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Dedicated to Hazrat Amir Khusro and
Ustad Nusrat Fateh Ali Khan Sahab

SUMMARY

Collective institutional entrepreneurship for fostering sustainable energy transitions in India

The objective of this dissertation is to explore the role of multiple actors and their collective strategies in transforming energy systems based on incumbent fossil fuel energy systems in India. India's energy system which is largely based on coal, large scale hydro power plants, oil and natural gas is currently facing substantial challenges related to climate change, energy security, energy poverty with the need to balance these concerns with demands for rapid economic growth. In order to tackle these energy challenges, the Indian government has started the Jawahar Lal Nehru National Solar Mission and the National Wind Energy mission for mainstreaming sustainable energy technologies such as wind and solar PV energy. Despite promising actions by the Indian government, there are still challenges for mainstreaming wind and solar PV energy due to plurality of social interests and objectives.

The challenges are also complex due to multiple and heterogeneous stakeholders at central and state government level in federal context like India and limited capabilities for implementation of policies and regulations. Resolving these challenges and moving ahead requires collective action between different actors with varying levels of power, resources, interests and motivation. This dissertation therefore focuses on understanding these challenges, the different strategies actors collectively use to transform institutional arrangements in the context of the energy system in India. This doctoral dissertation therefore examines the following central research question: *How do actors collectively challenge institutional arrangements in the context of energy transitions in India ?*

The dissertation builds on the sustainability transitions and collective institutional entrepreneurship literature. The main theoretical positioning of the dissertation is that while existing sustainability transitions literature has examined energy transitions using a number of conceptual perspectives, there are relatively limited empirical insights on the role of collective actor strategies in challenging dominant institutional arrangements. The introductory chapter of the dissertation presents an overview of the theoretical positioning of the research focusing on sustainability transitions and collective institutional entrepreneurship literature, research method and overview of the different papers included as chapters. Chapters two, three, four, five and six focus on answering the main research question by studying development of wind and solar PV energy in India through different theoretical lenses and empirical studies conducted at a different unit of analysis. Methodologically the dissertation takes a qualitative case study approach and uses archival data sources, semi-structured interviews and participant observations in forums and conferences collected during field work in India.

Chapter 2 focuses on social enterprises providing off grid solar PV solutions to disadvantaged people without energy access in India. It develops a broad classification of different upscaling dimensions of promising business model experiments in India and emphasizes the importance of institutional innovation for sustainability transitions.

Chapter 3 focuses on historical development of wind energy in India. This chapter builds upon insights from chapter one and looks at the role of institutional innovation in development of novel innovations. It highlights the importance of collective institutional entrepreneurship where multiple actors are adapting their institutional strategies while facing conflicts with each other. This chapter emphasizes the need for deliberating on ongoing conflicts between powerful and weaker actors by being open to inputs from marginalized actors and providing opportunities to them for participating in decision making process.

Chapter 4 compares wind energy development in India considered as an emerging institutional context and Finland considered as a mature institutional context. This chapter building upon insights from third chapter which compares institutional entrepreneurship in mature and emerging institutional contexts. This chapter concludes that emerging institutional contexts such as India, do not necessarily provide more opportunities for strategic change than mature institutional contexts but challenges for institutional entrepreneurship in emerging institutional contexts are qualitatively different from challenges found in mature institutional contexts.

Chapter 5 compares differences in implementation of grid connected solar PV energy in two Indian states (Gujarat and West Bengal) by using insights from the institutional entrepreneurship literature in a regional context. The study describes the reasons for successful implementation in Gujarat and less successful implementation in West Bengal by discussing role of three key actors: government officials within regional government, regional regulatory agencies and regional industry associations.

Chapter 6 analyzes two important points of debates associated with solar PV energy during the National Solar Mission in India related to stimulating domestic capabilities and efficiently using public financing mechanisms by following narratives of different actors in conferences and forums. This chapter emphasizes the role of forums for understanding discursive battles between actors competing with each other for alternative interpretation of taken for granted institutional arrangements.

Chapter 7 summarizes the main findings and the conclusion of the dissertation. In chapter seven, the main research question is answered along with the theoretical contribution of the dissertation to the sustainability transitions literature. By considering insights from the different empirical chapters, a simple typology of three overarching collective strategies which actors use in attempting to transform institutional structures associated with incumbent energy systems is developed. These collective strategies include: (1) Institutional adaptation focusing on experimenting within institutional constraints and outside institutional constraints in protective spaces; (2) Institutional

capacity building focusing on building new indigenous capabilities by drawing on transnational linkages; and (3) Institutional transformation focusing on deliberate attempt at transforming institutional arrangements through discursive battles between heterogeneous actors in forums. By developing this typology, the dissertation contributes towards recent debates on micro-foundations of sustainability transitions which relates to closer focus on the role of actors and their strategies on shaping socio-technical systems. Finally the dissertation points to ways of steering sustainability transitions by using insights from the typology, presents implications for policy and practice and provides avenues for future research.

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I would like to begin by dedicating this research to my grandfather Shri Janak Raj Malhotra who has always wished that I continue assimilating new knowledge everyday and embark on a research journey. When I started this doctoral research, I was not very experienced in matters of doing good research and writing scientific papers. However, I was quite determined and personally motivated to contribute towards sustainability challenges in emerging economies. During the process of my research I faced a lot of ups and downs, barriers and unforeseen situations just like any sustainable innovation journey. In fact, I consider myself learning from making a number of mistakes during my doctoral research and this has been the most interesting aspect in the last four years. At times, I was overwhelmed by different kinds of topics, ever increasing body of literature in different disciplines, their interconnections and challenges of developing novel theoretical contributions to a field of study.

Despite these ongoing challenges, I was fortunate enough to have support in form of my supervisors Rob Raven and Geert Verbong. I would like to thank them for their patience, intellectual support and encouragement despite my tendency to move in different directions during my doctoral research. They guided me by making sure that I was able to learn from ongoing mistakes and improve my research skills over a period of time. Specially Rob Raven closely worked with me during all stages of this dissertation and encouraged me to explore new ideas and develop my own stream of research. He closely monitored my work and made sure that I did not move in a different direction and helped me out when I was facing troubles. I would also like to thank him for being very patient with me and helping me during moments when I experienced difficulties during my doctoral research.

He continued to motivate me and I am grateful to him for passing on his vast tacit knowledge on presenting scientific research, writing scientific papers and making a contribution to an academic community. Rob Raven and Geert Verbong critiqued my work during several discussion and feedback sessions which helped me a lot in improving my work. I also benefitted a lot from their international networks and reputation which allowed to me access different scientific communities and develop my own identity as a research scholar. I would also like to thank them again for setting rigorous academic standards for me and keeping faith for finishing the dissertation despite the usual ups and downs. I believe that I could not have got more supportive supervisors as they gave me lot of personal freedom to explore myself during my doctoral research. I would also like to extend my special gratitude to Prof Frans Berkhout, Prof Peter Karnøe, Prof Lex Lemenns and Prof Henny Romijn for taking out their precious time for becoming my doctoral committee members and helping me improve my work.

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I would like to conclude by saying that I hope I can continue working on interesting research problems and sustainability issues in the future and develop long term capabilities for solving sustainability challenges in emerging economies. Finally, I thank the Almighty who made this research work possible!

Suyash Jolly
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ABBREVIATIONS AND ACRONYMS

AD: Accelerated depreciation

ADB: Asian Development Bank

APTEL: Appellate Tribunal for Electricity

ASSOCHAM: The Associated Chamber of Commerce and Industry of India

BJP: Bhartiya Janta Party

CII: Confederation of Indian Industry

CSE: Centre for Science and Environment

CSIR: Council of Scientific and Industrial Research

CASE: Commission for Additional Sources of Energy
CERC: Central Electricity Regulatory Commission

CERS: Consumer Education Research Society

CPI (M): Communist Party of India (Marxist)

CUF: Capacity utilization factor

CUTS: Consumer Unity and Trust Society

CWET: Centre for Wind Energy Technology

DANIDA: Danish International Development Agency

DCR: Domestic content requirement

DGAD: Directorate general of anti-dumping duties

DPR: Detailed project reports

DNES: Department of Non-conventional Energy Sources

EK: Confederation of Finnish Industries

EPC: Engineering, procurement and construction

EUROSOLAR: The European association for renewable energy

GBI: Generation based incentive

FANC: Finnish Association for Nature Conservation

FCE: Field configuring events

FDI: Foreign direct investment

GEDA: Gujarat Energy Development Agency

GERC: Gujarat Electricity Regulatory Commission

GERMI: Gujarat Energy Management Institute

GETCO: Gujarat Energy Transmission Corporation

GPCL: Gujarat Petrochemical Energy Limited

GUVNL: Gujarat Urja Vikas Nigam Limited

GWEC: Global Wind Energy Council

IEA: International Energy Agency

IEGC: Indian Electricity Grid Code

IITM: Indian Institute of Tropical Meteorology

IPP: Independent power producers

IFC: International Finance Corporation

IREDA: Indian Renewable Energy Development Agency

IWPA: Indian Wind Power Association

IWTMA: Indian Wind Turbine Manufacturers Association

INWEA: Indian Wind Energy Association

ISMA: Indian Solar Manufacturers Association

JNNSM: Jawahar Lal Nehru National Solar Mission

MAT: Minimum Alternative Tax

MERC: Maharashtra Electricity Regulatory Commission

MNRE: Ministry of New and Renewable Energy

MNES: Ministry of Non Conventional Energy Sources

MLP: Multi Level Perspective

MOU: Memorandum of understanding

MOP: Ministry of Power

NAL: National Aeronautical Laboratory

NAPCC: National action plan on climate change

NVVN: NTPC Vidyut Vyapar Nigam Limited

NCEF: National Clean Energy Fund

NSM: National Solar Mission

NSEFI: National Solar Energy Federation of India

NTPC: National thermal power corporation

OPIC: Overseas private investment corportation

PPA: Power purchase agreement

PDPU: Pandit Deen Dayal Petroleum University

RRF: Renewable Regulatory Fund

R&D: Research and development

RPO: Renewable purchase obligation

REC: Renewable energy certificate

SCOT: Social construction of technology

SEB: State electricity board

SERC: State electricity regulatory commission

SLDC: State load dispatch centre

SECI: Solar energy corporation of India

SNA: State Nodal Agencies

SNM: Strategic Niche Management

STS: Science and technology studies

TIS: Technological Innovation System

TERI: The Energy and Resources Institute

TNEB: Tamil Nadu Electricity Board

TVKY: Finnish Wind Power Association

TEM: Ministry of Employment and the Economy

TSO: Transmission system operator

VGF: Viability Gap Funding

VGGIS:Vibrant Gujarat Global Investors Summit

VTT: Technical Research Centre of Finland

WBERC: West Bengal Electricity Regulatory Commission

WBREDA: West Bengal Renewable Energy Development Agency

WBGEDCL :West Bengal Green Energy Development Corporation Limited

WIPPA:Wind Independent Power Producer's Association

WISE:World Institute for Sustainable Energy

WTO: World Trade Organization

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Chapter 1

Introduction

1.1 THE CHALLENGES OF ENERGY SYSTEM TRANSFORMATION IN INDIA

This dissertation takes its starting point by focusing on energy challenges in India and emphasizing the need for transformation of current energy system based on fossil fuels to an energy system based on sustainable energy technologies. India's energy problems continue to escalate, with ever-increasing oil imports, energy security, lack of energy access for a vast disadvantaged population and a continuous push for coal, large hydropower and thermal power. India's energy sector is facing several challenges, such as the mismatch between demand and supply, persistent energy shortages, high-transmission and distribution losses and poor institutional infrastructure. These problems are coupled with other severe difficulties, such as the weak financial position of energy utilities, non-payment of consumer bills, electricity theft, transmission and distribution losses and weak regulatory enforcement (Ganesan et al., 2014).

Financially bankrupt and politicized state energy utilities have been reluctant in investing in transmission and evacuation infrastructure for wind energy; they have often considered wind energy an unreliable source of energy and avoided meeting renewable purchase obligations (RPO) and power purchase agreements (PPA). Often, the state electricity regulatory commissions and state energy utilities in India have not taken adequate measures for enforcement of renewable purchase obligations, as they have become resistant to change through being historically politicized and captured by the vested interests of state government and regional politicians (Bhushan et al, 2014).
Wind and solar PV energy hold significant importance for meeting India's long-term energy needs, and have great potential for transforming India's incumbent energy system, which is based on fossil fuels such as coal, nuclear, large hydropower and thermal energy. The renewable energy sector in India started the development of wind energy in the early 1980s, due to concerns for energy security and oil crises that took place in the 1970s. This development started with demonstration projects and quickly grew with the use of accelerated depreciation benefits, which attracted small-scale investors. With respect to policy interventions, the Indian government has focused on supporting wind and solar PV by using specific types of policy measures such as market-based incentives, regulatory interventions, voluntary measures such as purchase obligations, deployment policies, tax mechanisms, mandatory standards, public procurement mechanisms and subsidies.

