [**Lease price**] *Rajasthan on* [**Government Land on lease**] *lease basis for 30 years. All the allocation procedures were done by* [**RRECL**] *nodal agency on behalf of the Government of Rajasthan under* [**JNNSM**] *JNNSM policy. The advantage Rajasthan has is that it holds* [**Large Barren Land banks**] *large area which is barren and not suitable for agriculture and moreover it is* [**Government Land very Cheap, Rajasthan land prices cheaper**] *cheap."* **[Respondent R3]**

> [**RRECL had identified land with good DNI**] *"In Rajasthan the government* [**Information sharing**] *suggested land to developers."*
>
> **[Respondent R2]**

R6 states that, their project was executed on private land which was identified with the help of Patwari. He expressed that, project faced problems in acquisition of land. The project was delayed because of local disturbances faced during the construction period.

> *"(…) this plant is on* [**Private Land**] *private land. Western Rajasthan has* [**Large Barren Land banks**] *large land availability and in abundance that was barren in nature and*

cannot be used for agriculture purpose. The land was identified with the help of a [**Patwari**] *local land arranger."*

[**Land acquisition was difficult**] *"Land acquisition was very difficult as we had to face challenges from* [**Local disturbances**] *local people and communities. Local disturbance were there because of which* [**issues of delay**] *we lost days for commissioning our projects."* **[Respondent R6]**

The associative network diagram in figure 6-10 shows the relationship between the responses given by the interviewees on Land Acquisition Challenges.

