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## Article

Institutional environment and credibility of public promotion of renewable energy. Lesson's from India's grid solar energy management in Gujarat state

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# Institutional environment and credibility of public promotion of renewable energy

## Lesson's from India's grid solar energy management in Gujarat state

### Abstract

Located in the equatorial Sunbelt of the Earth, emerging economies such as India have huge potential for the development of solar energy. India's concerted public promotion of the sector through the National Solar Mission has enabled the growth of over 1 GW grid solar power over the past three years. However, the sectorial growth at the state level has shown a significantly different outcome, with states such as Gujarat contributing more than half of the nation's installed capacity. Many other states contribute less than 1 %. Such lopsided growth at the regional level shows serious concerns for the sustained growth of the sector and for meeting India's overall national target of 20 GW by 2022. Experience around the world has shown the critical importance of local institutional environment in successfully impeding or stimulating public promotion of renewable energy. Literature on India's solar energy development however has so far been largely concentrated at the national level, sidelining the institutional dynamics affecting the sectorial growth at the regional level. This paper seeks to address this gap using the institutional analysis of factors affecting the successful public promotion of grid solar energy at the state level, by studying the case of Gujarat through stakeholder and expert interview. Following the new institutional economic perspective, this study develops a transaction cost economics cum positive political theory approach with focus on the role of intuitions in restraining actor's opportunistic behaviour and its implications on the credibility of governance structure.

## 1 Introduction

In the phase of the saturation and decline of solar energy markets in most European countries, late adopters such as India offers huge potential and opportunities due to its geographical advantage and untapped market. Located in the equatorial Sunbelt, India has one of the highest geographical solar energy potential in the world. In most parts of India, clear sunny weather is

experienced for about 300 days a year with an annual average global solar insulation ranging from 4 to 7 kWh/m<sup>2</sup> per day (cf. PUROHIT et al. 2013: 158). The increasing demand for energy and the twin objective of mitigating climate change and energy security has led to an increasing focus and public promotion of renewable energy in India. Despite being a late comer, India has taken a huge leap forward with the concerted effort of the Ministry of New and Renewable Energy, MNRE and the ambitious national solar mission for achieving 20 GW by 2022. Accordingly, India is emerging as an important player in the development of the sector and ranks amongst the second highest solar energy market potential in the world (cf. JASWAL 2009; SARGSYAN 2010; ERNST AND YOUNG 2012: 20). The progress so far has been encouraging at the national level — within three years India's installed solar power capacity has increased from 15.2 MW at the end of June 2010 to over 1233.73 MW by 31st Jan. 2013 (cf. NREL 2010: 35; MNRE 2013).

Despite this overall progress at the national level, the development at the regional level has shown remarkably different outcome. Of the total 1233.73 MW installed capacity, 66.8 % (824.09 MW) have come from Gujarat state alone — more than the capacity of all other 27 states combined (cf. MNRE 2013). Such lopsided growth at the state level shows serious concerns for the sustained growth of the sector and for meeting the overall national target of 20 GW by 2022. Achieving the national solar mission will require concerted efforts from all the states and re-evaluating the institutional environment at the individual state level to access why it has not taken off in most states.

Experience around the world indicates that local institutional environment and arrangement, at the state level, play a key role in determining renewable energy policy outcome. In particular ÜRGE-VORSATZ et al. (2004) in their case study of renewable energy policy instruments have highlighted the inadequate performance of policy instruments when they are not adapted to the local institutional capacity and environment. The role of institutional environment for economic performance and in particular the performance of public policies for renewable energy development has been illustrated in many leading studies (cf. NORTH 1990; WEINGAAST 1995; LEVY/SPILLER 1994; PEREZ/RAMOS 2009; KULKANARI 2010).

The existing studies on the development of India's solar energy sector has however been mostly confined to the central policy initiatives (cf. KULKANARI 2010; SHRIMALI/ROHRA 2012; HARISS et al. 2009; SARGSYAN 2010; SCHMID 2011) leaving a vacuum on the institutional dimension at the state levels. Within this backdrop, this paper seeks to address this gap and analyze the black-box of how local state institutional environment and arrangement affects policy outcome by studying the case of Gujarat from the period beginning 2009 to January 2013. The case study has been

analyzed through literature review of scientific studies, documents and reports of public organizations, private agencies and primary data collection through semi structured interviews with key stakeholders and experts along the tradition of Yin (2009) case study methods. Based on literature review the sample selection for the interview was carried out through purposeful sampling, which was then further expanded and refined through expert interviews and snowballing interviews with identified stakeholders. The final interview sample consisted of fifteen stakeholder groups along with five experts at the central and state level for in-depth interview to assess the overall factors affecting investment decision in the sector.

The proceeding section first introduces the overview of public promotion of the sector in India, followed by the theoretical and analytical framework of the study. Based on the analytical framework, the credibility of public promotion of solar energy in Gujarat is discussed further in the next section. Finally, through the research findings, the implication and way forward for Gujarat and the rest of India is elaborated along with the conclusion of the study.

## 2 Public promotion of solar energy in India: an overview

The institutional mandate for promotion of renewable energy in general and on-grid solar energy in particular is given through the Electricity Act, 2003; it acts as the principal statute governing the entire electricity sector in India. Based on this act, the National Electricity Policy 2005, the Tariff Policy 2006 contains specific policy provisions for the promotion of renewable energy sources. The provision for instruments such as cogeneration and generation of electricity from renewable sources, setting of renewable purchase obligation by state SERC (State Electricity Regulatory Commission) or preferential tariffs, criteria for competitive bidding to reduce generation cost for renewable energy etc. are given in the above acts and policies (cf. HORAM et al. 2013; ELECTRICITY ACT 2003; NATIONAL ELECTRICITY POLICY 2005; TARIFF POLICY 2006). These mandates and provisions at the central level are then complemented with individual state solar policies, as electricity is under the jurisdiction of both the central and state governments (cf. ELECTRICITY ACT 2003).

Under these provisions the promotion of solar energy had been mostly confined at the central level until recently. India was the first country in the world to set up a Ministry of Non-Conventional Energy Sources in 1992 which was then re-instituted as the Ministry of New and Renewable Energy (MNRE) in 2006. The Ministry functions through various state level 'nodal agencies', to implement the given mandate and help disseminate information, technology diffusion, financial assistance and technical trainings at the state level.