These technologies have been supported by corporate firms, entrepreneurs and small-scale investors who have been primarily motivated by commercial profits, energy security and new business opportunities arising in these sectors in India. They are also being seen as essential for a range of concerns and for meeting multiple objectives such as energy security and adequacy, climate change, local industrial development, national competitiveness, local capability building and energy access for the vast disadvantaged population (Krishna et al., 2014; Chaudhary el al., 2015). Grid-connected solar PV energy received significant political support after the National Solar Mission in 2009.

While wind energy has a large potential for meeting the ever-increasing demand for energy, solar PV energy is being seen as particularly important for creating a domestic industry, improving national competitiveness and for the possibility of creating local jobs.

Despite promising developments, the share of renewable energy is still low in the overall energy mix of India, with the majority of capacity addition still being carried out by coal and gas. Furthermore, capacity addition of wind and solar energy in India has slowed down considerably in recent years. For instance, although wind energy in India has reached a stage of maturity, it still faces a range of issues such as uncertainty in feed in tariffs by the state electricity regulatory commission, lack of financial viability of projects, financial losses of distribution utilities, difficulties in enforcing renewable purchase obligations, inadequate transmission and evacuation infrastructure, lack of policy and regulatory support and lack of grid management for wind energy integration into the grid. Despite the recent introduction of the National Wind Energy Mission in India, it is still difficult to expect long-term policy and regulatory support for wind energy in the country. Furthermore, grid-connected solar energy in India has not been developed as expected in the National Solar Mission, due to a lack of long-term policies and regulations, along with several institutional constraints. State governments are also finding it difficult to implement projects on the ground due to a lack of financing arrangements and the poor financial conditions of state energy utilities (Bhushan et al., 2014; Krishna et al., 2015). The government recently introduced a renewable energy law draft document with the aim of creating a national framework for mandatory renewable purchase obligations for all energy utilities in India, further facilitating development of renewable energy in the country. However, actual implementation of the proposed law needs to be seen in the near future before it can be considered a path-breaking institutional change (Bridge to India, 2015).

Due to the federal nature of India's energy system, the fact that there are multiple actors involved in mainstreaming solar PV and wind energy at the central and state governments adds complexity to the matter. The complex negotiations between multiple government bodies, regulatory agencies, ministries, firms, project developers and manufacturers, industry associations, civil society organizations, domestic and international NGO's, local citizens and villagers, state governments and a range of advocacy organizations makes sustainable energy transitions more intricate and challenging. The motivations, capabilities and interests and actions of multiple actors and the wider institutional context in which they operate must be taken into account in order to better understand sustainable energy transformation in India (Chaudhary et al., 2014; Krishna, Sagar & Spratt, 2015).

Insights resulting from these ongoing debates and developments in the Indian energy sector suggest that a greater focus is required on exploring the manner in which actors are transforming institutional arrangements in the context of energy transitions in

India. Considerable challenges exists with regard to mainstreaming wind and solar PV energy in India; these challenges relate to maintaining a balance between tradeoffs, such as the large-scale diffusion of wind and solar PV technology and supporting domestic manufacturing, providing low cost energy and energy access, and the eventual impact of politically supporting these technologies through public funds and tax payer resources. Although such competing objectives are also present in well-developed Western contexts, the challenges of combining socio-economic development with meeting sustainability goals are arguably more complex in rapidly developing economies.

Existing studies have shown that specific coalitions of actors need for be formed to gain influence over institutions and secure institutional arrangements in order for novel technologies to gain momentum and secure legitimacy (Jacobsson & Bergek, 2004). Since energy transitions are political in nature – given that individual and collective actors negotiate with each other –, it is necessary to analyze the transformation of the incumbent energy system by paying attention to contested power relationships between the heterogeneous actors shaping them (Karnøe, 2012). Therefore, the objective of this dissertation is to contribute towards a better understanding of the role of various actors and their actions in the development of solar PV and wind energy in India. Particularly, I focus on the role of distributed efforts among heterogeneous actors in transforming the institutional structures associated with the incumbent energy system in India. In order to address the issues mentioned above, this thesis primarily engages with the growing research community of 'sustainability transitions' scholars interested in long-term structural changes in socio-technical systems for a transition to sustainability(Geels & Schot, 2010; Markard et al., 2012). The dissertation also relates to multiple social, economic, environmental and political tradeoffs involved in sustainability transitions in the context of emerging economies that have been previously investigated to a lesser extent in transition studies (e.g., Berkhout et al., 2011; Romijn & Caniels, 2011; Murphy, 2015).

The dissertation is structured as follows. In chapter 1, I present the research motivation in section 1.2, followed by the research question in section 1.3. In section 1.4, I present a general overview of actor-oriented approaches for sustainability transitions, which form the theoretical basis of this dissertation. The literature review highlights the need for looking at the role of actor strategies in sustainability transitions' literature, and suggests that insights from collective institutional entrepreneurship can be useful in addressing the issues discussed in the introductory section 1.1. This is followed by looking at literature on collective institutional entrepreneurship in section 1.5. In section 1.6, I discuss the research method used in this thesis; this section explains the research design, the rationale for choosing a case study approach, the data collection and analysis methods, and reflects on the limitations of the methodology. Sections 1.7 and 1.8 in this chapter provide an overview of the research papers in this thesis and the overall structure of the thesis. Chapters 2, 3, 4, 5 and 6 form the main part of the dissertation, with five

different research articles present in these chapters. These chapters help in answering the overall research question and highlight the main contribution of this dissertation. The concluding chapter 7 summarizes the major findings by providing answers to the main research question; it also highlights the contribution of the thesis, provides policy and practical implications and suggests methodological limitations and potential avenues for future research.

1.2 SUSTAINABILITY TRANSITION STUDIES

The intention of this section is to introduce the theoretical debates in transition studies on actor-centered approaches in sustainability transitions. A research field has emerged under the heading 'sustainability transitions', essentially focusing on the transformation of the dominant socio-technical systems associated with societal domains such as energy, food, water and agriculture. The sustainability transitions literature, originating from disciplines such as evolutionary economics, Science Technology Studies (STS) and Social Construction of Technology (SCOT), has focused on key concepts such as Strategic Niche Management (SNM), Multi-Level Perspective (MLP), Technological Innovation System (TIS) and Transition Management (TM) (Markard & Truffer, 2008; Coenen & Diaz, 2010). Sustainability transitions are about fundamental and long-term transformations (50–100 years) of dominant socio-technical systems, which are politically driven and involve power relationships between multiple actors (such as firms, consumers, special interest and advocacy groups, governments, social movements, researchers, media and public actors). Such transitions involve political, technological, social, cultural, institutional and economic change, and include changes at individual, organizational, sectoral and societal levels in different functional domains such as water, energy, mobility, agriculture and housing. Thus, these changes are helpful in understanding and influencing transitions towards sustainability (Smith et al., 2010; Markard et al., 2012; Geels, 2015).

Over the years, a research community has grown into a new academic discipline that is relevant for studying societal challenges. A growing community of scholars originating in Europe and other countries around the world (such as India, China, Malaysia, US, Canada, Australia, South Africa and Japan) are part of an emerging network called the Sustainability Transitions Research Network (STRN). Sustainability transitions are challenging due to transitions occurring at multiple scales (local, regional, national and international), and are inherently uncertain due to rapid technological changes; moreover, they involve steering change by balancing multiple tradeoffs and contested power relationships between multiple actors. Furthermore, transitions involve dealing with unforeseen and emergent problems and steering change by adapting to uncertainty (Turnheim et al., 2015).

The sustainability transitions literature has emphasized the role of promising 'sustainability experiments' that represent planned initiatives embodying novel socio-

technical configurations, in which socio-technical learning takes place by bringing heterogeneous actors with different capabilities and resources together in order to influence sustainability transitions. These promising sustainability experiments have the potential of influencing dominant socio-technical regimes (Kemp et al., 1998; Berkhout et al., 2010). Within the transitions literature, the Strategic Niche Management (SNM) approach has focused on developing promising experiments and niches to develop promising sustainable innovations for creating systemic transitions. The transitions literature has emphasized the need for protecting innovations, since dominant institutional arrangements resist their growth; niche innovations need to be nurtured so that they can develop to a position where they can compete with incumbent technologies and exert pressure on the wider selection environment (Schot & Geels, 2008; Smith & Raven, 2012).

Within the sustainability transitions community, the Multi-Level Perspective (MLP) has been regarded as a dominant conceptual model and middle-range theory for describing and explaining socio-technical transitions. The Multi Level Perspective suggests that established socio-technical systems are often very resistant to change due to vested interests from incumbent and path-dependent institutional arrangements. This perspective focuses on socio-technical regimes that account for the stability of existing socio-technical systems, representing dominant institutional structures, vested interests, policies and regulations, user behavior and practices that need to be transformed for a transition to take place. MLP argues that a transition occurs when niche innovations are sufficiently built up (positive expectations, broader social networks and first- and second-order learning processes); exogenous developments at the landscape create pressures on dominant regimes, and tensions in the regimes create windows of opportunity for promising niches to transform them (Geels & Schot, 2007; Geels, 2010); the model also suggests that there is no one single cause for transitions to occur, as conditions for transitions linking up with each other are created by processes at multiple dimensions (Geels, 2011).

The sustainability transitions literature has emphasized the role of promising niches, which are protective spaces where innovations can nurture and develop further despite the harsh selection pressures imposed by the dominant socio-technical regime. Promising-niche innovations gradually develop through learning processes (such as first-order and second-order learning processes), the expansion of social networks (broad and heterogeneous networks) and the articulation of appealing visions and expectations (tangible, realistic, achievable and shared by several actors). However, care has to be taken to protect the novel niches up to a specific moment of time, as insufficient protection can lead to the premature development of niches and, consequently, to their failure. Protection should be withdrawn if novel niches have developed into commercially viable market niches. However, there are also dangers of excessive protection, as it can lead to rent-seeking and unproductive experiments and niches (Caniels & Romijn, 2008;

Schot & Geels, 2008). Recent studies have suggested that promising sustainability experiments are embedded in wider global and international technology, markets and resources networks, and such networks directly and indirectly influence the promising experiments for upscaling (Berkhout et al., 2010; Wieczorek et al., 2015). Therefore, the role of transnational linkages is crucial due to the access such linkages provide to critical dependence on relevant technological know-how, finance and expert knowledge for the development of promising technologies and the development of indigenous capabilities for developing novel niches (Romijn & Caniels, 2011; Binz et al., 2014; Gosens et al., 2014; Hansen & Ockwell, 2014).

Studies have also shown that promising experiments and niches face challenges in wider upscaling due to dominant institutional barriers associated with socio-technical regimes. The transformation of socio-technical systems as transformation towards sustainability depends on processes beyond the control and power of niche actors, as incumbent regime actors often control the rules of the game and resist socio-technical change (Smith et al., 2005; Verbong et al., 2010). The development of novel niches and wider upscaling is also challenging to the presence of dominant socio-technical regimes, where rules (regulative, normative and cultural cognitive dimensions) are institutionalized to a higher degree than rules present in niches. Socio-technical regimes are reproduced through existing regulatory, normative and behavioral practices, as well as through resistance by powerful actors controlling the dominant socio-technical strategies via powerful strategies (Geels, 2004; Geels, 2014). Building on these debates, studies have suggested the need for exploring the wider politics of sustainability transitions, as well as for giving attention to the power and politics involved in the transition process (Grin et al., 2011; Meadowcroft, 2011; Hess, 2014). Transforming the dominant socio-technical regimes is a complex and highly political process in which there might be a large number of winners and losers. Thus, an essential challenge for transforming unsustainable socio-technical systems also lies not only in developing sustainable niches, but also in destabilizing unsustainable socio-technical regimes while developing promising niches (Kern, 2015; Kivimaa & Kern, 2016).

Existing studies have shown that the transformation of incumbent socio-technical regimes depends on processes beyond the control of novel niches and involves the linking between niches and regimes for a wider socio-technical transformation (Smith, 2007). Debates within the literature have also emphasized the need for looking at transitions in the making for better insights on the interaction between niches and regimes, as well as on contestations within the niche and the role of heterogeneous actors in shaping transitions. Furthermore, there is also a need for understanding the strategies and interests of different actors involved in transitions, along with the contested power relationships between them (Elzen et al., 2012; Diaz et al., 2013). Studies have shown that the transformation of dominant socio-technical regimes should not be seen in terms of a shift from one socio-technical system to another (that is, from promising niches to regimes); rather,

they should be seen as a continuously negotiated accomplishment of heterogeneous actors with different motivations and frames of references (Garud & Gehman, 2012).

In recent years, a stream of scholarship within the transition studies has advocated that more research is required on the providing a broader perspective on the various strategies actors use to shape the development of promising innovations (Farla et al., 2012; Markard et al., 2012; Raven et al., 2015 b). Studies have also emphasized the need for developing a nuanced analysis of the relationship between institutions and agency of actors shaping transition trajectories. These debates suggest that there is a need for shifting attention away from the notion of proponents and opponents of sustainability transitions as incumbents and challengers, focusing on developing an in-depth understanding of the different actors, their strategies and interests in detail (Brown et al., 2013; Fergusson et al., 2014; Pesch, 2015). Building upon these debates in the sustainability transitions literature, the overall goal of this dissertation is to contribute to the understanding of socio-technical transitions by emphasizing the role of collective actor strategies in transforming institutional arrangements.