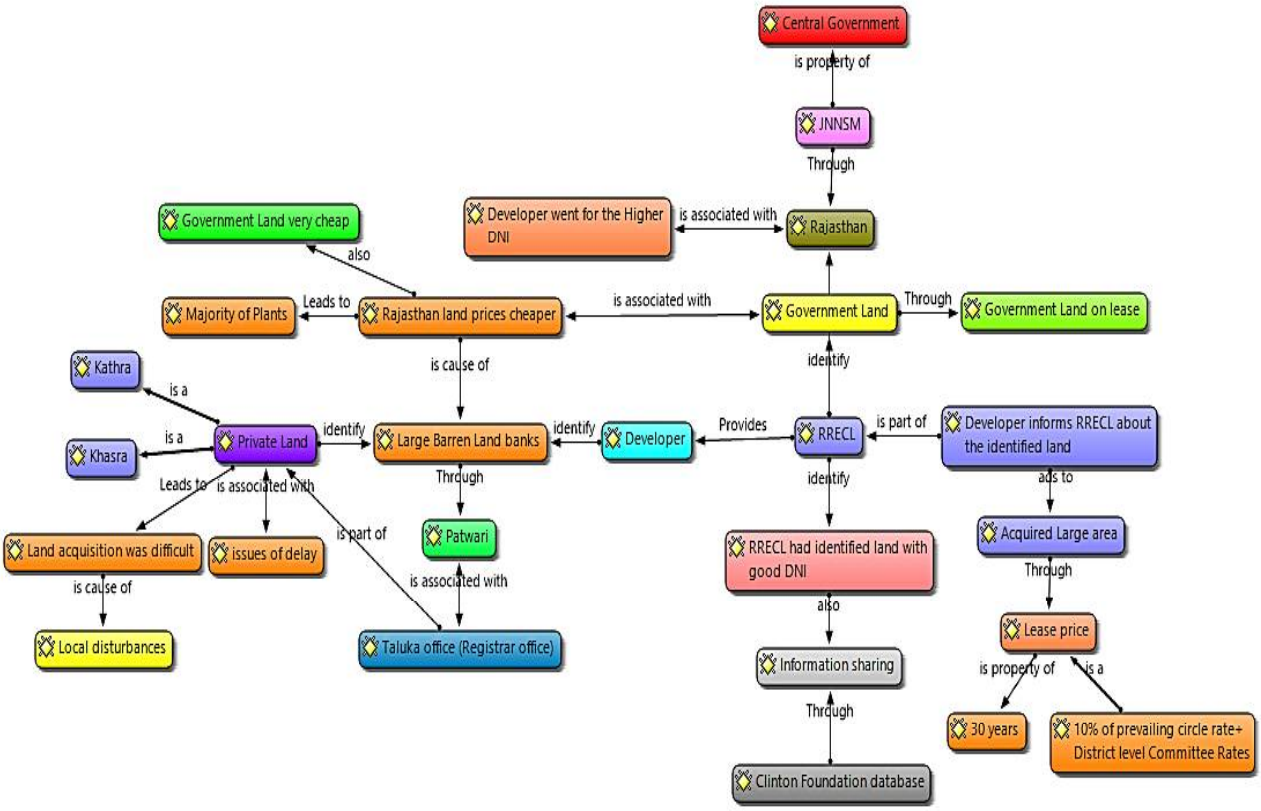

Figure 6-10 Associative network of outcomes on Land Acquisition Challenges in State of Rajasthan

Thus from the experiences shared by different respondents, it is evident that, Rajasthan had significant response to the role of Land Acquisition Challenges in the State.

6.6.6 Discussions on Administrative Challenges

The respondents shared a mixed experience on administrative challenges in the State. It was learnt from their responses that Rajasthan had provision of Single Window Clearance Mechanism (SWC), but it was time consuming, as it was not fully implemented. The reason given by respondents was that, RRECL had to seek clearances from Central Government on some matters which apparently caused delays.

It is evident from the responses, that bureaucracy and administration was weak and time consuming. The related clearances took time as a result of which developer had to experience delays in execution of their project.

The Power Purchase Agreements (PPA) was successfully signed with NVVN and it made sure the developers were made payments on timely basis as per PPA signed.

R1 explained that, Single Window Clearance (SWC) mechanism was not fully implemented and they faced delays in processing of application. He further states many developers faced problems in getting clearance on time which resulted in delays in commissioning of projects. This can be understood from the interview statement given below.

> [**RRECL**] *"RRECL was* [**Effective Single window clearance**] *effective in the matters which were in their hand. RRECL was in charge of promoting* [**Central Government**] *JNNSM in State and*

at times few matters were escalated to central government that [**Time Consuming**] *caused delays in some projects."*

[**Documents forwarding related to environment and forest clearance**] *"(…) RRECL helped in forwarding the documents related to environment and forest clearance to Centre."*

"(…) Single Window Clearance facility was available but it was [**Time Consuming**] *time consuming as it was not fully implemented and normally they were time consuming."*

[**Rajasthan Pollution Board**] *"(…) Rajasthan pollution control board gave the* [**Consent to Establish, Consent to operate**] *approvals related to consent to establish and consent to operate, which normally every state pollution control board does it."*

[RespondentR1]

Whereas **R3** mentioned that, approvals for their project were granted on time.

[**Effective Single Window Clearance**] *"Government facilitated land and approvals were granted on time."* **[Respondent R3]**

R6 expressed that their project experienced delays in execution due to issues in getting timely approvals.

[**Single Window Clearance was an issue**] *"Single Window Clearance was a somewhat cumbersome in Rajasthan,* [**Clearance in Rajasthan was time consuming**] *because of some problems it delayed our project."* **[Respondent R6]**

The associative network diagram in figure 6-11 shows the relationship between the responses given by the interviewees on Administrative Challenges.