A paradigm shift in India's climate initiative came with the launch of the National Action Plan for Climate Change, NAPCC, in 2008. It initiated the development of solar energy as a national mission to mitigate climate change. Under this plan, the national solar mission, JNNSM 2010 (Jawaharlal Nehru National Solar Mission), rolled out an ambitious national target of achieving 20 GW by 2022. The mission laid down a clear roadmap for the development of the sector through various policy instruments and budgetary support to create an enabling framework for the promotion of solar energy in all the states of India (cf. NAPCC 2008; JNNSM 2010). The national target under this mission is divided in three phases, with separate targets for on grid and off grid solar energy installations. The grid-connected solar power targets are set to 1 GW by 2013, 10 GW by 2017, and to 20 GW by 2022 in a three phase manner.

To achieve these targets various policy instruments — SPO (Solar Purchase Obligation), REC (Renewable Energy Certificate), FIT (Feed-in-Tariff) and other indirect financial subsidies — have been deployed. SPO is targeted at 0.25 % of the total 5 % RPO (Renewable Purchase Obligation) in the first phase and a target for gradual increase to 5 % by 2022. The FIT for phase-I was initially set at INR (Indian Rupee as of June 2010) 17.91/kWh for Batch-I of the first phase and INR15/kWh for the second batch. However due to over-subscription of the projects, the projects have been finally allocated through a competitive reverse bidding process where the price has gone down to as low as INR 7.41/kWh. The REC mechanism has been introduced with a floor price of INR 9300/MWh and forbearance price at INR13400/MWh, which is then traded at the India Energy Exchange Ltd. and Power Exchange India Ltd. (cf. CERC 2011).

Along with this policy instrument at the central level, seven other Indian states — Gujarat, Rajasthan, Karnataka, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu — have come up with their own state solar policies. Despite these initiatives none of the states — apart from Gujarat — have been able to attract considerable private investment based on individual state solar policy. This is reflected in the state level installed capacity as of 31<sup>st</sup> January 2013 (cf. Figure 1), where Gujarat state alone accounts for more than half (824.09 MW) of the entire installed capacity (1233.73 MW) in India. Close to the level of Gujarat is the case of Rajasthan, where the state has managed 251.25 MW of solar power, primarily through the central policy support. Figure 1 highlights the highly skewed state level development. Except for Gujarat and Rajasthan all other states have installed a capacity of less than 26 MW. Aside from the illustrated 16 states in Figure 1, the gravity of uneven development is illustrated by the fact that the remaining 12 states in India have no sectorial development till date.

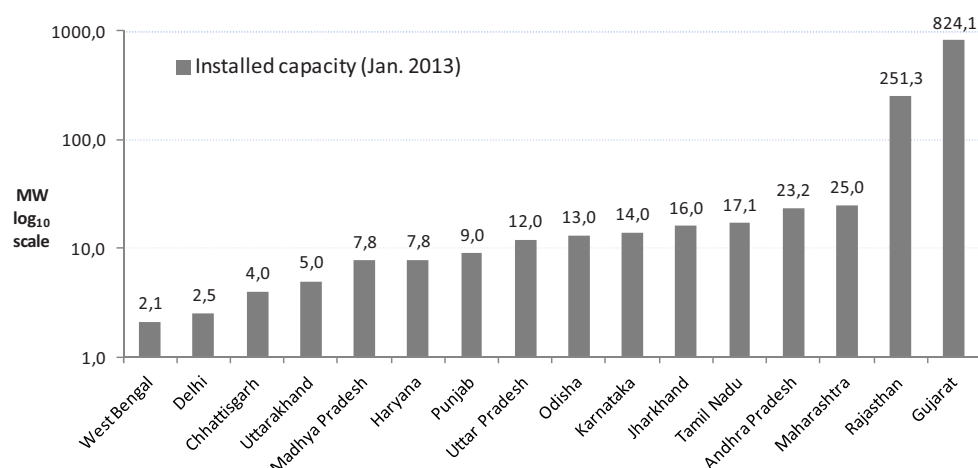


Figure 1: State-wise grid solar power, India; Source: MNRE 2013

In addition to the highly differential state level development, the sectorial experience over the past years indicates additional concerns as many of the allotted projects in many states have not been realized. This is shown in Figure 2, where most of the states have allotted projects (through PPA, power purchase agreement) much higher than the projects actually commissioned. The figure shows the number of states with PPA over 10 MW.

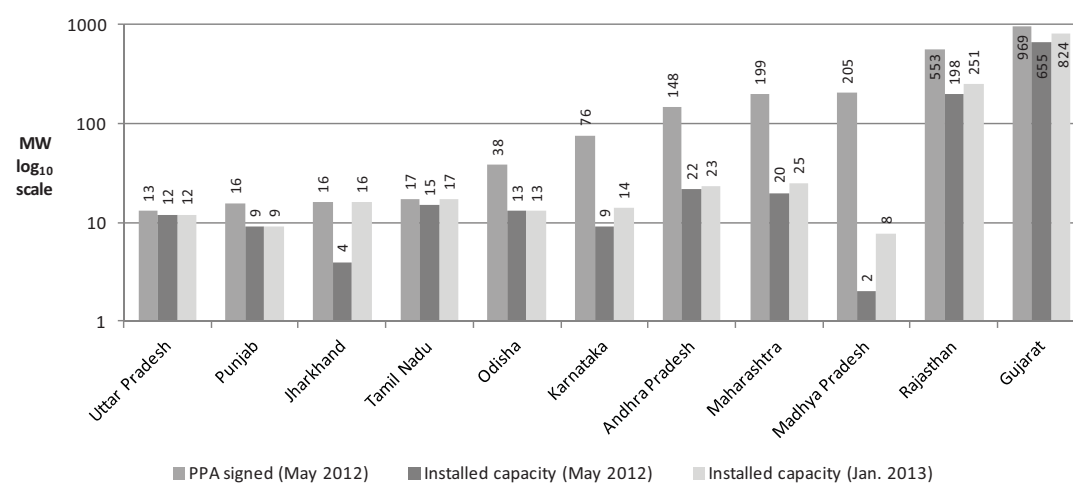


Figure 2: State-wise grid solar power: Projects allotted and commissioned, India; Source: MNRE 2013

The major reason why most of these allotted projects could not materialize or were delayed have been attributed mainly to the lack of facilitating local state institutional environment to foster credibility of these PPAs to raise project finance and provide other conducive environment for successful project implementation. In this regards three states — Madhya Pradesh,

Andhra Pradesh and Maharashtra — illustrates an extreme case, where the projects allotted were over 140 MW in May 2012 but the actual projects implemented after the project commissioning deadline (January 2013) have been below 26 MW in all the cases (BRIDGE TO INDIA 2012: 10-11; MNRE 2013). As a result, most of the states have not been able to fulfil their SPO obligation for the year 2012 (MNRE 2012).