1.3 RESEARCH MOTIVATION AND RESEARCH QUESTIONS

This dissertation is positioned within in a broader research field of sustainability transitions literature, and focuses on the development of wind and solar PV energy in India. The dissertation particularly focuses on empirically exploring the role of collective actor strategies in shaping sustainability transitions. It also aims to contribute towards better understanding the manner in which actors collectively collaborate and the ways in which they are in contestation with one another with regard to shaping sustainability transitions. Furthermore, the dissertation provides a better understanding of socio-technical transitions by linking micro-level actions of actors with meso-level developments occurring at the socio-technical system level (Farla et al., 2012; Markard et al., 2012). Such a perspective helps to better understand transitions occurring as a result of the strategies of multiple and heterogeneous actors shaping sustainability trajectories. This is line with other accounts, which have also suggested that institutional arrangements are not always constraining and that actors have the ability to collectively challenge the dominant institutional structures (Karnøe & Buchchorn, 2008; Garud, Kumaraswamy & Karnøe, 2010; Karnøe & Garud, 2012).

In order to address the research focus of the dissertation on collective actor strategies, this dissertation mobilizes insights from the collective institutional entrepreneurship literature, which focuses on overcoming collective inaction by developing collaborations between heterogeneous actors for transforming institutional arrangements. The notion of collective institutional entrepreneurship is also useful, as it helps to shift attention away from hyper-muscular, heroic efforts of institutional entrepreneurs that challenge established institutional arrangements, as well as from passive actors who feel constrained by dominant institutional arrangements with no hope of challenging

them. This perspective also pays attention to collaborative efforts and conflicts between heterogeneous actors (Wijen & Ansari, 2007; Aldrich, 2010).

Based on these insights, the main research questions of the dissertation are as follows:

Research question 1: *How do actors collectively challenge institutional arrangements in the context of energy transitions in India ?*

Research question 2: *What lessons can be drawn for the sustainability transitions literature, based on derived insights from the collective institutional entrepreneurship literature, for the study of sustainability transitions ?*

To answer these two central research questions, I draw upon insights from sustainability transitions and collective institutional entrepreneurship literature. The different empirical chapters of the dissertation answer the first research question by showing different kinds of collective strategies mobilized. The dissertation finds the following collective strategies: (1) Institutional adaptation focusing on experimenting within and outside institutional constraints in protective spaces; (2) Institutional capacity building focusing on building new indigenous capabilities by drawing on transnational linkages; and (3) Institutional transformation that focuses on deliberate attempts to transform institutional arrangements through discursive battles between heterogeneous actors in forums. The dissertation contributes to the sustainability transitions literature by developing this typology of collective strategies that actors mobilize to challenge dominant institutional arrangements. By developing this typology, the dissertation contributes to recent debates on the micro-foundations of sustainability transitions, which relates to a closer focus on the role of actors and their strategies for shaping socio-technical systems (Farla et al., 2012; Bakker et al., 2014). The dissertation also empirically contributes to the sustainability transitions literature by highlighting the heterogeneity of actors within niches, in terms of opposing coalitions, and the contested power relationships between them; it even suggests a need for a fresh look at approaches being used to study sustainability transitions. The specific contributions of the dissertation are discussed in detail in chapter 7.

I will use the remainder of this introductory chapter to present the general theoretical outline of the dissertation, focusing on recent debates on the role and strategies of actors for shaping sustainability transitions literature and collective institutional entrepreneurship literature. The specific theoretical backgrounds of the individual papers in the thesis are not discussed here; instead, they are discussed in detail in the individual papers. My intention with sections 1.4 and 1.5 is to introduce the general theoretical background and the key theoretical concepts used in the dissertation. The different empirical chapters build on the theoretical concepts discussed in these sections.

1.4 THE ROLE OF ACTORS AND THEIR STRATEGIES IN SUSTAINABILITY TRANSITIONS LITERATURE

The goal of this section is to introduce the theoretical debates in transition studies regarding actor-centered approaches in sustainability transitions. These debates start from the premise that there is also a need for shifting attention away from the notion of proponents and opponents of sustainability transitions as incumbents and challengers, moving towards a more in-depth understanding of different actors, their strategies and their interests at stake (Garud & Gehman, 2012; Jorgensen, 2012). Studies have shown that the emergence and development of innovations is a more complex, multi-faceted process that involves strategic action by heterogeneous actors and that is shaped by institutional structures which constrain and enable their actions (Musiolik & Markard, 2011). Actors are involved in designing, generating and creating new networks, as well as in bridging organizations for the development of novel niches and exerting pressure on socio-technical regimes (Brown et al., 2013).

Recent studies focusing on this perspective have suggested that there is a need for moving beyond proponents and opponents of sustainability transitions, focusing more on divergent interests and expectations of different actors shaping transitions. Actors might change their role depending on their interests; therefore, there is a need for focusing on the extent to which actors are motivated to support transitions despite setbacks (Bakker, 2014). Studies have shown that a range of actors – such as governments, incumbent firms, industry associations, foundations, think tanks, political action committees, government affairs offices, public relation firms and organizations, advisory committees, and NGOs – are involved in influencing transitions. Furthermore, incumbent actors use a range of strategies such as mobilizing discourses to defend their interests, drawing on technical capabilities and financial resources to improve their performance and mobilize political power for shaping key policy agendas (Geels, 2014 b).

Other studies have shown that during transitions, actors struggle to exercise power, negotiate, and even cooperate with other actors within the constraints and opportunities of existing institutional structures. Actors steer transition pathways through a range of strategies, such as providing information to the political decision makers through lobbying and advocacy, testifying as experts in public hearings and forums, organizing press conferences, communicating through press releases, reporting research results and supplying decision makers with position papers or technical reports. Actors also adopt confrontational strategies such as opposing laws through litigation, protests and increasing media attention on key issues (Geels & Penna, 2012; Geels, 2014 a; Smink et al., 2015).

Furthermore, transition scholars have also looked into the strategic work carried out by technology advocates for mainstreaming innovations; these include fit- and- confirm strategies that focus on improving the socio-technical competitiveness of the technology, improving viability in existing markets and confirming to the dominant institutional

arrangements, while not putting any significant efforts in changing the rules of the game. On the other hand, stretch-and-transform strategies focus on reframing the rules of the game and reforming institutional structures in order to challenge dominant socio-technical regimes. Stretch-and-transform strategies are more difficult than fit-and confirm-strategies, and require the building of socio-political networks that legitimize innovations in relation to broader social, political, environmental and economic goals. Furthermore, technology advocates mobilize socio-political narratives such as arguments for employment and industrial opportunities, climate change, energy security, export opportunities and national competitiveness to increase the legitimacy of innovation, challenging the dominant selection environment (Smith & Raven, 2012; Raven et al. 2015 a; Raven et al., 2015 b).

Recent studies in the sustainability transitions literature have also pointed to significant conceptual overlaps between sustainability transitions and institutional theory, as the transformation of socio-technical regimes requires the transformation of dominant institutional arrangements, as depicted in institutional theory (Geels & Schot, 2010; Geels, 2011). Therefore, an institutional approach that focuses on the role of institutional arrangements and the role of actors in transforming them is important to better understand socio-technical transitions. Despite the centrality of institutional arrangements in transition processes, recent studies have emphasized the need for elaborating on the role of actor's agency within highly institutionalized socio-technical regimes, and the manner in which deeply structured rules associated with socio-technical regimes are transformed by the purposive action of actors. These actions include changing regulations, modifying public perception and creating alternative spaces for change by transforming existing institutional structures (Funfschilling, 2014; Funfschilling & Truffer, 2014). Recent contributions in the sustainability transitions literature have also addressed the role of both formal and informal institutional arrangements, such as local cultural norms, daily routines of actors and professional culture in transformation of dominant institutional arrangements (Wirth et al., 2013; Hansen & Coenen, 2015).

Despite these promising studies, there is still a need for more research on the relationship between the transformation of dominant institutional structures and the strategic actions of actors, so that sustainability transitions can be better understood. Therefore, an institutional approach that focuses on the role of collective and heterogeneous actors in transforming institutional arrangements is important for better understanding socio-technical transitions (Wijen & Ansari 2007; Aldrich, 2010; Aldrich, 2011). To summarize, this section has introduced the general theoretical background of this dissertation, and the concepts discussed in this section are further explored in the individual papers in the dissertation. In the next section, I discuss the relevant literature on collective institutional entrepreneurship.

1.5 BACKGROUND LITERATURE: COLLECTIVE INSTITUTIONAL ENTREPRENEURSHIP

In this section, I focus on the major debates in institutional theory and institutional entrepreneurship literature, as they are useful in addressing the key research questions in the dissertation. I will draw on concepts such as institutional entrepreneurship, institutional work, collective institutional entrepreneurship and field configuring events to situate the theoretical background of different empirical chapters. Here, I provide a brief description of the different strands of the literature from institutional theory used in the different chapters in the dissertation; in this section, I only provide a general overview of the literature, without focusing on its relevance for individual chapters.

Institutional arrangements take the form of rules and norms of behavior, regulations and social arrangements that are often difficult to change. In essence, institutional theory has focused on explaining how organizations are constrained by dominant institutional arrangements. Furthermore they need to seen as legitimate and improve their prospects of survival (DiMaggio & Powell, 1983; Wooten & Hoffman, 2008). Institutional arrangements are broadly classified into regulative, normative and cognitive dimension, which guide the behavior of actors and organizations. The regulative dimension of institutions focuses on rules, policies, regulations and laws which constrain actors' behavior through coercive measures. The normative dimension denote the beliefs, values and norms, while the cognitive dimension focuses on taken for granted assumptions in the society (Scott, 2010; Greenwood & Hinings, 2015).

In the past, institutional theory essentially focused on actors conforming to dominant norms, beliefs and cultural assumptions without having the choice to challenge the dominant institutional arrangements (Greenwood et al., 2011). Existing institutional approaches have also been criticized for being unable to explain the manner in which organized actors with resources, political power and social skills challenge the dominant institutional arrangements that constrain their actions. The literature on institutional entrepreneurship has attempted to redress these issues by suggesting ways in which actors – individually as well as collectively – challenge institutional configurations reflexively, while being conditioned and constrained by the very same institutional arrangements (Garud et al., 2007; Battilana et al., 2009).

The literature on institutional entrepreneurship suggests that new institutional arrangements develop when institutional entrepreneurs collectively realize novel opportunities and transform existing institutions through their political skills and entrepreneurial efforts (Hargadon & Douglas, 2001; Maguire et al., 2004). Engaging in institutional entrepreneurship is a risky process, and requires motivation on the part of institutional entrepreneurs in order to challenge the dominant institutional arrangements (Dorado, 2013). Prior research in the institutional entrepreneurship literature has focused on the role of a range of actors such as industry associations, governments, firms, advocacy groups and more in shaping the institutional environment through

different strategies such as lobbying to secure resources, cultivating new relationships with decision makers, and gaining political support for their initiatives (Barley, 2010; Child & Rodrigues, 2011). A few studies have also indicated the importance of actors working under resource and institutional constraints developing ingenious solutions and using strategies to defy and circumvent institutional constraints (Lampel et al., 2014). In recent developments in institutional entrepreneurship literature, scholars have also investigated the ability of actors to formulate institutional strategies in institutionally constrained environments with limited resources, and the manner in which actors navigate such complex institutional environments (Khoury et al., 2015). There is also a growing body of literature on social movements, acknowledging that they play an important role in the transformation of institutional arrangements through collective and contested action (Guerard et al., 2013). The emerging literature on social movements has documented the role of activists, grassroots groups, NGOs, civil society organizations and SMO (specialized technology social movements) in leveraging distinct capabilities, knowledge and strategies for influencing the dominant institutional environment. Empirical accounts of social movements have emphasized activities such as strategic framing and the creation of new political opportunities, advocacy and lobbying, the use of pressure tactics, framing environment friendliness, mobilizing resources and enrolling new consumers in challenging institutional arrangements (Sine & Lee, 2009; de Bakker et al., 2013; York et al., 2015).

While the concept of institutional entrepreneurship has been used to discuss the relationship between agency and institutional structure, it has also been criticized for attributing too much power and foresight to actors for transforming institutional arrangements. Scholars have emphasized the micro-foundations of institutional change by highlighting the day-to-day actions of actors as they create institutional change in concrete social settings (Powell & Colyvas, 2008; Furnari, 2014). The emerging literature on institutional work describes the efforts of actors to create, maintain and disrupt existing institutional arrangements for the institutionalization of novel practices. The concept of institutional work has been defined as "the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions" (Lawrence and Suddaby, 2006, pp. 215), and it particularly focuses on day-to-day practices of actors while they try to creatively maneuver the complex institutional environment of which they are a part. Existing studies have focused on different kinds of institutional work such as advocacy for rules and regulations, conducting demonstrations and campaigns, mobilizing political and regulatory support for initiatives, lobbying for resources, spreading new knowledge and skills and developing new rules and regulations (Lawrence et al., 2013). Therefore, the concept of institutional work highlights the dynamic nature of institutions and the invisible and mundane actions of actors in day-to-day situations, rather than the heroic action of institutional entrepreneurs and the mundane work accomplished by actors in terms of improvising solutions instead of

strategic action, as emphasized in the institutional entrepreneurship literature (Smets, Morris & Greenwood, 2012; Muzio, Brock & Suddaby, 2013).