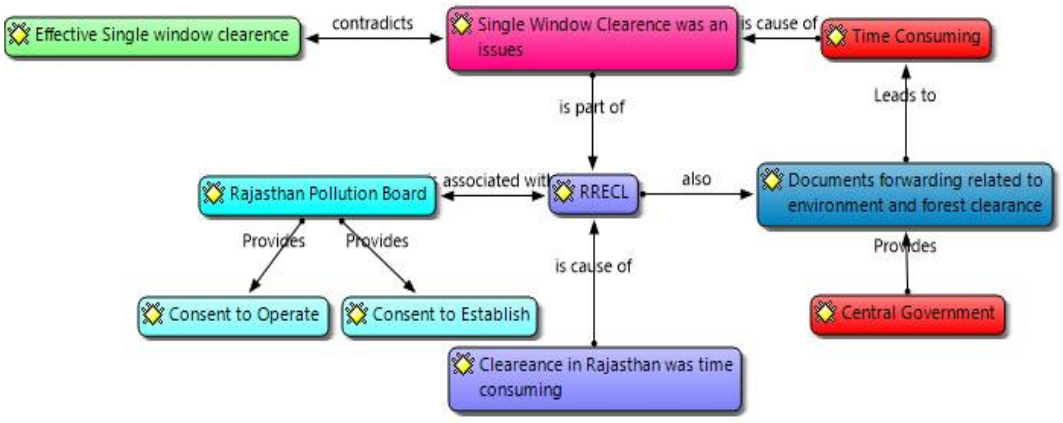

Figure 6-11 Associative network of outcomes on Administration Challenges in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that, Rajasthan had no significant response to the role of Administrative Challenges.

6.6.7 Discussions on Regulatory Barrier

It is learnt from respondents experience that under JNNSM competitive bidding had no negative impact on tariff (which was discovered through this process), moreover, it helped in price discovery and creating a competitive market.

The competitive bidding made sure that serious players entered the market, new and efficient technologies were incubated.

Rajasthan as State had no role in regulation of the sector as majority of grid connected solar PV power plants came under JNNSM through a

competitive based tariff decided by Central Electricity Regulatory Commission (CERC).

Under JNNSM policy government had no Merit Dispatch Order for solar power plants, the developers were assured of whatever the plant generated will be fed to grid.

R5 expressed that, bidding process under JNNSM policy was not an issue instead it helped in developing market in a competitive manner. Competitive bidding helped in discovering the true price for solar sector. The regulator Central Electricity Regulatory Commission (CERC) announced the benchmark capital cost for SPV.

> *"No I don't think so that* [**Reverse Bidding**] *reverse bidding is having any* [**No negative impact**] *negative impact instead it is helping the sector grow* [**Market Competition**] *competitively and* [**Price Discovery**] *discovering the real price of technology. I feel giving higher Feed in Tariff is not the solution for longer run as Gujarat is doing. Yes initially the sector needed support to grow but this cannot be the solution in long run.*" **[Respondent R5]**

It is clear from the following statement by **R4** that, process of selecting the bidders should be more stringent because reverse bidding can lead to such low prices which are not at all feasible furthermore makes it difficult for the serious player to be competitive.

> [**Reverse Bidding**] *"Reverse bidding is being done for the first time in this sector. Normally we heard from international market about FiT, Tax Incentives, RPS, Net Metering, Subsidies/Rebates. It is good in one way that it helps in* [**Price Discovery**] *price discovery,* [**Market Competition**] *brings in competition, brings in*

[**Serious players**] *serious player and helps in* [**Incubation of New Technology**] *incubation of new and* [**Efficient technology**] *efficient technologies. Central Electricity Regulatory Commission sets the benchmark capital cost and asks developers to bid competitively. I feel that regulator should look into the* [**Criteria for selection of projects**] *criteria set for developers participating in the bidding process. It should be more* [**Stringent**] *stringent and not only on the basis of net-worth of the company, because many times it leads to very* [**Unrealistic and impractical price**] *unrealistic and impractical price discovery and serious ones loses out on opportunities."*

R4 further explained that, government tried to call serious bids by asking the player to deposit ₹10,000 for each paisa discount offered on tariff declared by CERC (MNRE, 2010). On successful commissioning of the project the money deposited will be converted to Performance Bank Guarantee (PBG). Further this PBG is kept as guarantee against the performance of the plant. This is clear from the statement given by the developer.