Within this backdrop the successful case of Gujarat has the potential for lessons that can be learned and adapted by other states as all Indian states function under the same electricity regulatory framework and similar socioeconomic background.

### 3 Theoretical perspective

Transaction to renewable energy in general and solar energy sector in particular presents a special governance challenge as investments are made in specific assets and investments once made cannot be redeployed to alternative uses without loss of productive value. So, incentivizing private investment in this sector requires a long term investment safeguard to ensure reasonable return on the investment. It requires the credibility of instruments implementation of given policy to ensure a reasonable rate of returns for the investors.

The stake of the credibility in renewable energy policy implementation is the necessity to guarantee government commitment to enforce contractual provisions within the policy instruments during the period of return of investment for project developers. (cf. FINNON/PEREZ 2011). Credibility of commitment through the new institutional economics perspective or in particular the works of NORTH (1994) and SHERPSLE (1991) can be seen either through the motivational or the imperative sense. A commitment is motivationally credible if the players continue to want to honour the commitment at the time of performance as the incentive is compatible and hence self-enforcing. On the other hand, in the imperative sense, it is also credible if the player cannot act otherwise at the time of the performance because performance is coerced or discretion is disabled.

Within this backdrop the study develops a transaction cost economics cum positive political theory approach with a focus on the role of intuitions in restraining actor's opportunistic behaviour and its implications on the credibility of governance structure. These theories shed light on the efficient organization of transactions and subsequent actor's interaction during policy implementation within the constraints of the institutional environment.

**Organization of renewable energy transaction:** Renewable energy policy instruments such as FIT BI and RPO are long term contracts amongst public authorities, project developers and obligated purchasers as indicated in Figure 3 (cf. FINNON/PEREZ 2011). Following the transaction cost economic principles of energy regulation (cf. GOLDBERG 1976; WILLIAMSON 2010) the relation between these three parties can be analyzed at two levels (cf. PEREZ/RAMOS-REAL 2009; FINNON/PEREZ 2011). At the first level public authority acting as principles delegates the responsibility of development to the obligated purchaser (electricity suppliers) by setting certain amount of renewable energy purchase obligation through the regulatory contract. It defines certain parameters of the obligatory purchase specification, pricing rules, compensation mechanism etc. And at the second level the regulatory contract specifies a set of contractual parameters of the relation between renewable energy producers and purchasers. It defines certain parameters of the administered contracts such as price and quantity provision, production cost, secondary duties etc.

Such regulatory contracts are inherently incomplete as all future contingencies cannot be included in the contracts due to bounds on rational and cost consideration. In effect such contracts are ex ante measures to guide future transaction and the incomplete nature of such contract opens doors for opportunistic behaviour by parties least committed in the transaction (cf. WILLIAMSON 1996). Drawing from the seminal works in energy regulation (cf. GOLDBERG 1976; LEVY/SPILLER 1994; PEREZ/RAMOS-REAL 2009) this risk of transaction hazards due to the opportunistic behaviour can be analyzed in the following three dimensions.

The first dimension of risk of opportunistic behaviour is the relation between government and project developers. It can arise due to rent seeking behaviour of governments through expropriation of the quasi-rent of project developers by changing the incentives structures (such as price and quantity provisions) or entirely changing the policy instruments. Conversely there is also a risk of regulator capture, wherein the project developer influences the regulators for undue revenues. The second dimension of opportunistic behaviour between the private parties can arise if the projects developers want to extract the maximum rent from their sales of solar energy to the mandated purchasers by influencing rules of support in their favour. On the other hand, the mandated purchaser can also exert their market power in areas of grid connectivity or renege on their payments. The third dimension of opportunistic behaviour can arise due to opportunistic behaviour of third party interest groups that try to influence policies to their own interest — such as environmentalist interest groups lobbying for both pro renewable energy regulation and against the sector by pro-nuclear groups or groups representing the interest of the conventional energy sector.



**Institutions and credible governance structure:** To protect against the above risk of transaction hazards, institutions are designed to deal with the basic time inconsistency inherent to most transactions, namely opportunism coupled with the inability to write fully contingent contracts (cf. SPILLER 2010). Institutions are the rules of the game of a society or more formally are the humanly devised constraints that structure human interaction, they are composed of formal rules (statute law, common law, regulations), informal constraints (conventions, norms of behaviour, and self-imposed codes of conduct), and the enforcement characteristics of both (cf. NORTH 1995: 23).

Institutions affect and address the risk of transaction hazards involved in public regulation of renewable energy in two ways – firstly through the ex-ante defining of regulatory incentives and secondly by affecting the enforcement characteristic through regulatory governance process (cf. LEVY/SPILLER 1994). In NORTH's (1995) assertion this requires first getting the rules of the game right and the following administrative capacity that can implement this rule. Both this regulatory incentives and regulatory governance are choice variables in the hands of policy makers. These choices are constrained by the specific institutional endowment of the nation.

Institutional endowment or institutional capacity of a nation consists of five elements following NORTH (1990, 1991) and LEVY/SPILLER (1994). First there are the country's legislative and executive institutions which define the formal mechanisms for making and implementing laws and regulations for renewable energy promotion. In addition it also defines the relationship amongst legislative, executive and judiciary. Secondly, the country's judicial institution defines the dispute settlement system amongst the different stakeholder's involved in the sector. Third are the customs and other informal norms that constraints the action of individuals or institutions. Fourth is the character of the contending social interests within a society and the balance between them and finally the administrative capabilities of the nation.

A regulatory incentive structure comprises the rules governing renewable energy pricing, direct or indirect subsidies, grid interconnection, relaxation of permits for project clearances and other related fiscal incentives that incentive private investment. The nation's Institutional endowment through the administrative capacity (e.g., bureaucrats, academics, lawyers) determines the design and successful implementation of such regulatory incentives. These regulatory incentives affect the economic performance but their impact (positive or negative) comes to the forefront only if regulatory governance has successfully been put into place (cf. LEVY/SPILLER 1994).