Furthermore, there is a substantial focus in the literature on the distributed nature of institutional entrepreneurship (Dorado, 2005; Garud, Hardy & Maguire, 2007), with institutional change occurring as a result of the uncoordinated efforts of heterogeneous actors with different levels of motivations and interests (David, Sine & Haveman, 2013). Debates within the institutional entrepreneurship literature have proposed the finding of a middle ground; that is, adopting a less heroic notion of actors who are neither 'cognitive dopes' (actors who simply accept constraints imposed by institutional arrangements) nor ' hyper-muscular agents ' (actors who heroically challenge institutional arrangements) (Battilana et al., 2009; Aldrich, 2011). Moreover, legitimating innovations is a contested and difficult process, as there are multiple and conflicting actor groups and each of them may bring different justification principles and evidences to support their point of view (Scott, 2010). The collective action model of institutional innovation emphasizes the importance of conflict, power and politics in the transformation of dominant institutional arrangements. According to this perspective, institutional change does not occur as a result of individual entrepreneurial action, but due to the efforts of multiple actors cooperating as well as being in contestation with one another (Hargrave & Van de Ven, 2006; Hargrave & Van de Ven, 2009). A distributed view of institutional entrepreneurship emphasizes the collective dimension of the institutionalization process, suggesting that the process of institutional transformation is far more contested and political in nature than merely a heroic story of change, as depicted in the institutional entrepreneurship literature (Aldrich, 2010). Studies have also shown that institutional innovation is considerably challenging due to the friction, resistance, and contestation that take place as a result of the dynamic tension between institutional persistence and innovative change (Raffaelli & Glynn, 2015).

Within the organization studies literature, scholars have recognized the importance of 'field-configuring events' in shaping organizational fields and in the development of new organizational fields (Lampel & Meyer, 2008). Such events represent temporary social organizations and collective settings where different actors get together and shape the emergence of a new institutional field. This literature suggests that field-configuring events provide spaces for interaction between multiple actors for a limited duration of time, and shape the emergence of new fields (Garud, 2008; Schüßler et al., 2015). Another stream of literature emerging from STS (Science and Technology Studies) has emphasized the role of 'hybrid forums', which are open spaces creating opportunities for heterogeneous actors including experts, political elites, technicians, specialists, laypersons and spokespersons to deliberate on matters of concern and to resolve ongoing controversies (Callon et al., 2009). Hybrid forums play an important role in identifying 'concerned groups'; that is, actors that are often excluded from policy decisions and

whose identities have been marginalized by powerful and elite actors (Garud & Gehman, 2012; Garud, Gehman & Karunakaran, 2014).

Complementing these perspectives, few studies have suggested the importance of reflexivity and deliberation and distributed the problem-solving approach for challenging institutional arrangements. This perspective focuses on collective action, and involves engagement with heterogeneous actors while allowing learning from small success and multiple failures to take place. By engaging in multiple failures and abandoning unsuccessful efforts, actors gain a fresh perspective on problems and devise strategies for resolving them.

Multiple and heterogeneous actors experiment based on their preferences and adjust their actions based on their ongoing interactions and learning with the institutional environment, as actors often face unanticipated developments while trying to transform institutional arrangements. Such a perspective is also useful for understanding the role of distributed experimentation and the manner in which actors take small actions, learn from the ongoing successes and failures of their actions and develop a new understanding for resolving sustainability challenges in a distributed and collective manner (Ferraro, Etzion & Gehman, 2015; Etzion et al., 2015).

Building on these insights, it is suggested that there is a need for a more participative approach that are less heroic and experimental in nature and that promotes a long-term engagement of heterogeneous actors in shaping sustainability transitions. To summarize, this section has introduced the general theoretical background of this dissertation, and concepts discussed in this section are further explored in the individual papers in the dissertation. The individual papers in the dissertation develop the insights discussed here in order to answer more specific research questions. The next section focuses on the research approach and methods of data collection and analysis used in the dissertation.

1.6 RESEARCH APPROACH

This section presents the research approach used in the dissertation; it describes the approach undertaken in order to answer the research questions, as well as the different sources of data collection and data analysis. The research question addressed in this dissertation demanded a context-sensitive and qualitative case study approach that took the motivation and strategies of the heterogeneous actors into account in a complex and uncertain environment with a rapidly changing technological environment (Garud & Karnøe, 2003). A qualitative case study approach was utilized for this research, as it allows the understanding of motivations and actions of heterogeneous actors and offers a rich understanding of the transformation of institutional arrangements (Greenwood & Suddaby 2006 ; Khavul, Chavez & Bruton, 2013).

A case study approach is also useful in that it allows for flexibility in the data collection and contextualized judgments by researchers during the research process, while being open about unanticipated insights (Yin, 2009). Case studies serve the purpose

of testing existing theories and of developing new theoretical insights on the basis of empirical data emerging from the case analysis. Furthermore, a qualitative research approach is also particularly suitable for studying process-related research questions and for conducting in-depth investigations of poorly understood phenomena (Eisenhardt & Graebner, 2007; Langley & Abdallah, 2011). Case studies can be selected on the basis of the phenomenon of interest, theoretical significance and availability of rich data for carrying out the case analysis. Case studies are often classified into single and multiple studies, where the objective behind conducting multiple case studies is to carry out a cross-case analysis and draw out generalized implications from the analysis (Edmondson & McManus, 2007; Yin, 2009).

The research conducted in this dissertation consists of five different case studies (that is, five social enterprises in solar PV; wind energy in India; wind energy in Finland and India; solar PV development in Gujarat and West Bengal, and solar PV debates in conferences). Methodologically, I have focused on conducting an empirical analysis at multiple units of analysis (that is, organizations, national, cross-national, regional and temporary events) and adopted a flexible approach for the data collection and data analysis. I also tried to make my research as context-specific as possible by deeply grounding my case studies in the field and by using empirical insights from the field to develop my research further. The case studies were selected on the basis of specific empirical observations during the initial desk-research stage, as well as based on the emerging understanding of the situation during the fieldwork and its theoretical significance; that is, gained knowledge that was useful for answering the key research question of the dissertation as well as practical considerations, such as sufficient and adequate amount of archival data in the cases and access to relevant experts through semi-structured interviews. Practical considerations such as being native to the research context, access to field sites and conducting case studies by taking cultural sensitivities into account were also important. Despite these careful considerations, it was still quite challenging to conduct empirical research in a large country like India, with several practical and administrative barriers.

In this dissertation, the empirical research is based on archival material and data from semi-structured interviews and participant observations I gathered during two research visits to India, in 2012 and 2013, for a period of nine months, focusing on the development of wind and solar PV energy. The majority of fieldwork in India was undertaken between April of 2012 and August of 2012, and between June of 2013 and November of 2013. Although a variety of data sources were collected, read, analyzed and used to develop a background understanding of wind and solar PV energy in India, not all of them are reported in detail in this dissertation. Here, I only provide a brief overview of the data sources used, with the individual chapters showing the data sources in detail for each respective case study. Furthermore, sections 1.6.1, 1.6.2, 1.6.3 and 1.6.4 only provide a general overview of the data collection and data analysis procedures

in the dissertation, without providing details about specific data collection and data analysis procedures used in individual chapters.

1.6.1 Archival sources

One essential aspect of data collection for case study research is the use of multiple data sources, which helps researchers address a broad range of issues, increasing the robustness of emergent findings and triangulating multiple data sources in order to obtain greater insights into the case study (Yin, 2009; Tuertscher et al., 2014). Using extensive archival data sources was also useful for this research, as they proved valuable for providing historical insights into the development of solar PV energy and offered significant background information on the development of the studied technologies. A variety of archival data sources were utilized for data collection in this dissertation, including research reports, academic books, scientific articles, websites, trade magazines, policy and regulatory reports, government documents, industry reports and summaries of workshops and conferences produced by organizers.

Other sources included reports from research institutes and universities, reports by consultancy firms, PowerPoint presentations from industry conferences and video material such as public speeches and expert interviews available on YouTube. Additionally newspaper articles were collected, which was helpful in complementing insights from documentary sources and in tracing the broader public discourse on wind and solar PV energy in India, along with finding insights on ongoing debates between various actors. An overview of the different data sources used is provided here for the purpose of seeing the different kinds of sources used for obtaining insights from multiple perspectives. The details in the table below provide relevant examples (in a non-exhaustive list) of all the archival data sources used. The individual chapters list the specific data sources used in the respective case studies (see table 1.1 for a detailed listing of the archival data sources used).

Table 1.1: Overview of the archival data sources used in the dissertation

Types of data source	Relevant examples of sources	Type and relevance of information provided
Regulatory documents	Reports and regulatory orders of regulatory agencies (Central Electricity Regulatory Commission and State Electricity Regulatory Commissions) and Forum of regulators Example: http://goo.gl/6enKhs	Relevant for insights into important regulations, tariffs, renewable purchase obligations, details about solar PV and wind energy, capturing important information on regulatory agencies' perspective on implementing regulations and involving a broader range of actors while drafting and implementing regulations
Policy documents	Policy documents and reports produced by national and state government agencies on wind and solar PV energy. Example: Strategic Plan for New and Renewable Energy Sector by the Ministry of New and Renewable Energy (http://goo.gl/5uL8ct); Gujarat solar policy (http://goo.gl/RinHyW)	Insights into historical overview of important policies and incentives developed by the government and overview of political commitment by the government agencies for mainstreaming the technologies
Industry reports	Reports by international organizations describing details about the industry. Example: GWEC India wind energy outlook (http://goo.gl/GIU5tK)	Useful for providing a broad overview of the latest trends in technological development and critical issues faced by firms and industry (for example, problems of transmission, land, competiveness, manufacturing, etc.)
Industry trade magazines and information outlets	Trade magazines. Examples: Windpro by Indian Wind Power Association (http://goo.gl/hQnUq3); publications by Indian Wind Turbine Manufacturer's Association (http://goo.gl/PIJEgr)	Overview of advocacy and lobbying efforts of industry associations for suitable incentives, policies and regulations; collective action activities; obtaining insights into important issues facing the industry and latest technological trends

Books and doctoral thesis	Books and doctoral thesis for rich historical details on case studies: Wind power development in India by G.M. Pillai; Doctoral thesis: Cross-border transfer of climate change mitigation technologies: the case of wind energy from Denmark and Germany to India	Overview of the historical development of renewable energy in India; insights into different issues (policy, regulation, social impact, eventual impact on users) associated with wind energy; the doctoral thesis was useful in obtaining large amounts of information on the historical development of wind energy in India and an overview of different wind turbine manufacturers
Academic articles	Several research articles published in international journals (for example, Energy Policy, Renewable Energy and Sustainable Energy Reviews, Renewable Energy, Innovation and Development, Global Environment Change, Research Policy) describing wind and solar developments in India	Useful for looking at earlier accounts by researchers on the development of wind and solar PV energy in India; useful for obtaining access to systematically written information with theoretical insights in many cases; these sources were also useful for obtaining relevant information about the strategies employed by different actors the barriers they faced
Scientific reports	Reports and information by a scientific organization on wind energy development in India; the National Institute of Wind Energy (Example: http://goo.gl/JvZORA)	Insights into the latest technological developments, resource assessment, technological standards in wind and solar PV energy in India
Reports from civil society groups	Example: Facing the Sun: Policy for sustainable grid-connected solar energy; State of renewable energy in India: A citizen's report by the Centre for Science and Environment; Clean energy regulation and civil society in India, by Prayas Energy Group	Insights into the negative impacts of wind and solar energy, such as impacts on local population and natural environment; rent-seeking practices of industry actors engaged in the development of wind and solar PV; participation of public and civil society groups in the regulatory and policy process

Case studies	Existing case studies carried out on similar topics (Example: http://goo.gl/uVzh33)	Case studies by academics and practitioners served the purpose of providing additional information and a new perspective on the cases being used
Websites	Websites of regulatory agencies, nodal agencies, government organizations and wind and solar energy firms	These webpages were used to obtain access to relevant interviewees from different organizations and gather the latest information on wind and solar PV energy developments
Newspaper articles	Examples: Hindu Business line, Times of India, Economic Times, Down to Earth, Business Standard, Business times and Financial Times	Overview of recent developments and policy debates; understanding key controversies and framing by different actors; mapping quotes from experts and their perspective on important issues
Conference proceedings and PowerPoint presentations from conferences	Conferences and forums are useful for studying narratives and activities of actors in real time. Example: Solarcon India (Example: http://goo.gl/reHRdr)	Notes from presentations and informal exchanges with speakers and participants helped in obtaining a more informed perspective on conflicts, contestations and disagreements between the actors, as well as an overview of narratives and anti-narratives of different actors on important issues
Consultancy reports	Reports by consultancy organizations providing a broad overview of important policies and regulations and future projections for the industry (Reports by Bridge to India; McKinsey; PWC; ABPS Infrastructure Services; Ernst and Young. Example: http://goo.gl/8ntSRq)	Helpful in obtaining details about future projections associated with the technologies; overview of current challenges and details about important policies and regulations