"Bid bond of 10,000 is submitted by developer on each paisa discount per kWh per MW. (…) for example, in 1MW if a developer proposes 10 paisa discount over the capital cost declared by CERC then he is liable to submit ₹ 1,00,000 as bid bond amount. If incase the bidder is not able to meet the bid and moves back then that money will not be refunded and if he goes on to commission the project at said bid that amount will be converted to [**Performance Guarantee**] *Performance Bank Guarantee."*

"While you are signing a PPA the [**penalties on below minimum supply of power**] *power supply is mentioned on annual basis, this can fluctuate up to ±10% of the mentioned supply. This is assessed quarterly basis if the fluctuation is more than that, then generator is penalized through this* [**Performance Guarantee**] *Performance Bank Guarantee."*

It is evident from the statement given by **R4,** sun radiations are source for generation of electricity, which is intermittent in nature and solar power plant does not come under the purview of Merit Dispatch Order. This is can be drawn from interviews given below by different developers in State of Rajasthan.

"Solar is categorized as must run plants just like hydro. It means whatever the plant generate it will be fed into the grid and these plants do not come under [**No merit order for dispatch of power**] *dispatch merit order."* **[Respondent R4]**

The associative network diagram in figure 6-12 shows the relationship between the responses given by the interviewees on Regulatory Barrier.

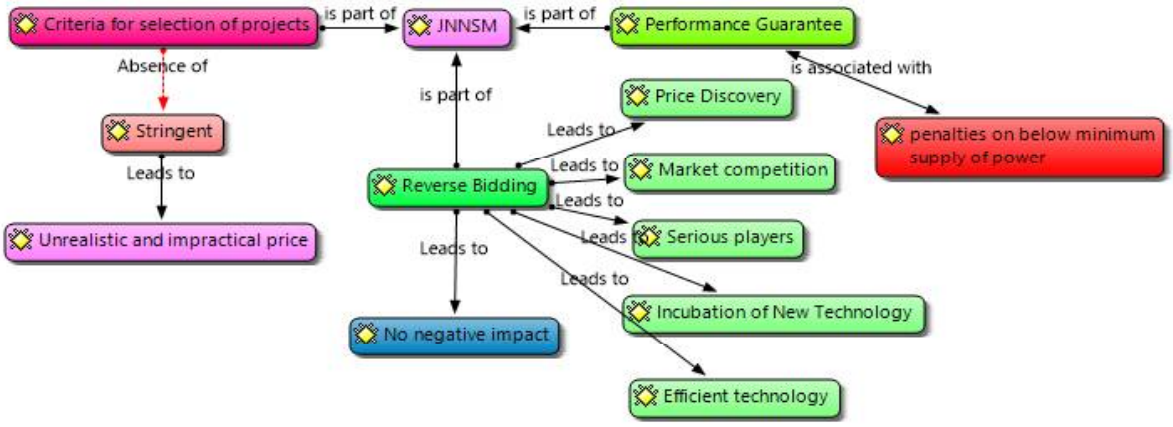

Figure 6-12 Associative network of outcomes on Regulatory Barrier in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that Rajasthan had no significant response to the role of Regulatory Barrier in the State.

6.6.8 Discussions on Market and Technology Barrier

It is evident from the interviews that country lacks matured market for solar energy sector.

It was learnt from the responses that, developers had a very little choice to make between PV manufacturers in India. Moreover there were issues related to efficiency of PV modules manufactured in India.

Hence most of developers had to import modules and related equipment from different countries. Most preferred country for importing Crystalline PV modules was China followed by Japan and Canada, whereas USA was most preferred for importing Thinfilm PV modules by the developers.

The respondent communicated that developing a grid connected solar PV power plant in country is more of a logistic management as most of the plant part, whether modules, cables, inverters or modules were imported. Rajasthan lacks the advantage Ports in its region as compared to Gujarat, which lead to increase in logistic cost to 10%-15%. The logistic cost of accounts to 1%-2% of total project cost.