The nature of a nation's regulatory governance is defined through its Institutional provision of the role and separation of power amongst its legislative executive and the legislative body. The crucial issue is to what extent the structure and organization of these institutions impose con-

straints upon the potential risk of the opportunistic behaviour of both private and public agencies, on whether the system provides the necessary checks and balance for efficiently upholding and implementing regulatory contracts. Accordingly, the evaluation of credibility of governance structure is assessed on first getting the regulatory incentives structure right and secondly the accompanying local institutional environment that provides clear and stable public commitments to safeguard long term investment (cf. LEVY/SPILLER 1994; NORTH 1991; WEINGAST 1995; FINNON/PEREZ 2011).

## 4 Analytical framework

The basis of the institutional analysis in the organization of the solar sector is drawn from the four levels of social analysis following the New Institutional Economic principles (cf. NORTH 1991; WILLIAMSON 2000). At the lowest level is the alignment of incentives (price and quantity) to respond to the market needs. The second level is the “institutions of governance”- the governance structure (policy instruments) which governs day-to-day interactions to minimize transaction hazards (transaction costs). At the third level is the formal rule (constitutions, laws, and property rights) which defines the rules for transaction in the sector. At the highest level are the “institutions of embeddedness” (informal institutions, costumes, traditions, and norms) which define societal believe systems and belief in the governance of solar electricity sector; which vice versa defines all the other three levels.

Building from this perspective of social analysis, the institutional analysis of transaction in solar energy sector is carried out through the IATSE framework (Institutional Analysis of Transaction in Solar Electricity Sector) as shown in Figure 3. The IATSE framework has been adopted and put to operation through the Institutions of Sustainability (IoS) framework (cf. HAGEDORN 2002) and the framework for "Diffusion of renewable energy technologies in emerging economies" (cf. FREITAS et al. 2012).

The IATSE framework considers societal interaction within the institutional environment and contains the process of conflict, mutuality and an attempt to restore order to mitigate conflict and realize mutual gains (cf. COMMONS 1932; WILLIAMSON 2000). Accordingly the analysis of the social interaction in the renewable energy sector is made by taking transaction as the basic unit of analysis.

The basic conceptual unit in the IATSE framework is the action arena, where investment decisions for adoption of renewable energy technology (RET) takes place. In an action arena, ‘[...] participants and an action situation interact as they are affected by exogenous variables [...] and

produce outcomes that in turn affect the participants and the action situation' (OSTROM 2005: 13). An action situation occurs 'whenever two or more individuals are faced with a set of potential actions that jointly produce outcomes [...]' (OSTROM 2005: 32).

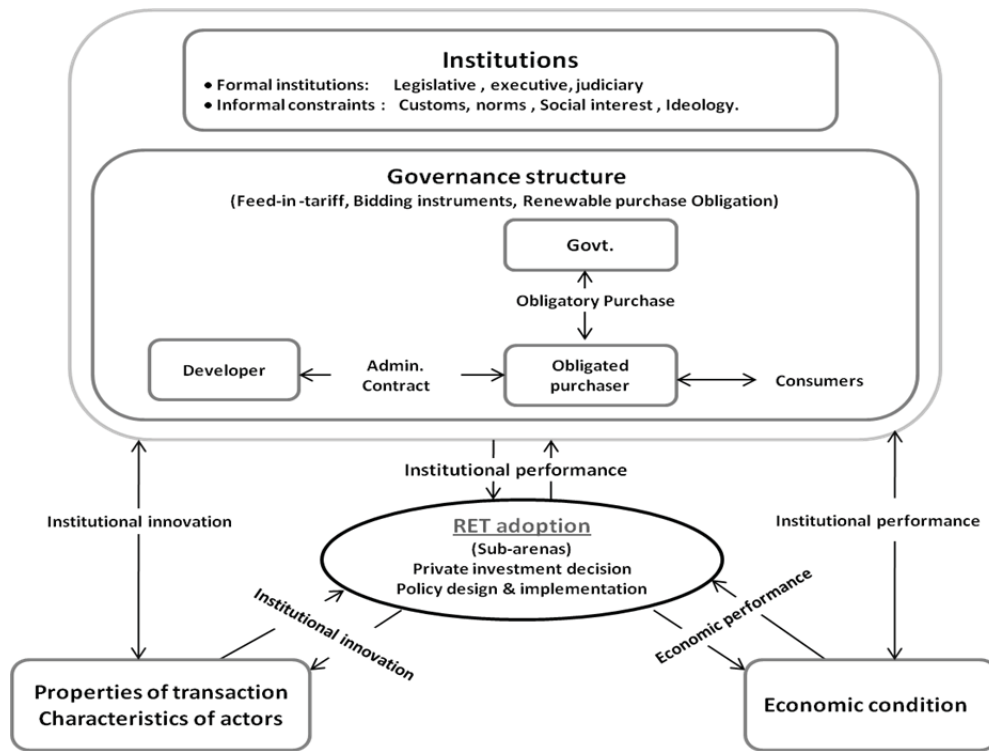


Figure 3: IATSE framework; Source: adapted from WILLIAMSON 2000, HAGENDORN 2008, FREITAS et al. 2012

This framework provides a transaction interdependent cycle by integrating the various characteristics of actors, properties of transactions, exogenous economic condition, institutions environment and governance structures and shows their importance in action arenas. These key transaction interdependent exogenous factors are elaborated as follows:

**Institutions:** Legislative, executive, judiciary and informal constraints that define stakeholder's interaction in the sector.

- **Governance structure:** Based on the institutional environment are the governance structure — the various policy instruments such as FIT, BI and RPO which are in place to govern day-to-day interactions in order to mitigate conflict and realize mutual gains.
- **Properties of transaction and characteristics of actors:** The asset specificity of investment and the behavioural attributes of public authority and private players focusing mainly on the opportunistic behaviour of actors involved.

- Economic conditions: The enabling preconditions which reflect the state of technology, geographical resource potential and other economic conditions such as finance, land-use, grid connectivity etc. that affect the economics of renewable energy production.