Reports by advocacy groups and think tanks	Reports by think tanks and advocacy groups for providing a broad overview of technological development and policy advice: Example: reports by CSTEP (http://goo.gl/N9FB9L)	Useful for obtaining a less biased perspective on ongoing developments and different perspectives than those of government, firms, industry associations and civil society groups
Video material (Conference recordings and YouTube videos of experts discussing solar PV and wind energy in India)	Video material containing interviews with relevant experts, panel discussions, and also recorded material from industry forums and conferences (Relevant examples: https://goo.gl/xYgmFq; https://goo.gl/bsbFI3; https://goo.gl/DvqvTN; https://goo.gl/WXiKef)	Insights into opinions and strategies of actors in cases where it was not possible to interview them in detail, in addition to gathering insights about their perspectives on ongoing developments in wind and solar energy in India
Other relevant sources, such as industry blogs	Industry blogs covering regular discussions on renewable energy in India, such as Windpower monthly. Relevant examples: (http://goo.gl/tE7n1K); Bridge to India (http://goo.gl/ucWliK); Panchabuta (http://goo.gl/nMG86q); Energy Next (http://goo.gl/CToFyB); Movya (http://goo.gl/GVDW0L); PV Tech (http://goo.gl/cAoWWj)	Helpful in systematically gathering information on recent debates and discussions, as well as the opinions of different stakeholders; gathering information on latest trends and being updated regularly for studying processes in real time

The archival data sources were collected and summarized until a stage was reached when it was possible to know that sufficient data matching the theoretical concepts had been collected for the case study analysis. The use of different types of data sources helped in obtaining a more accurate interpretation of the role of different actors, their actions and ongoing developments. I regularly maintained the archival data sources collected in specific digital folders, and prepared summaries of relevant insights for the case studies from the vast amount of data collected. I tried to keep track of ongoing developments in wind and solar PV energy by collecting additional data whenever necessary, in order to fill gaps in the already-collected data and to reduce possible bias due to limited insights found in previously collected data.

1.6.2 Semi-structured interviews

I utilized semi-structured interviews for data collection in this dissertation, as they provided a rich and deep understanding of the strategies used by different actors, their worldviews and new issues that were difficult to find out using archival data sources. Semi-structured interviews are useful for obtaining real-time and retrospective information on the actions of different actors while trying to understand their accounts and lived experiences; they are also useful for allowing linkages to be drawn between theoretical concepts and empirical data, also offering flexibility to explore new insights. Through semi-structured interviews, it was also possible to obtain important accounts regarding significant change processes and key decision-making processes which cannot be easily – or often – found in archival data sources and which contain insights that can only be captured through individual, personalized accounts (Maguire et al., 2004; Langley & Abdallah, 2011).

Field visits were carried out in 2012 and 2013 for the purpose of conducting semi-structured interviews; these visits took place in different Indian cities that were geographically located at large distances from each other, such as New Delhi, Bengaluru, Chennai, Hyderabad, Pune, Gandhinagar, Ahmedabad and Kolkatta. The interviews were conducted in different cities throughout the country, as wind and solar industry representatives and relevant experts were not all present in one or two major cities in India. The first visit focused on collecting data for studying wind energy in India, while the second visit was more focused on studying solar PV energy. Before carrying out the fieldwork, desk-based research was carried out by collecting relevant archival data for the cases and for the purpose of finding the relevant experts to be interviewed. Desk-based work was still carried out during the fieldwork, in order to complement ongoing findings from field research and for the purpose of collecting additional data.

Potential interviewees were first identified by studying the archival data sources, and were initially contacted by email requests, phone calls and personal meetings to explain the aims and objectives of the research. The interviewees were selected on the basis of their expertise in Indian solar PV and in the wind energy industry, with

specialized knowledge and expertise spanning different aspects of the industry. The selection of interview experts was based on criteria such as long-term experience in the industry, expertise, names mentioned in media debates, newspaper articles and other data sources and references provided by other experts. The interviewees included representatives from wind and solar PV energy firms, independent experts, consultants, manufacturers and project developers, professors in universities, scientists in research institutes, nongovernmental organizations, industry associations, government organizations, energy utilities, industry associations, regulatory commissions, advocacy organizations, civil society groups, NGOs, lobbying organizations, social enterprises, and more. Academic experts who were outsiders to the wind and solar industry were helpful in providing a critical view of ongoing developments. Care was taken to balance the different perspectives; that is, to choose stakeholders who were involved in policy formulation as well as implementation. Further efforts were made to include a wide range of stakeholders, in order to obtain a broad range of perspectives and diverse views from heterogeneous stakeholders on important issues.

However, it was difficult to gain access to all potential interviewees due to their busy schedules, logistical issues and general difficulties in accessing government and firm officials in the context of a developing country like India. It was particularly difficult to contact and gain access to representatives from wind and solar PV firms, due to the fact that there was no direct way of contacting them without prior reference, along with difficulties due to their busy schedules. In cases where personalized face-to-face interviews were not possible – either due to the interviewee's busy schedule or logistical issues –, phone interviews were conducted or contact via email was established. A snowballing approach was used to find and meet additional interviewees whom other interviewees recommended and considered important for the intended purpose of the study. Despite the practical and administrative difficulties, I conducted 42 interviews with different solar PV and wind energy experts in India, with eight interviews with wind energy experts taking place in Finland along with a co-author of chapter 4. The interviews are used in the different chapters accordingly; while some interviews provided very relevant insights about different actors' strategies, other interviews served the purpose of providing background information about wind and solar PV energy in India. Details about the interviews are mentioned in the table 1.2 below.

Table 1.2: Semi-structured interviews carried out during the field research

Number	Position of the interviewee	Type of organization	Location
1	Manager	Social enterprise (solar PV energy)	Bengaluru
2	Head and director	Social enterprise (solar PV energy)	Hyderabad
3	Head and director	Social enterprise (solar PV energy)	Auroville, Puducherry
4	Director	Social enterprise (solar PV energy)	Hyderabad
5	Director, wind energy division	Government organization	New Delhi
6	Secretary general	Industry association (wind energy)	Chennai
7	Chief economist	Wind energy firm	Pune
8	Director, wind energy division	Advocacy organization	Pune
9	Group coordinator, civil society organization	Civil society group	Pune
10	Professor	Administrative and research institution	Hyderabad
11	Independent expert and first chairman	Regulatory commission	Bengaluru
12	Chief of bureau	Media organization	Chennai
13	Director	Research institution	Chennai
14	Secretary general and executive	Wind energy industry association	Chennai
15	Director	Consultancy organization	New Delhi/ Chennai (Telephonic)
16	General manager, policy and government relations	Wind energy firm	Gurgaon/ Dehradun (Telephonic)
17	Director	Wind industry organization	Chennai
18	General manager	Wind energy firm	Chennai
19	Director	Wind energy research institute	Chennai

20	Director	Advocacy organization	Chennai
21	Convener	Civil society organization	Hyderabad
22	Trustee	Civil society organization	Chennai
23	Professor	University	Chennai
24	Director, engineering	State electricity regulatory commission	Chennai
25	Member secretary	State energy coordination cell	Hyderabad
26	Deputy general manager	State renewable energy nodal agency (Andhra Pradesh)	Hyderabad
27	Deputy general manager	State renewable energy agency (Tamil Nadu)	Chennai
28	Chief engineer	State electricity transmission corporation	Hyderabad
29	Senior engineer	State electricity distribution company	Hyderabad
30	Principal secretary / Policy maker	Government department on energy	Gandhinagar
31	Member, Finance	State electricity regulatory commission	Gandhinagar
32	Research Scientist	Energy research institute	Gandhinagar
33	President	Industry association (solar PV energy)	Ahmedabad
34	Chief general manager	Civil society organization	Ahmedabad
35	Director	Consultancy organization	Ahmedabad
36	Senior executive projects	State energy utility	Gandhinagar
37	Policy maker	Government energy department	Kolkatta
38	Past director/policy maker	Renewable energy development agency	Kolkatta
39	Director	Government agency	Kolkatta
40	Advisor, Engineering	State electricity regulatory commission	Kolkatta
41	Regional manager	Knowledge-transfer organization	Kolkatta

42	Center head	Civil society group	Kolkatta
43	Senior attorney	Legal firm related to wind energy development	Helsinki
44	Professor	University	Lappeenranta
45	Transmission system operator	Manager	Helsinki
46	Environmental organization	Energy campaigner	Helsinki
47	Wind farm developer	Chief executive officer	Lappeenranta
48	Wind energy firm	Managing director	Helsinki
49	Wind energy firm	Project manager	Helsinki
50	Wind energy firm	Managing director	Helsinki

Before conducting the interviews, all interviewees were provided with an introduction letter outlining the content and purpose of the research, along with a request for their consent regarding the interviews. I introduced the purpose of my research, data collection methods and use of the data being collected from the semi-structured interviews in the letter or email sent requesting an interview. In the email, I also informed the interviewees about my data collection procedure, kind of data expected from the interview and their permission to conduct the interview. In some cases, I also had to visit the interviewee's office or call multiple times to request an interview. An interview guide was prepared in a notebook prior to the interviews by deriving insights from themes in the literature, making the questions less theoretical and then tailoring questions to the role and background of the interviewees. The interviews particularly focused on the interviewee's role in wind and solar PV development in India, their key decision-making processes and views on past and current developments.

In addition, questions were asked on how new policy and regulatory initiatives came about, as well as questions regarding the implementation measures followed by the stakeholders and their impact on subsequent developments. During the interviews, the phrasing of the questions in the interview protocol was adjusted based on the interviewee's background, as the interview guide was regularly modified as interviews progressed during the course of the research. During the semi-structured interviews, the experts were given ample opportunity to tell their stories and accounts, as the questions were open-ended in nature so as to allow a range of responses without limiting the natural flow of discussion. Furthermore, the order of questions during the interviews also varied depending on the flow of the conversation during the interview, and additional questions were asked based on the interviewees' responses. The semi-structured interviews helped to make sense of ongoing developments and to identify controversies and differences in opinion during the emergence of wind and solar PV energy in India. In some instances, additional questions were asked in relation to specific details or remarks an expert

interviewee mentioned during an interview. Notes were prepared during the interviews, alongside the tape recording of the interviews. In a few instances, the interviews were conducted by telephone and were not tape-recorded due to logistical reasons or if the interviewees were not comfortable with the interview being recorded. The majority of the interviews were summarized by listening to the audio recordings and writing down important lessons learned from the interviews. When interviews were not recorded, field notes were read again in order to find key issues mentioned by the interviewees. Additionally, while conducting the interviews, it was also possible to collect a range of empirical materials such as detailed reports, documents, PowerPoint presentations on relevant issues facing the wind and solar PV industry from the interviewees.

The in-depth interviews helped in identifying key issues that had not come up in the analysis of secondary data sources, and provided new and alternative interpretations to the development of solar PV energy and wind energy in India. The interviews and field research carried out helped to better understand the issues and problems faced by the practitioners in the local institutional context and utilize these in-depth insights for the purpose of data analysis (Barkema et al., 2015). My approach during the interviews focused on acquiring a rich understanding of the different interviewees' perspectives, iterating the questions asked by generating insights from previous interviews and theoretical concepts and developing a broader understanding of the ongoing developments. Efforts were made to rule out alternative interpretations by revising the insights gained from the semi-structured interviews and complementing them with new archival data sources. The raw data gathered from the interviews was summarized according to the theoretical concepts by using manual qualitative content analysis and selecting relevant quotes for the purpose of presenting a theoretically interesting account (Reay, 2014). Although the interviews helped in better understanding the role of actors and their actions, a higher number of focused interviews with specific experts (such as energy utilities, wind and solar PV firms and government experts at senior positions) would have resulted in deeper insights. Insights from the archival sources were useful in reducing the problems associated with a limited number of interviews, and also reduced interviewees' possible bias regarding the interpretation of ongoing developments in wind and solar PV energy.

1.6.3 Participant observations

Besides interviews and secondary data sources, participant observations were undertaken in a number of industry conferences, regulatory hearings and workshops for additional data collection for this dissertation. These events allow the collection of real-time data and the gathering of rich data with respect to the perceptions of different actors and their actions in concrete social settings. Analyzing and studying events also present opportunities for rich empirical studies, by considering an ethnographic inquiry and following the actors and their actions as they engage in these concrete social settings.