R5 explained that, solar market is not developed in India. The Indian manufactured crystalline silicon modules are expensive as compared to Chinese and Japanese manufactured modules. He further pointed that the solar business is more of effective logistics, as it plays an important role. It accounts to almost 2% of the total project cost, mostly all related equipment are being imported. **R5** further state that unqualified

manufacturers can not affect the market because, first it is difficult to outpace Chinese PV modules cost of manufacturing and secondly it is difficult to meet the demand of solar sector in India.

It is clear from the following statements that attaining project feasibility was difficult with Indian manufactured PV modules.

R5 commented that, companies have teams engaged in quality assessment of modules and other equipment required for solar PV power plant as they make sure that right module technology and equipment are deployed for the plants.

> *"In India solar projects are more of a* [**Logistic management**] *logistics management as most of the* [**Import of Inverters, Import of Panels, Imports of Cables, Imports of connectors**] *plant equipment and machineries like Panels, Inverters, Cables, and Connectors are* [**imports**] *imported from different countries."*
>
> [**Unregistered and unqualified Manufacturers**] *"Unqualified module manufactures will* [**No negative impact**] *not have any significant impact or I should term these as new manufactures, who are venturing into this business as diversification as they saw new opportunities. They hired people with experience and started their business but they were mainly* [**Manufacturing of Low Watt Peak (Wp) rating modules**] *manufacturing low Watt peak (Wp) rating modules which make it very difficult for them to impact the utility scale market of solar PV.* [**China is more competitive as it has cheap labour**] *China is still cheaper and there landing cost is less than the cost of sale in India."*

"Every [**Developer**] *company has* [**Assessment of the Modules manufacturer**] *quality assessment team which has certain* [**Feedback from the other consumers**] *parameters to adhere to and do their due diligence of the modules."*

[**Modules from USA, China, Japan, Canada**] *"Modules are sourced from China for our projects.* [**China is more competitive as it has cheap labour**] *China captured the PV market between 2009 - 2011 and still they are going good."*

"Port availability has played important role and Gujarat had this competitive edge over many other states. The average logistic cost per watt is around ₹1 to ₹1.50 then a 1 MW will cost around ₹15,00,000 which is almost 2% of the project cost."

R5 continued to share his experience in the sector by stating that India does not hold the potential for silicon manufacturing in near future.

[**Immature market, Limited PV Manufacturers**] *"(…) I don't think manufacturing of silicon will ever take routes in India or even China. Gulf is coming in a big way and it can hire cheap labour from the subcontinent. Wafer manufacturing is not much capital intensive business and cells can be done at a lesser cost in* [**China is more competitive as it has cheap labour**] *China as it has the cheapest labor as of today."* **[Respondents R5]**

R2 stated that in Rajasthan, they experienced increased cost for logistics as compared to Gujarat.

"In Rajasthan the [**Logistic cost increases by 10% - 15%**] *cost of logistics is higher as compared to Gujarat which increases to almost 10% - 15% more due to* [**Unavailability of Port**] *non-*

availability of ports. In [**Rajasthan**] *Rajasthan the turnaround period for a container from port to site comes to almost 7 days*"

[Respondents R2]

R6 mentions that, they imported PV modules from China, company provided 25 year guarantee on modules. The logistics cost is almost 2% of total project cost.

[**Developer**] *"We have a cumulative installation of 50MW and all modules have been* [**Maximum import from China**] *sourced from a Chinese company. They give a* [**25 year guarantee**] *guarantee of 25 years on their module which is the life cycle period of modules covering all the technical issues."*

[**Logistic cost 1% - 2%**] *"(…) logistic cost is approximately 2% of total project cost.***"** **[Respondent R6]**

The associative network diagram in figure 6-13 shows the relationship between the responses given by the interviewees on Market and Technology Barrier.