Renewable energy development is a result of the interplay of the four key transaction interdependent exogenous factors in the action arena which was presented above. The action arena is influenced by the above sets of interdependent exogenous factor as follows: depending on the attributes of transactions and exogenous economic condition, actors with bounded rational and self-interest coordinate themselves based on the rules of the games and the governance structure to affect renewable energy technology adoption. In essence renewable energy technology adoption requires first the conducive economic environment and the accompanying supportive policy incentives to incentivize private investment and secondly the appropriate institutional mechanisms that ensure the successful implementation of given policies and also adjust to induced change and external shocks.

## 5 Credibility of public promotion in Gujarat

Applying the IATSE framework the credibility of public promotion of solar energy in Gujarat is analyzed in two stages. The first stage investigates the formal institutional environment governing stakeholder interaction through secondary data. This is done through the document review of existing scientific studies on the sector, electricity laws and policies, reports available with both public and private agencies concerning solar electricity governance in the state. The document review mainly focuses on the provisions and interactions between the legislative, executive and the judiciary that facilitates private investment in the state.

With the understanding of the background the condition of the institutional environment governing the sector, the second stage investigates the nature of policy implementation through semi structure interview with both stakeholders and expert in the sector. The sample selection for interviews have been initially carried out through sampling based on document analysis of secondary data and further refined through five expert interviews in 2011. Stakeholders are divided into different groups based on organizational independence and their role. Fifteen stakeholder groups, ranging from the regulatory agencies to project developers were identified based on their role and relevance in the sectorial development (cf. Figure 4). Except for project developers (six selected for interviews), the number of interviewees in each stakeholders group ranges from one to three depending on the relevance and role of the organization and extend

of information needed from the different departments within the organization. In total thirty six semi-structured interviews were conducted.

The semi structured questionnaire for the interviews are broadly divided into two segments. The first segment dealt with the background of the organization, the role, responsibility and the form of participation of each stakeholder in the sector. This sheds light on the effectiveness of the regulatory incentives and ex ante private perception of guarantee of safeguard. The second segment deals with the governance of the sector, the problems and challenges faced by the stakeholders during policy and project implementation and feedback for better governance of the sector. The empirical data collected was then analysed using Atlas.ti software, wherein emerging patterns and conclusions are drawn as discussed in the proceeding section.

The network of stakeholders interviewed and involved in the development of the sector is illustrated in Figure 4 below.

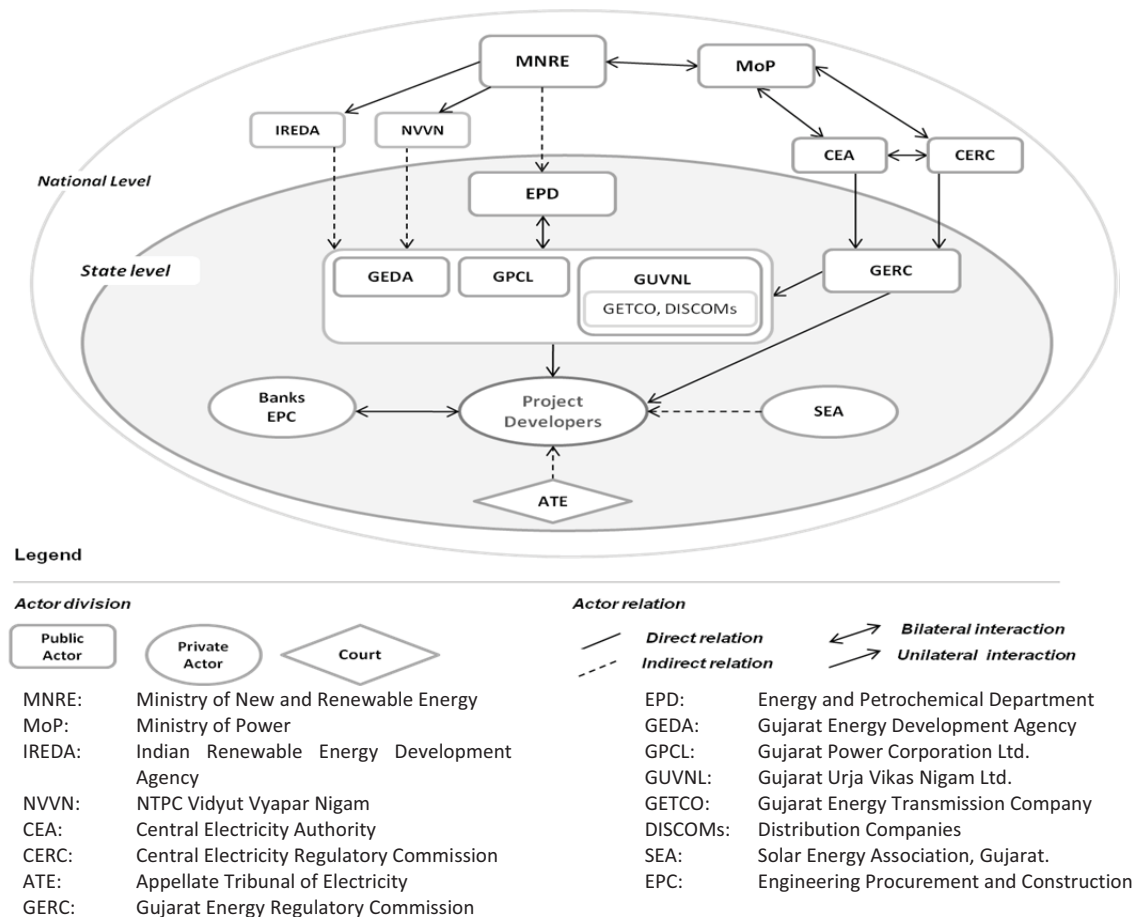


Figure 4: Stakeholder Network: Solar Electricity Sector Gujarat; Source: own figure

Unlike other Indian states the sectorial development in Gujarat has grown independently from the state efforts as indicated by the stakeholder interaction within the grey shaded region in Figure 4. Despite the existence of central policy and budgetary support the growth of the solar sector in the state has been solely driven by the state solar policy of 2009. Empirical evidence from stakeholder interviews indicates limited collaboration with the central government in terms of policy and financial support; except for sectorial governance through the central electricity regulatory agencies (CEA and CERC).

The stakeholders at the state level are centrally coordinated and controlled under the Energy and Petrochemicals Department (EPD) headed by the Principal Secretary of State, which in return is guided by the elected leadership of the state in policy matters. At the institutional level, the sector is governed through the electricity laws and regulated through the independent regulations of state electricity regulatory commission, GERC. The implementation of the state policy is carried out by GEDA and GUVNL. Finally the sanctity of the rules of the game are maintained through the independent body, APE, which carries out dispute settlement functions under the legal provisions of the center and the state.