Furthermore, analyzing events also allowed for the collection of rich details, through following actors, discussing, debating and negotiating in real time and in concrete social settings (Zilber, 2014; Delgado & Cruz, 2014). During the field research in India, I visited industry conferences and events such as SOLARCON India, Future of Solar Energy in India, regulatory hearings by state electricity regulatory commissions such as TNERC (Tamil Nadu Electricity Regulatory Commission) and APERC (Andhra Pradesh Electricity Regulatory Commission) and workshop on the formulation and implementation of low-carbon policies in the electricity sector. Participation in these events was useful in obtaining access to data and experts which would have been difficult to find through other data sources utilized in the dissertation. To begin with, I gathered information about the event organizers, background of the events, attendees, different sessions in the events as well as other activities before and after the events. I prepared notes of important discussions and tape recorded some conversations and debates; during the events I also collected presentations by experts, recorded the ongoing discussions and photographed and video-recorded important debates and discussions, especially during the question-and-answer sessions after expert presentations. During these events I even participated by walking around between groups of people and introducing myself to the people around, listening to the conversations and conducting observations. The observations were written down by preparing field notes for the purpose of drawing out novel empirical insights. Besides the observations, I also talked informally to the experts present in the events during lunch and tea breaks for establishing contact and clarifying issues that were not understood in detail during the event sessions. I documented whatever I could from the different sessions in the events, developing my interpretation of the events and also collecting additional data available from the event organizers and participants. After the events, I also tried to track down media coverage of the events, collect newspaper articles and prepare event summary reports. This helped me strengthen and improve the interpretations of the events and their relevance in shaping long-term development of wind and solar PV energy in India.

1.6.4 Data analysis

After the data collection process, I tried to summarize different kinds of data from archival sources, semi-structured interviews and participant observations in order to draw out relevant insights from the research data collected. An initial analysis of the multiple sources of data helped me obtain a broader understanding of the various strategies used by actors to shape the development of wind and solar PV in India. The use and combination of different types of data sources helped to reduce possible bias – such as partial accounts by interviewees – and provide a more accurate overview of the development of solar PV and wind energy in India. The aim of the data analysis was also to focus on developing an understanding of the summarized data from the perspective

of different actors, their actions and the manner in which they tackled various obstacles while trying to mainstream the technologies in question.

To analyze the data, I adopted an approach that involved thoroughly knowing the summarized data by reading it in detail and preparing notes, analyzing the data using theoretical concepts and then making broader interpretations of the emergent findings. In practice, this was a highly iterative process, as I moved back and forth between summarized data and theoretical concepts, checking for alternative explanations and drawing theoretical insights for the purpose of developing a rich case narrative (Klag & Langley, 2013). I took additional care to be open to the interpretation and analysis of data and to consider alternative explanations wherever necessary to improve the consistency of the account and the richness of the qualitative account (Reay et al., 2014). Furthermore, efforts were made to ensure the trustworthiness of the analysis, by gathering additional data wherever necessary and eliminating interpretations which seemed unnecessary for the purpose of presenting the case studies.

1.7 OVERVIEW OF RESEARCH PAPERS IN THE DISSERTATION

The five papers that form this dissertation are included in the dissertation as chapters 2, 3, 4, 5 and 6. These chapters can be read as individual research papers with their own specific research questions, literature review, research method, analysis and contribution. All the empirical papers in this dissertation are connected to each other conceptually, and empirically focus on solar PV and wind energy in India. Only chapter 4 has a different empirical case analysis, at it focuses on contrasting wind energy developments in India and Finland. In this way, it has been ensured that the papers are theoretically and empirically novel, though with a common connection in order to answer the overall research questions of the thesis and contribute towards the sustainability transitions literature.

Table 1.3: Overview of the research papers included in this dissertation

SNO.	Title	Theoretical approach used	Research case and data	Unit of analysis	Main contribution
1	Upscaling of business-model experiments in off-grid solar PV energy in India.	Business models, social entrepreneurship, development studies, sustainability transitions, collective institutional entrepreneurship	Five solar PV business models in India	Organization/ innovative business models	Develops a typology of upscaling dimensions for promising business models by social enterprises and suggests the importance of institutional innovation and collective action for wider upscaling of promising sustainability initiatives
2	Collective institutional entrepreneurship and contestations in wind energy in India	Collective institutional entrepreneurship in long-term historical context	Historical development of wind energy in India	National context	Emphasizes the importance of collective institutional entrepreneurship in the development of wind energy in India and the need for managing ongoing conflicts by including weaker actors in the decision-making process

3	Institutional entrepreneurship in transforming energy systems towards sustainability: Analysis of wind energy development in Finland and India	Comparative investigation of collective institutional entrepreneurship in mature and emerging institutional contexts	Contemporary development of wind energy in India and Finland	Cross-national: Comparison of emerging and mature institutional contexts	Contributes to a better understanding of differences in institutional strategies in the development of wind energy in mature and emerging institutional contexts, using the typology of political, technical and cultural work; provides insights about the extent to which emerging contexts provide more opportunities for strategic action than mature institutional contexts
4	Role of institutional entrepreneurship in the creation of regional solar PV energy markets: Contrasting developments in Gujarat and West Bengal	Collective institutional entrepreneurship in regional contexts	Development of grid-connected solar PV in Gujarat and West Bengal	Regional/ Sub-national comparison	Contributes to a better understanding of institutional entrepreneurship in regional context by examining the role of critical actors and their institutional strategies for steering regional sustainable energy initiatives

5	Field-configuring events in sustainability transitions: The case of solar PV energy in India	Sustainability transitions, Field configuring events	Ongoing development of solar PV by studying two conferences	Temporarily organized events such as conferences and forums	Contributes to a better understanding of political dynamics of niche protection by analyzing narratives and counter-narratives in temporally organized events and offering a real-time analysis of political debates associated with niche protection

In this section, I summarize the different empirical chapters in the dissertation in terms of theoretical lens used, research method, data sources, unit of analysis and main contribution. The research papers included as chapters of the thesis are written as independent research articles for journal publications. Four of the five papers are co-authored. These papers are included either as published by the respective journal, submitted to the journal or with details about previous submission in conferences and current stage of revision. Now I provide a brief overview of the different research papers and the respective research issues they address.

Paper 1 (Chapter 2) investigates five promising off-grid solar PV business models that influence the dominant socio-technical regime associated with fossil fuels in India. This paper mobilizes the literature on social entrepreneurship in order to discuss different kinds of business models in off-grid solar PV energy and their upscaling strategies in seven different dimensions. The paper utilizes insights from the sustainability transitions, development studies, business models and social entrepreneurship and collective institutional entrepreneurship literature; it is based on a qualitative investigation of the social enterprises using archival data and semi-structured interviews. The main research question of this chapter is: *What are the different dimensions in which the novel business model experiments in off-grid solar PV energy in India have upscaled?* This chapter focuses on the fact that not many previous studies have focused on the upscaling dimensions of promising business models by social enterprises. To understand the various dimensions in which social enterprises have upscaled, I developed a typology of upscaling dimensions for social enterprises (quantitative, organizational, geographical, deep, functional, replication and institutional). The chapter discusses the hybrid nature of social enterprises; that is, the balance between social, economic and environmental values in a resource-constrained and weak institutional environment in India. The chapter highlights that these social enterprises engage in institutional innovation by working creatively in weak institutional environments to develop solutions for poor, disadvantaged communities. The chapter concludes by emphasizing the role of collective institutional innovation, as individual social entrepreneurs with promising business models seldom can challenge dominant institutional arrangements and rely on collaborations with a range of outside stakeholders and on a wider institutional context. The findings from this chapter form the basis of the second paper by essentially highlighting the role of collective institutional innovation in sustainability transitions.

Paper 2 (Chapter 3) builds upon the insights from the first paper and emphasizes the role of collective institutional innovation for understanding the development of innovations. This chapter analyzes the development of wind energy in India by using insights from the collective institutional entrepreneurship literature. Based on historical archival data and semi-structured interviews, this chapter discusses the development of wind energy in India. The main research question of this chapter is*: How has institutional entrepreneurship shaped the development of wind energy in India*

during the period 1985–2014, and which controversies and conflicts can be identified ? Instead of portraying the heroic role of institutional entrepreneurs in challenging dominant institutional arrangements, this chapter emphasizes the role of the ongoing accomplishment of multiple actors and their distributed action. The chapter shows that institutional entrepreneurs act collectively without always having a clear strategy for shaping future developments, while continuously adapting their strategies to face unanticipated developments. The empirical account presented in the paper shifts the focus away from the fairly smooth and linear processes of institutional transformation to a nuanced account, by emphasizing setbacks and contestations between heterogeneous actors in the process of wind energy development in India.

Paper 3 (Chapter 4) builds upon research carried out in chapter 3. Drawing on recent literature on institutional entrepreneurship in emerging economies, this paper compares India (emerging institutional context) and Finland (mature institutional context) with regard to wind energy developments. This chapter is based on archival data sources and semi-structured interviews from Finland and India, and focuses more on contemporary developments in wind energy in both countries. The main research question of this chapter is: *What are the differences in the ways in which actors have collectively engaged in shaping the institutional context for wind energy development in Finland and India?* The main focus of this paper is to empirically illustrate the differences in institutional strategies in mature and emerging institutional contexts by utilizing the typology of political, technical and cultural work based on insights from the institutional entrepreneurship literature. This chapter emphasizes the need for looking at differences in collective institutional entrepreneurship in different contexts, and whether emerging institutional contexts provide more opportunities for collective institutional entrepreneurship than mature institutional contexts.

Paper 4 (Chapter 5) focuses on investigating the role of institutional entrepreneurship at the sub-national level by studying differences in implementation of grid connected solar PV energy in Gujarat and West Bengal. This chapter is based on archival data sources, field research in two Indian states and semi-structured interviews. The main research question of this chapter is: *How and why was implementation of grid connected solar PV different in Gujarat than in West Bengal ?* This chapter is a comparative study between two regions: one region that experiences a successful implementation of grid-connected solar PV and another region that faces challenges in implementation. By describing the developments in the two cases – Gujarat and West Bengal –, the paper uncovers the role of various regional actors and the different strategies used by them to address the challenges associated with implementing grid-connected solar PV energy.

Finally, **Paper 5 (Chapter 6)** responds to calls for more politically informed and real-time analysis of sustainability transitions. The paper builds upon the sustainability transitions and field-configuring events literature, and utilizes observations in conferences, informal interviews and archival data sources. This paper takes a closer look at the role

of temporally bounded field-configuring events (FCEs), which encompass a broad set of collective events including professional industry conferences, trade shows, regulatory hearings, business meetings and a range of collective settings. By bringing together a range of heterogeneous actors, these events provide participants with a rich context for interaction, collective sense-making and a better understanding of the politics of sustainable energy transitions. The research question of this chapter is*: How can FCEs be a useful analytical category for the analysis of politics aspects of niche protection dynamics in socio-technical transition studies?* This chapter focuses on the role of field-configuring events, and discusses ongoing developments in the National Solar Mission by mainly focusing on two industry conferences embedded in an ongoing stream of activities. This paper concludes by suggesting that while field-configuring events can be excellent sites for studying the development of niche innovations and politics of niche protection in real time, these events also have limited influence in shaping ongoing trajectories for sustainability transitions, and have a more indirect influence in terms of increasing opportunities for collective action.

Chapter 2

Upscaling of business model experiments in off-grid solar PV energy in India[1]

Upscaling of business model experiments in off-grid solar PV energy in India

Suyash Jolly, R.P.J.M. Raven, Henny Romijn

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ABSTRACT

Rapidly developing countries like India face numerous challenges related to social and environmental sustainability which are associated with their fast economic growth and rising energy demand, climate change, and widening disparities between rich and poor. Recently a number of claims have been made in the literature that the prospects of alternative development pathways in emerging economies in Asia are becoming more likely, and that these economies might even leapfrog Western initiatives. This paper contributes by reporting on the five most visible and established initiatives in the area of off-grid solar PV energy in India, specifically honing in on the innovative business models that are evolving. We develop a new typology of upscaling dimensions in order to analyse these five initiatives. They are found to be quite successful, but have difficulty in terms of reaching the poorest of the poor (deep upscaling) and bringing about required institutional change (institutional upscaling).

Keywords: India, social entrepreneurship, solar PV, upscaling, business models

2.1. INTRODUCTION

Billions of people live without access to modern energy services. About 1.3 billion people worldwide still do not have access to electricity, and around 2.7 billion people rely on traditional biomass as their primary source of energy (International Energy Agency 2011). It is widely accepted that the lack of access to affordable, reliable energy services is a fundamental hindrance to human, social, and economic development and is thus a major impediment to achieving the Millennium Development Goals (Srivastava and Rehman 2006). In India a huge portion of the population still depends on state-distributed and subsidized kerosene, animal and human energy, candles, and traditional biomass such as wood, harvest residues and cow dung; all associated with substantial issues such as health problems, energy poverty, burden on state and national financial budgets, and local environmental degradation (Nouni et al. 2009; Rehman et al.2010).