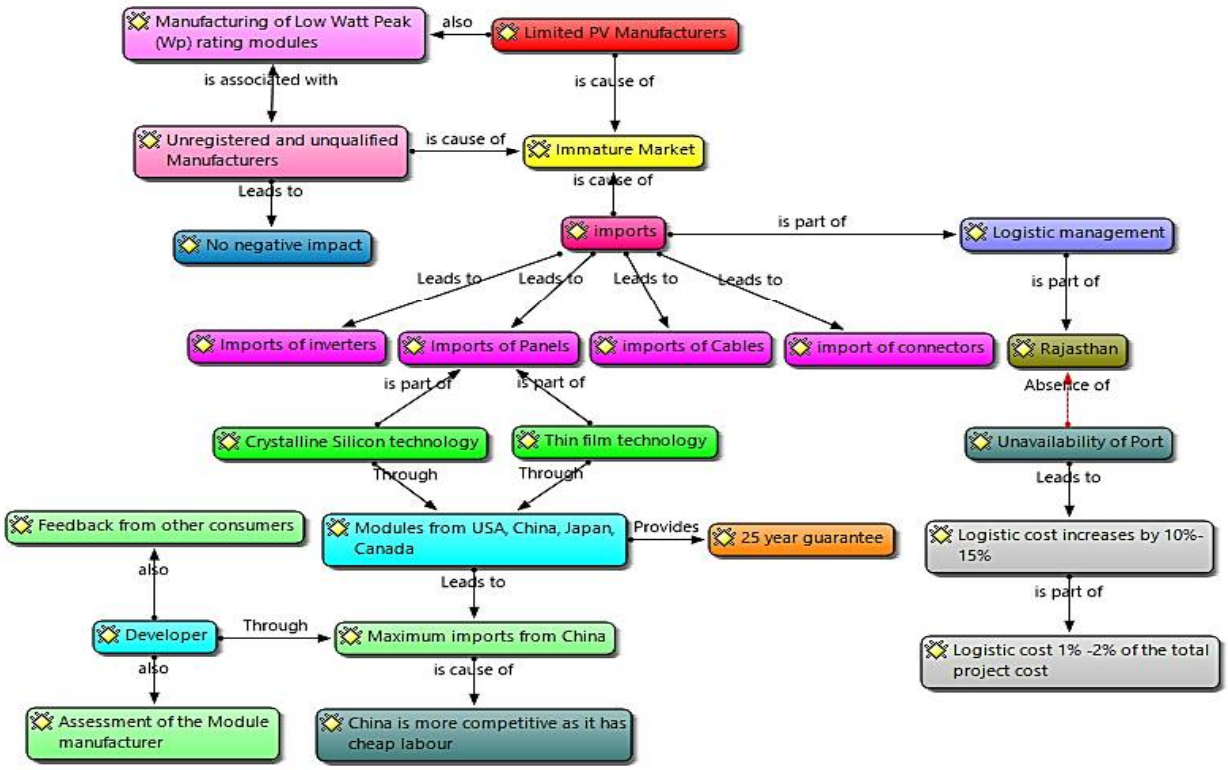

Figure 6-13 Associative network of outcomes on Market and Technology Barrier in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that Rajasthan had no significant response to the role of Market and Technology Barrier in the State.

6.6.9 Discussions on Development Cost Barrier

The development cost or also known as pre operating cost which was not a barrier for developers a large. Responses by developer pointed out that it is hardly 10% of total project cost.

The development cost consists of different heads as per the CERC guidelines are:

- Insurance Cost: 0.5%

- Contingency: 0.5%
- Interest during Construction (IDC): 5%
- Financing cost: 1%
- Project management cost: 1%
- Pre-operative Cost: 1%

The respondent **R4** and **R5** stated that, development cost was not a concern. The developers who are desirous of installing a grid connected solar PV power plant, had to fulfill the minimum financial criteria and one of them was net worth. As per JNNSM policy the net worth of a developer has to be 3 Crore per MW.