The in-depth interviews of the above stakeholders and experts in the case study of Gujarat indicate that the success of solar energy development in Gujarat has been mainly driven by the vision and commitment of public agencies, which utilized the existing favourable conditions for the development of the sector in the state. The vision and commitment of public agencies led to an ambitious state solar policy in 2009. This policy laid down a clear roadmap and incentive structure for promotion of the sector and the accompanying efficient regulatory governance that led to the successful implementation of the policy instruments. The main factors for this success are further elaborated below under the following four broad themes: enabling precondition, institutional and policy level, governance level and informal institutions.

## 5.1 Enabling precondition

The state of Gujarat had three enabling preconditions facilitating the successful development of the solar electricity sector:

**High geographical potential:** The state of Gujarat is located in the western region of the country and has amongst the highest solar irradiation in the country along with Rajasthan state. The state covers a total area of 45,65 km<sup>2</sup> and is blessed with an average of 300 sunny days in a year and direct solar insolation of 6.4 kWh/m<sup>2</sup> per day (NREL 2010). Such high solar insolation has led to high system output and attracted initial private interest in the region.

**Good grid infrastructure and solar power evacuation:** Gujarat is the first state in the country to enact State Infrastructure Development Act in 1999 and it is the only power surplus state in India (cf. PPP INDIA 2011; TOI 2012). The state has amongst the best performing State Electricity Transmission Company in India. The state transmission company GETCO, has enabled a drastic reduction of transmission and distribution losses from 30.60 % in 2004/2005 to 20.1 % in 2010/2011 along with investment in latest technology for transition towards smart grid. This development has led to the provision of a reliable grid infrastructure which reduces the risk of system failure and facilitated efficient integration of solar energy into the grid.

**Strong financial health of utility companies:** While most of the Indian state electricity utilities are struggling to balance their finances with increasing deficit every year, GUVNL in Gujarat has a robust financial health with a high profit margin every year. Such a strong financial health of the DISCOMS (distribution companies) is crucial for raising finance for solar project developers such as the PPAs between project developers and DISCOMs serve as payment guarantee and act as financial instruments for raising project finance from the banks and other financial institutes. The strong balance sheet of GUVNL has been the main source of bankability of solar PPAs in Gujarat and easy access to finance for project developers in the state.

## 5.2 Proactive public promotion and commitment

These enabling conditions have been harnessed through clear and proactive public promotion which provided the necessary local institutional environment to attract private investment. The vision and commitment of public agencies led to the state solar policy of 2009 which laid down a clear and attractive regulatory incentive structure and the required detailed provision for safeguarding private investment. This aspect is further elaborated in the section below.

### 5.2.1 Vision and commitment of public agency

Gujarat state, through the leadership of the political players and implementing public agencies, has been the first state in India to come up with a state solar policy in 2009. With a clearly laid out policy objectives the commitment of implementing agencies led to an efficient implementation of policy instruments. Interviews with private investors and project developers indicate clear and attractive policy provisions and good governance as the most important driving force in attracting private participation. The state has been known for its proactive measures in attracting private investor through various workshops and seminars such as the biennial international — “Vibrant-Gujarat-conclave”. The commitment from public authorities is also illustrated

in the track record of development in Gujarat, as it is amongst the fastest growing states in India, with the highest rate of investment under projects implemented in India and a double digit growth rate of 10 % over the past five years.

### 5.2.2 State solar Policy 2009

The concerted public promotion of the sector led to the Gujarat state solar policy, 2009 (SOLAR POWER POLICY 2009), which came out with a clear roadmap for the development of the sector along with attractive policy instruments and investment friendly environment which instilled confidence amongst private investors as elaborated below.

**Clear aim and objective:** The state solar policy 2009 set a clear roadmap for the development of the sector until 2014 in a phase manner. The target for the first two phases was set at 500 MW with a fixed FIT. However due to overwhelming response from private developers the capacity was expanded and 971.5 MW projects were allocated in the first and second phase. By May 2012 a capacity of 654.81MW of solar power was installed and by Jan. 2013, 1233.73 MW of solar energy were commissioned under these two phases. The success in the two phases led to a high response from project developers. 18,000 MW worth of projects preregistered with the government by prospective developers for any future allocations. No states in India have received such positive response from private investors.

**Policy instruments:** Gujarat had a fixed FIT tariff for 25 years with clear guidelines for tariff calculation and adjustment over the years, sending a clear signal to private investors. The tariff has been set at INR15/kWh for the first twelve years from the date of project commissioning and INR 5/kWh for the next 13 years for all project commissioned on or before 28-01-2012 (cf. GERC 2010). For the subsequent period for MW scale — projects commissioned in the period 2012 to 2015 — the tariffs (Levelized tariff for 25 years) were set ranging from INR 9.28/kWh to INR 8.03/kWh for projects availing accelerated depreciation and INR10.37/kWh to INR 8.97/kWh for projects not availing accelerated depreciation (cf. GERC 2012). The clarity in tariff structure and long term power purchase agreement duration ensured the stability of such policy instruments and instilled confidence. This helped in the long term planning by prospective investors.

**Investment friendly environment:** Gujarat solar policy was pro investment and market friendly as reflected in many of the provisions in the state policy in dealing with land allotment in Solar Park, power evacuation system and other related infrastructural provision which are not clearly provided in the policies under JNNSM and some other state policies. Out of the total 971.5 MW PPA signed, 231 MW capacity projects were provided land in Solar Park located at Patan. Other



crucial project development challenges such as the responsibility of finding and acquiring land for project development was arranged by the state under GPCL in the 500MW capacity in Charanka (Charanka is the largest and one of Gujarat's solar park initiatives built on a 2,000-hectare (4,900-acre) plot of land near Charanka village in Patan district. It hosts 17 different solar projects with a 500 MW of solar power systems capacity.). Due to this pro active measures, project developers in Gujarat had nominal delay attributable to unavailability of land or disputes in land acquirement as experienced in other states. In addition, GPCL took the responsibility of providing right of ways, and other related infrastructure facilitating project development such as electricity supply, water supply, and road construction at the Solar-Park project site. The state also took the responsibility of power evacuation under GETCO, which had assisted in the timely evacuation of power. Such proactive measures by the state enabled timely implementation of projects and minimization of project cost for developers.