Like in most emerging economies, the development of a modern electricity supply system in India has been mainly confined to a centralized electricity system based on fossil fuels, especially coal – largely following development pathways of developed economies. Coal is expected to remain a prominent fuel within the overall electricity mix in India and increase to produce more than 70% of all power generated in 2030 (International Energy Agency 2011). This development trajectory has potentially large benefits, because it can assist in meeting the demands for power by a rapidly growing middle-class population, and it will improve overall environmental efficiency of the power sector by using state-of-the-art technology (currently Indian power plants are among the least efficient in the world). However, the choice for further development of an Indian fossil-based system of centralized energy planning and supply has also other very fundamental consequences, especially those related to climate-change inducing effects, exhaustion of fossil fuels resources (and increasing competition for these resources on global markets) and risks of energy security and vulnerability to terrorist attacks. Obviously pursuing a centralized fossil fuel based development pathway needs rethinking in the light of these challenges – something that is increasingly acknowledged by both countries in the developed and the developing world.

An important question in this debate is where innovations are coming from that can contribute to more sustainable development pathways. Often cited examples in the West are Germany and Denmark, who are frontrunners in developing and applying renewable energy technologies. However, recently a number of claims have been made in the literature that the prospects of alternative development pathways in emerging economies in Asia are also becoming more likely, and that these economies might even leapfrog Western initiatives (Berkhout et al. 2009; 2010; Hultman et al. 2011; Kaplinsky 2011; Romijn and Caniëls 2011; Binz and Truffer 2009). This literature argues that globalization, the development of science and technology capabilities in non-Western countries and rapidly growing local markets are changing the geography of innovation. A 2010 special report on innovation in emerging markets from The Economist claimed

that 'The world's creative energy is shifting to the developing countries, which are becoming innovators in their own right rather than just talented imitators. A growing number of the world's business innovations will in the future come not from "the West" but "the rest"' (The Economist 2010). Levi et al. (2010) argue that 'India is not likely to offer major breakthroughs, but it will create increasingly cost-effective business models for supplying energy in developing economies'. Hence, it is argued that this shift in innovation from the West to the rest has important implications for the direction that innovation processes are taking, with a more direct interest in developing products for the poor and with substantially lower environmental footprints.

These claims are still largely based on anecdotal cases and macro-statistics. This paper aims to contribute to this literature by substantiating some of the claims with new evidence on the five most established and visible solar energy initiatives in India (SELCO, AuroRE, THRIVE, NEST and D.light Design). Solar energy products such as solar home systems (SHS) and solar lanterns are among the technologies that are gaining increasing attention from social entrepreneurs and social enterprises in India for electrification of subsistence households in off-grid areas. The five initiatives in this paper, we argue, represent the seeds of a potentially very different development pathway than the centralized, fossil fuel based electricity system. They are not just different in technological terms, but also in terms of the visions behind the initiatives and the business models applied. All initiatives can be characterized as social enterprises that specifically aim to target poor people and provide them with basic means of energy supply using various financial mechanisms at hand. They have focused on a value proposition through need-based quality products and services, i.e. energy solutions by taking account of usability in hostile environments, affordability, social heterogeneity, inequality (notably due to caste issues) and local customs. Following Berkhout et al (2010), we characterize these initiatives as 'sustainability experiments' that explore potentially very different socio-technical development pathways compared to those embedded in incumbent socio-technical regimes for centralized, fossil fuel based electricity supply. In other words, sustainability experiments can be the seeds, and provide learning platforms, for major socio-technical shifts towards substantially cleaner and more socially just energy systems, i.e., a sustainability transition in energy systems.

The five initiatives we study in this paper have all developed rapidly over the past 5-15 years. Still, their revenue or the amounts of energy generated by their products and projects are very small compared to total energy demand in India or compared to the world solar market. This is not unusual for emerging innovations and makes an analysis of traditional economic indicators such as market share or revenue less useful. Therefore, in this paper we focus on understanding in what ways these initiatives have upscaled their businesses until now. To understand how these organizations have upscaled, we document in this paper the results of an extensive review of social entrepreneurship

literature and relevant development studies literature, which has resulted in a typology of upscaling dimensions for social enterprises.

This paper continues as follows. We first discuss in section 2 insights on upscaling from the literature on social entrepreneurship and from development studies. We draw special attention to institutional upscaling, which is perceived as a collective process, and bring in insights from literature on system innovations, especially strategic niche management. The section ends with a new typology of upscaling. Section 3 is devoted to data collection methods. Section 4 introduces the five Indian initiatives and contains the empirical analysis. The paper ends in section 5 with conclusions and sets out relevant elements for future research.

2.2. THEORETICAL BUILDING BLOCKS

2.2.1 Upscaling in social entrepreneurship and development studies

Within the entrepreneurship field as a whole, 'social entrepreneurship' deserves special attention here. Social entrepreneurship encompasses the activities and processes undertaken to discover, define and exploit opportunities in order to enhance social wealth by creating new ventures or managing existing organizations in an innovative manner. Social wealth may be defined broadly to include economic, societal, health and environmental aspects of human welfare. Essentially, then, one can conceive of social entrepreneurs as key players in sustainability transitions (Witkamp et al. 2011). According to Witkamp et al (2011) social entrepreneurship is pitted against two extant 'regimes', i.e., the business regime where profit maximization and increasing shareholder value is the major goal; and the civil-society regime where societal objectives take a major role and profit maximization takes a back seat. Social entrepreneurship therefore continuously faces tensions between private profit making and fulfilling societal objectives.

Most social entrepreneurs have an ability to create new connections among people and organizations for new paths, or business models, in which these tensions are managed and societal value is created. In so doing, (social) entrepreneurs also create and develop the institutions and infrastructures needed for development (Garud et al. 2007; Dees 2009; Mair and Marti 2009; Santos and Chowdhury 2010; Zahra et al. 2008, 2009). According to Mair and Marti (2006), Robbin (1984), and Sud et al. (2008), entrepreneurs can leverage resources to create new institutions and norms or transform existing ones. Maguire et al (2004) speak about entrepreneurs' leading efforts to identify political opportunities, frame issues, and induce collective efforts to infuse new beliefs and norms into social structures. In other words, social entrepreneurs can foster development in many different ways, by getting new legislation or regulations passed; getting old legislation or regulations enforced; shifting social norms, behaviors and attitudes among fellow citizens, corporations, government personnel; changing the

way markets operate; and finding ways to solve problems or meet previously unmet needs.

Several social entrepreneurship studies have discussed the phenomenon of upscaling (Alvord et al. 2004; Bloom and Chatterji 2009; Santos and Chowdhury 2010; Dees 2009; and Smith and Stevens 2010). The latter define upscaling as increasing the impact produced by a social-purpose organization to better match the magnitude of the social need or problem it seeks to address. They distinguish upscaling and deep scaling. Upscaling refers to the growth in social value by expanding a current program to other geographic locations. This involves effort and costs in terms of building infrastructure, organizing and developing an ecosystem, obtaining licenses, and educating customers in a new region. Deep scaling refers to focusing energies and resources on achieving greater impact in the same location where the enterprise was started by engaging in activities like, improving the quality of services, achieving greater penetration of the target population, finding new ways to serve people, extending services to new people and developing innovative financial management approaches.

Karamchandani et al. (2009) and Klein (2008) have a somewhat different view. They refer to upscaling as the capacity of the enterprise to expand quickly, effectively and efficiently. Upscaling can also mean expanding the capacity of the existing business, in the sense of developing resources, building a knowledge base, employing people, developing management systems and even developing a culture. According to them, upscaling thus includes serving more people with the same product within the same region as well as extending into new markets i.e. different geographies. In a given situation the meaning of upscaling to a large extent depends on the motivation of the enterpreneur. Some enterprises may focus on developing a specific region in terms of new products and services before scaling geographically, while others may choose to scale into new geographies before venturing into new products and services.

According to Dees et al. (2004), choosing the right path towards broader social impact is a complex matter since it involves judgment, experimentation, and continuous learning. They develop an approach towards upscaling based on following five R's, i.e., Readiness, Resources, Receptivity, Risk, and Return. Bloom and Chatterji (2009) suggest the SCALERS model, i.e., Staffing, Communicating, Alliance-building, Lobbying, Earnings-generation, Replicating, and Stimulating market forces. Santos and Chowdhury (2010) suggest that successful upscaling can be achieved by disseminating information through the use of best-practice blueprints or intermediaries such as multilateral organizations and consulting firms.

Since our study is set in an emerging economy with deep-rooted social inequality and poverty in addition to environmental problems, it is pertinent to also examine literature about development projects, programmes and NGOs for possibly useful insights about upscaling. Gillespie (2004), Myers (1984), Uvin and Miller (1994) and Uvin (1995) have developed taxonomies of different types of upscaling and paths to

achieve it. Uvin (1995) defines 'quantitative scaling' as reaching increasing numbers of people; 'functional scaling' as adding unrelated new activities to existing programmes; 'political scaling' as an organization's members participating in or influencing political activities; and 'organizational scaling' as increasing the degree of self-financing through subcontracting. Myers (1984) discusses 'institutional scaling', i.e., involvement in processes and mechanisms for promoting wide stakeholder participation; 'geographical scaling', i.e., expanding project coverage to other communities/municipalities; 'technological scaling' i.e. broadening a project's technological scope, or implementing appropriate technologies to increase productivity; and 'economic scaling', i.e., bringing down unit costs. Other issues that have been discussed include timing and duration of upscaling. Writers about development have obviously found it difficult to come to grips with the phenomenon. According to Uvin and Miller (1994), "All in all, the literature on upscaling is reminiscent of the Loch Ness monster. It has been sighted enough to make even the skeptical give it a measure of respectability; [but] … its description is as varied as the people who have written about it."

2.2.2 Institutional upscaling as a collective process

One big complication is that an individual social entrepreneur usually does not have all the competences, resources, and legitimacy that are necessary to create a full infrastructure for a new business. Santos and Chowdhury (2010) point out that while social entrepreneurs are often successful in establishing effective business models to address problems in their local areas of operation, they face enormous challenges in scaling their operations and achieving greater social returns for constituents such as funding agencies. According to Dees (2010) they need a supportive ecosystem and infrastructure such as targeted financial services, cultural encouragement and accommodating legal and regulatory mechanisms. These conditions have to be created in concert by a large number of actors, since complex environmental problems are rooted in behaviors, norms, institutions, social structures, and policies. Individual entrepreneurs usually cannot bring about radical institutional change on their own without broad societal support. Rarely do individual actors possess sufficient power, resources and charisma to bring about institutional change (Garud et al. 2002; Leca et al. 2008).

Therefore, governments, multi-lateral aid agencies, philanthropic organizations, social investors, financial service organizations, universities, consultants, corporations, bankers, and the media, all play an important role in creating conditions that help social entrepreneurs to scale their impact in a timely, significant and cost-effective way, while at the same time prevailing institutions limit the possibilities for institutional entrepreneurship (Dees 2010). Actors are not entirely free, but embedded (Garud and Karnøe 2003; Garud et al. 2007). Entrepreneurs may need to 'run in packs', which means coordinating their actions to simultaneously pursue their own and collective

interests, simultaneously cooperating and competing with others as they develop and commercialize their new ventures (Van de Ven 2005).

As the numbers of entrepreneurs grow, a complex network of cooperative and competitive relationships begins to generate critical mass and produce effective collective action. This infrastructure includes institutional arrangements to legitimate, regulate, and standardize a new technology; public resource endowments of basic scientific knowledge, financing mechanisms, and a pool of competent labor; the creation and development of markets, consumer education and demand, proprietary R&D, and the development of manufacturing, production, and distribution functions by private entrepreneurial firms to commercialize an innovation for profit. This infrastructure may be developed by superstructure organizations often specializing in coordinating flows of information or coordinating the activities of substructure organizations (Van de Ven 1993, 2005; Jacobsson and Johnson 2000).

Concerted action from different social enterprises and mobilization of support from multiple other actors in the innovation system for diffusion and legitimization of new institutional arrangements might thus be key requirements for social enterprises that aim to upscale their businesses for solar home systems in India. This is also recognized in a related stream of literature that aims to understand how advocates of radical, potentially more sustainable technologies gain increasing support for their technologies. This literature under the heading of Strategic Niche Management (SNM) is part of evolutionary approaches to understanding systemic transformation in socio-technical systems towards sustainability (Kemp et al. 1998). In SNM, innovations with promising sustainability characteristics are conceptualised as emerging and developing in 'niches', i.e. emerging institutional environments that provide a (partially) protected space in which actors experiment and incubate promising concepts or prototypes.

The relation between the emerging institutional environment, the space it generates, and the activities performed by innovating actors within that space is conceptualized as cyclic and co-evolutionary. Experiments represent small initiatives in which the earliest stages of socio-technical learning and co-evolution take place. Experiments typically bring together new networks of actors with knowledge, capabilities and resources, who cooperate in a process of social learning (Berkhout et al. 2010). If successful, experiments generate locally useful lessons, but the experiment's advocates might also try and translate results into wider applicable lessons, e.g. through 'internal' networking with similar initiatives by participating in workshops, organizing site-visits and publishing handbooks. Advocates might also collaborate in shaping the institutional environment more directly through 'external' networking, for example by setting up field-level organisations that lobby governments, user groups, science-actors or relevant business actors for beneficial institutional changes.