> *"Net worth was not a problem as such and was manageable* [**No negative impact**]. *It was necessary as seriousness in the sector was required."*
>
> *"Pre installation cost (Project Development cost) does not matter much it is very low percentage of the total project cost* [**No negative impact**]*."* **[Respondent R4]**
>
> [**Net-worth cost was high**] *"Net worth criteria was* [**No negative impact**] *not serious issue for any of the projects did by the company"*
>
> [**Pre-installation investments high**] *"(…) the pre operation cost hardly makes any difference to total cost* [**No negative impact**]*."*
>
> **[Respondent R5]**

The associative network diagram in figure 6-14 shows the relationship between the responses given by the interviewees on Development Cost Barrier.

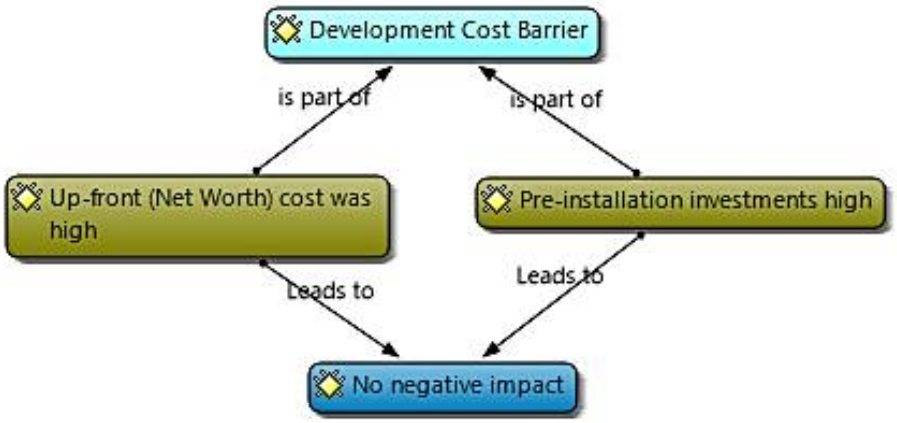

Figure 6-14 Associative network of outcomes on Development Cost Barrier in State of Rajasthan

On summarizing the experiences shared by different respondents, it is evident that Gujarat had no significant response to the role of Development Cost Barrier in the State.

6.7 Epilogue

This chapter discussed about Rajasthan as a State, it provided information on its power sector, generation capacity, solar energy sector and its generation.

This section reports the overall finding of several interviews conducted in Rajasthan. The assessment across different respondents from the same State was shown through associative network diagrams in previous sections, as it helps researcher to better understand State's response to the role of identified barriers and challenges for grid connected solar PV power plants. This process facilitated researcher to develop a strong base for cross case analysis.

The figure 6-15 shows the overall findings of current case study. The factors encircled are those barriers and challenges to which Rajasthan had significant response, as a result of which State was able to attract investment for grid connected solar PV power plants in its region. Whereas, factors which lie outside the circle, are the ones to which Rajasthan couldn't have significant answer to mitigate them. As interpreted, these are factors which State alone cannot answer, moreover strong national policy measures need to be taken to support the State(s) in mitigating some them.