### 5.3 Efficient regulatory governance

The organizational structure reflected in the stakeholder network in Figure 4 enabled a clear separation of the role and jurisdiction of different agencies responsible for policy formulation, policy implementation and dispute settlement. This organizational structure reflects a pyramid structure of authority and control; wherein the EPD in consultation with the elected leadership is responsible for policy formulation and coordinating the entire sector by assigning clear role with no overlapping responsibility and jurisdiction. In effect EPD acts as the apex body governing the sector. At the operational level, GEDA, GPCL and GUVNL which reports to EPD, is responsible for carrying out the state policy objectives. Under the state solar policy 2009, GEDA and GPCL are assigned as the nodal agencies, with GEDA responsible for overseeing project allocation, policy implementation and operational support and GPCL overseeing the task of developing large scale Solar-Parks. In addition GETCO undertakes power evacuation and grid related issues. GUVNL as a parent organization oversees the task of purchase of power from project developers. The pyramid organizational structure allows smooth and efficient coordination within different departments under EPD. This organizational arrangement facilitated private investment through the following ways:

- Pyramid structure: The pyramid organizational structure provides clarity of role, jurisdiction and authority within the different departments. This has facilitated efficient coordination within different department and facilitated fast movement of files intra and across departments resulting in efficient bureaucratic work. Such clearance and the coordination mecha-

nism has enabled the minimization of costs attributed to search of information, coordination and enforcement for both project developers and public agencies.

- Absence of political interference in the governance process: The political role in the development of the sector has been largely limited to the policy formulation process. Once the policy objectives and instruments are outlined, the coordination and implementation of the policy is left to EPD, GEDA, GPCL and GUVNL. This structure of jurisdiction and separation of role has facilitated the autonomy and independence of implementing agencies from political interference and brought about a sense of ownership, responsibility and accountability by implementing agencies.
- Institutional safeguard: The institutional safeguard is provided through ATE which acts as an Independent body for dispute settlement in the sector. Such independent dispute settlement mechanism reassured the trust in the system in case of any future dispute.

## 5.4 Informal institutions

The semi structured interviews with the heads of departments for policy implementation in the entire stakeholder network echo strong pride and trust in the vision of the government and ownership in their work as there was no political interference in the implementation of the policies. Independent functioning of each department is clearly illustrated through the transparent project allotment, tariff settlement and dispute settlement processes. The sense of ownership indicated in the interviews is reflected in the proactive work culture practiced by the implementing agencies. Such work ethics have led to fast decision making which has contributed to the overall credibility of public promotion of the sector. The behavioural attribute of work ethic of the Gujaratis is also re enforced in the culture of trade and business, where Gujaratis are historically known to excel in India (cf. Lamb 1995; Mehta 2001).

## 6 Way forward

Policy implication and lessons learned from the research findings are discussed in the following two broad themes under Gujarat and for rest of India.

### 6.1 Gujarat: Opportunity and challenges

Despite the progress in the state there are constraints that have to be addressed within the solar policy and beyond the timeframe of 2014. The first challenge lies in addressing the issues that have emerged during the first two phases. So far there have been strains for providing infrastructure (as the capacity has been ramped up from 500 MW to 968.5 MW) in terms of providing associated infrastructure in solar parks (such as Charanka) and other independent projects. Grid connectivity was an issue with GETCO as it has to ramp up grid capacity within a short period without an increase in man power within the department. Aside from the man power deficit there were further technical constraints in supply of technical material for power evacuation due to limited production capacity of the industry. In addition, GETCO had capacity constraints in terms of arranging transportation and solving right-of-way issues. The third phase beyond 2014 needs to take such issues into consideration. Capacity building and planning in the process of project allotment is vital for long term sustained growth of the sector.

Aside from these challenges, a clear road map beyond the year 2014 needs to be drawn up as business strategies and infrastructure planning for project development in the solar sector requires long term planning. So far REC (Renewable Energy Certificate) proposals for 250 MW capacities have been received and are under consideration. Due to difficulties in enforcing SPO (Solar Purchase Obligation) at all India level, planning is required on how to regulate SPO at the state level and integrate it at the national level. Another major issue raised by public authority is the burden to state utilities and the public for buying solar electricity at high prices. The long term growth of the sector cannot be driven by state support forever. Opportunities for alternate financing mechanism such as CDM (Clean Development Mechanism) or other part-financing options need to be explored. For the long run sustained growth, an alternative strategy, integrating more of market mechanism for gradual shift towards competitive market needs to be drawn up. Market mechanism such as the polluters-pay principle of the German EEG (German Renewable Energy Act) with periodical competitive lowering of remuneration rate for new plants to incentivize technology efficiency and cost minimization by manufacturers is a model which can be adopted.

## 6.2 Lessons for rest of India

The case of Gujarat has illustrated the critical importance of favourable local environment which the efforts at the central and state level can learn lessons from. Some of the critical points are illustrated below. This section analyses the policy experienced under Phase-I of JNNSM and implications for other Indian states vis-à-vis the experience in Gujarat.

### 6.2.1 Renewable energy legislation: Need for coordinating individual state effort

The lopsided differential development of solar energy at the state level indicates the need for coordinating efforts at the central level. This coordination effort has been started through the RPO/SPO directives at the central level. However so far, there is no legally binding mechanism or renewable energy legislation to ensure implementation of this obligation at the state level. As a result many states have not met their SPO targets and have not faced any penalties so far. As of August 2012, only three states — Gujarat, Rajasthan and Uttarakhand — have met their RPO target (cf. MNRE 2012). This has led to states with highly excessive capacity, such as Gujarat, bearing the burden to finance the sector with few initiatives from most states. To ensure wider adoption and sustained growth at the state and national level, legal enforcement of SPO obligation is needed. The crucial need of such separate renewable energy legislation has also been emphasized in many leading studies on renewable energy in India (cf. BAKER/MCKENZIE 2008; SHRIMALI/ROHRA 2012). As such, states with SPO deficit can buy from states with excess capacity and the burden can be spread across the states for overall sustainable growth of the sector. A clear commitment to RPO enforcement from individual states would boost investor confidence, attract long term investment, drive growth of the REC market and facilitate a gradual shift towards competitive market.

### 6.2.2 Project selection and tariff bidding

Unlike the fix FIT in Gujarat, all projects under Batch-I and Batch-II of Phase-I of JNNSM have been allocated by competitive reverse bidding, though initially projects were envisaged to be developed by providing a fix FIT. The shift from fix FIT to reverse bidding occurred due to over-subscription of projects. The reverse bidding in Batch-I led to the reduction of initial FIT of INR 17.91/kWh to weighted average of INR 12.16 and in Batch-II the aggressive bidding by project developers led to project bid as low as INR 7.49/kWh from the initially starting bid of INR15/kWh. This aggressive bid can lead to the risk of affecting the financial viability and com-

promising the quality of the overall project. Such aggressive competition is good for market development and needs a mature market. However in emerging markets, such as in India, the market should be allowed to grow through reasonable financial incentives, otherwise such auction mechanisms with aggressive biddings would negate the very objective of providing incentive to the developers. Apart from the need for a reasonable FIT there is also a need for clarity of long term level of FIT. An emerging market such as in the Indian market will require a gradual growth with comparative stable support systems to ensure long term growth.

### 6.2.3 Determination of FIT and REC price

Under JNNSM, FIT levels have been envisaged to be revised annually by CERC through a method primarily based on the cost-spread revealed through consultation with the industry. This method for price discovery needs to be expanded beyond the industry. Limited consultation with industry may lead to disproportional rent for the developers since these prices are based on the information provided by prospective developers — the ultimate recipients of such incentives — who may have incentives to inflate the cost in order to increase their returns. To address such issues, apart from industry consultation, price discovery can include inputs from independent research institutes, civil society organizations, international organizations and inputs from experience from countries with long term experiences and successful track record.

In addition to price discovery, the current limited five year price-signal period for REC is not conducive for raising finance in the sector as bank loans for solar projects are evaluated on a ten year period. The limited five year floor and forbearance price for REC leaves an uncertainty of price for the remaining five year period as banks are uncertain of the risk associated with price fluctuation. To address this issue a ten year price signal can be introduced along with basis for price signal calculation beyond the ten year period.

### 6.2.4 Need for aligning financial instruments

High initial costs and a lack of easy and consistent financing options form some of the biggest barriers primarily in developing countries (cf. BECK/MARTINOT 2004). Unlike most other infrastructure projects, solar projects require upfront 70 % to 80 % of the planned capital expense. Various project developers have cited the limited availability of appropriate financing instruments as a major challenge. Due to the emerging nature of the market, financial institutes assign high risks and uncertainty to solar project as they have no experience in this new technolo-

gy. Unlike the developed market in the west non-recourse project financing are limited and developers often relying on their ability to finance projects on their own balance sheets.

Accordingly challenges and delay due to financial clearance has been widely experienced in India's Phase-I of the national solar mission. In this regards lack of bankability of PPAs with state DISCOMs have emerged as a major issue. Unlike Gujarat most DISCOMs in other Indian states are in bad financial positions and the PPAs signed by this DISCOMs lack credibility for securing bank loans since DISCOMs themselves are in a bad financial condition. The existing measures at the central level need to address such risks. Measures such as the payment security scheme through the GBS (Gross Budgetary Support) are an initiative in the right direction, though limited to few projects. To ensure a long term robust financial market there is a need for further building on the existing stakeholder network and bring together various international and domestic Indian financiers along with policy-makers, donors, developers and sector experts to address the challenges and opportunities for financial market development. The central focus of such future financial policy measures should be targeted to encourage private sector participation while not creating unsustainable public incentives.

### 6.2.5 Need for provision of enabling precondition

The case of Gujarat has illustrated the crucial need of enabling preconditions for long term growth of the sector. At the national level, India still faces huge challenges for providing reliable and efficient grid infrastructure as reflected in the recent break down of the country's northern grid for two days. The provision of reliable grid systems for power evacuation and hassle-free metering and billing is crucial for reduction of uncertainty, power loss and financial viability of solar projects. Addressing such challenges is crucial for sustained long term growth of the sector as solar sector is still in the cost-reduction phase with cost disadvantage vis-a-vis conventional power. To this end, long term growth will require a gradual up-gradation of grid technology for gradual shift toward smart grid and the ongoing effort for such transition needs to be supported by concrete policy instruments and R & D (research and development) programmes.

Another important facilitating precondition is the provision of reliable solar irradiation data. Such irradiation data is crucial for project planning by potential developers for understanding project costs, project finance and returns for project viability at determined or expected tariffs. Acquiring such high quality satellite based irradiation data for specific location is beyond the capacity of small scale investors apart from the high cost. To attract such potential private investors, public agencies can prepare a reliable database at the national level. The efforts under the CWET (Centre for Wind Energy Technology) are aiming in the right direction and will need

further capacity building. Along with this effort, a continual support in terms of R & D initiatives for cost reduction and efficiency of the system and human resource capacity building needs to be further encouraged to respond to the market needs.

## 7 Conclusion

The energy demand in India, as the fifth largest energy consumer in the world, is forecasted to increase over the coming years due to increasing economic and population growth and renewable energy such as solar has a pivotal role to play in India's endeavour for energy security and sustainability. India has begun a journey in the right direction with the focus on solar energy as one of the national missions. The progress over the last three years in terms of installed solar energy capacity at the national level shows an encouraging sign.

Ensuring sustained long term growth will however require addressing the lopsided development at the state level. The case of Gujarat has illustrated lessons that could be integrated in other state policies and policy learning that could be transferred at the national level. It has illustrated the critical importance of favourable local institutional environment for a successful public promotion. It has illustrated the need for and the importance of a well-defined policy with clear and attractive incentives structure and the accompanying local administrative capacity and commitment from public agencies for successful policy implementation.

The study has also illustrated that the long term growth of the sector cannot be sustained through public support. There is a need for gradual shift towards market driven growth. Accordingly, policy measures need to facilitate this shift and incorporate measures for reduction of cost of solar energy for making it financially viable without policy support in the long run. In the short run though, concrete policy measures are needed for the transition towards such market driven growth. To enable this transition the crucial need of the hour for India's on grid solar energy sector lie in first building the necessary enabling conditions related to grid and other infrastructure, establishing credible financial instruments and stepping up R & D and human resource development efforts. Secondly, working towards ensuring that the existing policy instruments are abided by involved parties by incorporating separate renewable energy legislation. Finally an increased legitimacy of public promotion of the sector through greater public participation and create robustness of the policy instruments through multi-stakeholder consultation in the policy process.

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