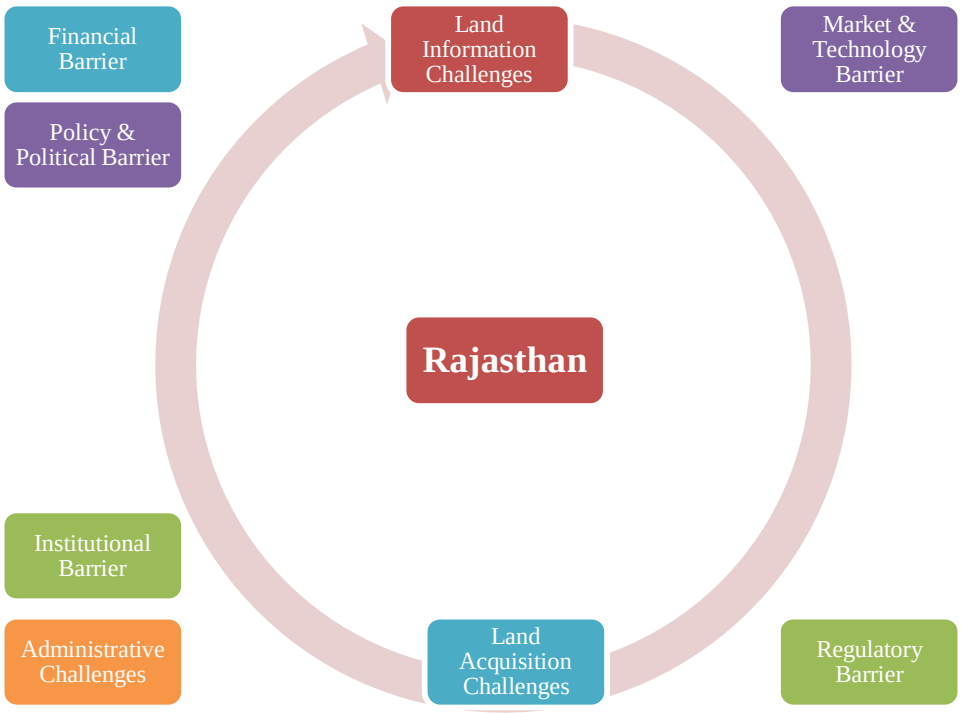

Figure 6-15 Results of Gujarat Case Study

It was understood that Financial Barrier is market driven and not State driven, inspite of the fact Rajasthan has strong investment environment for solar energy sector.

The Market and Technology Barrier alone cannot be mitigated by State as the overall manufacturing cost of PV modules is expensive anywhere in the country. Moreover, technology R&D in country is lacking due to which definite reductions in cost is not predictable. Hence, country will continue to depend on other countries like China, Japan and USA for sourcing modules as well as related equipment.

Due to the fact that all plants have come under JNNSM and during the study no plant was executed under Rajasthan Solar Policy, it is understood that State had no significant response to Policy and Political Barrier, i.e. policy lack the merit to win trust of investor and other stakeholder at large. Though, Government of Rajasthan assisted developers in identifying potential land sites for executing their projects, on behalf of Central Government under JNNSM.

The State was also unable to mitigate the challenges related to Administration, which resulted in delays of projects. The procedures were multi-tiered and time consuming, hence there was inefficiency in administration.

Further, the Institutional Barrier can be managed by State, but as of today State lacks such facilities to assist stakeholders and to contribute significantly in development of solar sector.

This completes the Within Case analysis for Case Study of Rajasthan.

The next chapter discusses Cross Case analysis for two cases.

Chapter 7

Cross Case Analysis

7.1 Introduction

This chapter presents the Cross Case analysis for Gujarat and Rajasthan along with the findings. In this chapter, similarities and dissimilarities between two case studies are presented. The findings from two case studies are compared on identified Barrier and Challenges. The table and figures presents the conclusive findings on State's response to the role of identified Barriers and Challenges found in Chapter 3.

7.2 Similarities and dissimilarities between cases

Table 7-1 presents the comparison of two States on the basis of their fact file.

Table 7-1 Cross Case findings on fact file of Gujarat and Rajasthan

S.No.	Parameters	Gujarat	Rajasthan
1	State Capital	Gandhinagar	Jaipur
2	Area (Sq. km)	1,96,024	3,42,239
3	Population(2011 Census)	6.04 Crores	6.86 Crores
4	Population Density(per Sq.Km)	308 persons	201persons
5	Districts	26	33
6	Average GSDP growth rate (%)	16 %	17.9 %
7	Sex Ratio (2011 Census)	917 females per '000 males	926 females per '000 males
8	Key Industries	Textiles, Engineering, Petrochemicals, Drugs &	Mineral Based Industries, Textiles, Tourism, Gem