Socio-technical experiments can encompass a wide range of projects, pilot plants and demonstration facilities initiated by firms, public research organizations and

universities, community and grassroots organizations, and so on (Berkhout et al. 2010). In this literature, experiments are seen as playing a key role in the development of innovations that have the capacity to modify or even replace dominant 'socio-technical regimes'. Regimes constitute the extant social, institutional and technological fabric of economic activity. Experiments may involve novel technological, actor, and market configurations, and are therefore likely to face considerable initial uncertainties, problems, misalignments and high costs compared with conventional, incumbent regimes to which they offer more sustainable alternatives.

Previous research on niche development of sustainable energy systems (primarily set in high-income countries) has concentrated on technological experiments and their role in regime change. Few studies have focused on entrepreneurial firms and their importance as prime movers. Entrepreneurs do have an important role in transition processes since they are agents of creative destruction, with potential to commercialize sustainable innovations and consequently foster the necessary institutional change that favors such innovations (Markard and Truffer 2008).

2.3. Analytical approach and data collection

On the basis of the literatures reviewed above we propose the following dimensions of upscaling for investigating the cases in this paper:

1. Quantitative: Upscaling in terms of number of beneficiaries (Uvin and Miller 1994; Uvin 1995).
2. Organizational: Upscaling in terms of expanding the capacity of existing business, i.e., developing resources, building a knowledge base, employing more people, or developing management systems (Klein 2008; Westall 2007).
3. Geographical: Upscaling in terms of regional expansion, i.e., serving more people in new regions and extending into new markets (Klein 2008; Karamchandani et al. 2009).
4. Deep: Upscaling in the sense of achieving greater impact in an existing location, e.g., through reaching increasingly poorer segments of the population (Rogers et al. 2006; Smith et al. 2009).
5. Functional: Upscaling in terms of developing new products and services (Klein 2008).
6. Replication: Upscaling in terms of replication of a particular business model, by supporting and incubating new entrepreneurs (Westall 2007).
7. Institutional: Upscaling in terms of transforming existing institutions and creating new ones (Maguire et al. 2004; Mair and Marti 2009; Robbin 1984; Sud et al. 2008).

In Table 2.1 we define several empirical indicators for each of these dimensions of upscaling. These dimensions were used to analyse upscaling of the ventures

studied in this paper, on the basis of their track record and progress achieved so far.[2]

Table 2.1: Indicators for assessing upscaling performance of sustainability experiments along different dimensions

Dimensions of upscaling of sustainability experiments	Empirical indicators
Quantitative	Number of beneficiaries/people
Organizational	Organizational growth, improvement in technical and managerial capacity, development of infrastructure and resources, development of knowledge base and management systems, diversifying funding sources and becoming financially self sustainable, upgrading in the external value chain, dissemination of knowledge and ideas, research and development activities
Geographical	Expansion to new geographical locations (local communities, villages, municipalities, cities, states and countries)
Deep	Reaching extremely poor and vulnerable sections of the population, and/or greater impact in the same location where the enterprise was started
Functional	Increase in number and type of project activities, new products and services
Replication	Creating, incubating, or supporting new entrepreneurs; creating new affiliates, developing new branches; franchising
Institutional	Modification in public policy and regulations at national and international level, transformation of existing institutions (regulative, normative and cognitive)

In order to analyse upscaling of the Indian solar sustainability experiments on each of these seven dimensions, we distinguish ' high' (+++), 'medium' (++) and 'low' (+) upscaling performance in Table 2.2, based on an assessment of their achievements to date, and retrospective analysis.

2 It should be noted here that these dimensions of upscaling are not mutually exclusive and some might pre-suppose others. For example, substantial quantitative upscaling might only be possible in tandem with organizational upscaling.

Table 2.2: Description of different categories for assessing upscaling performance of sustainability experiments

Dimensions of upscaling	High upscaling performance (+++)	Medium upscaling performance (++)	Low upscaling performance (+)
1. Quantitative	Reaching millions of beneficiaries	Reaching hundred thousand beneficiaries	Reaching thousands of beneficiaries
2.Organizational	Employing more than two hundred people, having multiple offices, manufacturing and assembly facilities and work places, large number of funding sources and investors, presence in multiple stages of external value chain, presence of specialized R&D centre's and innovation departments for innovative activities, knowledge dissemination activities in media	Employing more than one hundred people, a few offices, manufacturing and assembly facilities and work places, four to five investors and funding sources, presence in one or two stages of the external value chain, R&D activities but no specialized departments for such activities, limited knowledge dissemination activities in media	Employing less than one hundred people, confined to one central office and manufacturing and assembly facilities, dependent on one or two main investors and funding sources, presence limited to one stage of external value chain, very limited research and development and knowledge dissemination activities in media
4. Geographical	Presence in more than ten countries apart from the home country, around 40 to 50 % coverage in states/ regions in the home country depending upon the geography of the home country	Presence in around five to ten countries ,around 20 to 30 % coverage in states/ regions in the home country depending upon the geography of the home country	Presence limited to home country, around 10 to 20 % states/ regions in the home country depending upon the geography of the home country

4. Deep	Reaching people at the extreme Bottom of Pyramid (earning less than 1 USD per day, PPP); significant presence (around 70 to 80 %) in villages, local communities and districts in the location from where the enterprise operates	Reaching people close to the Bottom of Pyramid (earning between USD 2 and 5 per day, PPP); presence (around 40 to 50 %) in villages, local communities and districts in the location from where the enterprise operates	Reaching people above the top of the Bottom of Pyramid (earning more than 5 USD per day, PPP); presence (around 10 to 20 %) in villages, local communities and districts in the location from where the enterprise operates
5. Functional	More than ten mainstream products and services, significant number of activities and schemes for customers	Around ten mainstream products and services, limited activities and schemes for customers	Around four to five mainstream products and services, very limited activities and schemes for customers
6. Replication	Creating, incubating and supporting hundreds of new entrepreneurs, around hundred branch organizations or affiliates	Creating, incubating and supporting less than hundred of new entrepreneurs, less than one hundred branch organizations or affiliates	Creating, incubating and supporting less than fifty new entrepreneurs, less than fifty branch organizations or affiliates
7. Institutional	Bringing powerful social change by destabilizing existing institutions and creating new institutions	Modifying certain institutions through persuasion, lobbying and collective activities	No significant efforts in modifying or destabilizing existing institutions, no significant activities in lobbying

The data for the research was collected over a period of three months, from December 2009 to February 2010, in different locations in southern India. Primary data was collected through six interviews and was complemented with secondary data. Interviewees mostly included all company founders and other relevant individuals working for a significant amount of time working in the organization. Informants were asked to explain how their organizations were founded, how they grew, how they were organizing their enterprises and how they planned to upscale. Open questions were used to gather information about the start up process and how the upscaling process went so far. Generally the initial portion of the interviews focused on the history of the enterprise along with challenges faced till today. The later part of the interview was focused on questions informed by table 1. Interviews generally lasted for around one and half hours to two hours depending upon the availability of the interviewees. D.light Design could not be contacted for direct interview and most information exchange took place through email. Finally, site visits of the social enterprises added insights about how they were really functioning.

We obtained secondary information through the organizations websites, presentations in seminars, financial reports, business plans, market analyses, and research documents prepared by the people working in the organizations. In addition, we relied on case studies prepared by other researchers on the organizations, accounts in published literature, interviews of the entrepreneurs in newspapers and web articles etc.

2.4. RESULTS

In this section the case study results are presented. The details of the cases are mentioned in table 2.3.

Table 2.3: Details of the case studies

Case	SELCO	AuroRE	THRIVE	NEST Solar	D. light Design
Founders	Dr. Harish Hande and Neville William	Hemant Lamba	Dr. Ranganayakulu Bodavala	D.T. Barki	Sam Goldman and Ned Tozun
Founding year	1995	1998	2001	1998	2007
Location	Bangalore	Auroville, Puducherry	Hyderabad	Hyderabad	New Delhi
Vision	*"Empowering the lives of underserved populations by creating linkages between income generation and sustainable energy services"*	*" Establishing a platform for renewable energy by integrating service providers, users, manufactures, financers and policy makers"*	*" Provide clean and reliable lighting solutions to billions of people around the world, improving the living conditions of people "*	*" Eliminating light poverty from the world by providing innovative lighting solutions to poor "*	*" Enable households without reliable electricity to attain the same quality of life as those with electricity and replacing kerosene with clean, safe and bright solar light"*
Type of organization	For profit social enterprise	Nonprofit organization, community based organization	NGO with separate commercial enterprise	For profit enterprise	Commercial social for-profit enterprise
Profitability	Almost break even stage i.e. neither profit nor loss; outstanding loans; faced heavy financial losses in 2005-2006	Break even stage; minimum profits earned through external projects	Break even stage with the commercial venture Thrive energy technologies financing the NGO THRIVE	Break even stage after suffering heavy financial losses in 2003	Break even stage expected to reach in some years

Core innovation	Customized energy solutions based on user needs, installation and after sales services. Incubation lab for formulating new ideas in providing renewable energy solutions	Energy Service Provider (ESCO) acting as a system integrator and installer providing high quality renewable energy systems, research and development of various energy technologies	Research and development activities on LED technology	Design, development of new and innovative solar energy products; manufacturing and assembly facilities for polycrystalline PV technology	Product designcapabilities with competencies in R &D and high volume manufacturing

Organizational set up	Headed by Dr. Harish Hande and several people in senior management ;around 170 employees; network of energy service centers, regional branch offices and head quarters in Bangalore	Headed by Hemant Lamba , Kavit Kumar looks at financial administration matters and Hemant Shekhar works at various research projects., Several voluntary employees	Headed by Dr Ranganayakulu Bodavala along with Mr Sreekamal Bandopadhyaya as project manager and Mr Satish Somepalli as the director of finance; 94 employees in production in manufacturing and production and 142 employees for field operations; strong team of engineers and technicians.	Headed by Mr D. T. Barki with Bharat Barki as director of NEST; Jagan Mohan Rao, K Vasudeva, J V Ramana, Manohar Reddy as important stakeholders; around 45 employees; currently around 15 direct employees work at the head office and workshop in Hyderabad and 7 people working in the factory at Bangalore	Headed by Don Tice with around 70 employees in four offices across the world in New Delhi, Tanzania, Shenzhen, and Hong Kong, Cayman Islands, U.S.A; 25 people working in India, 15 in China, 11 in Tanzania, 2 part time staff in US.

Business model (product and services, customer interface, infrastructure management, financial aspects)	Local assembly operations which source different components from wholesalers and distributors such as TATA BP Solar, located in Bangalore depending upon price of components; Network of regional branch offices and energy service centers which have teams of technicians, managers, salesmen and actively engaged in selling, installing, and servicing energy related products and services; Customized packages developed for consumer financing	Energy Service Provider (ESCO) acting as a system integrator and installer; acting as a maintenance and service company offering maintenance services to end users; No external financing due regulations of the Auroville community; solar business PV of Auroville runs on a commercial basis by earning revenues from projects; runs on a non-profit non-loss basis.	Importation of microchips from U.S.A, batteries from China, LED lights from Japan, and local assembly operations in Hyderabad for development of solar lanterns; network of energy kiosks for reaching rural people Partnerships with various NGO's, organizations like the United Nations, World Bank; customized financing mechanisms for customers through partnerships with micro finance institutions, women's groups, rural banks and international financial institutions	Design, development of new and innovative solar energy products; manufacturing and assembly facilities for polycrystalline PV modules in Bangalore ,design of electronic controllers in Hyderabad, outsourcing of other components to local manufacturers in Hyderabad Reaching customers through network of dealers and sub dealers who are independent businessmen; distribution through NGO's, CSR programmes and global organizations such as GTZ; Customized financial	Sales and marketing and R&D division in New Delhi, East Africa's sales office in Dar es Salaam, Tanzania, product design and international sales and marketing division in Hong Kong; manufacturing & production in Shenzhen, China Commercial dealers and distributors and the open market for product sales; partnerships with NGO's and microfinance institutions Investment from

Threat to business model	High variability in the price of components i.e. cost of the installed PV modules, batteries and converters for solar home systems; false promises by government for grid electricity to poor people; need for local technicians	Lack of finances and workforce; high subsidies for conventional fuels	Lack of research and development and large scale manufacturing of LED technology in India; rapid fluctuations in LED prices; Intellectual property issues	High distribution costs; Presence in multiple parts of PVvalue chain makes it difficult to balance manufacturing, sales, marketing and distribution	High import costs for solar energy components; high storage and distribution costs; gaining good product distribution capabilities in rural areas; intellectual property issues due to cheap substitutes in the market

Our assessment of the upscaling of the five enterprises is summarized in table 2.4, based on an analysis of their past performance and ongoing progress. We will elaborate on these upscaling dimensions below.

Table 2.4: Upscaling performance in different dimensions for different case studies

Dimensions of upscaling	SELCO	AuroRE	THRIVE	NEST	D.light Design
Quantitative	++	++	++	++	+++
Organizational	+++	+	++	++	++
Geographical	+	++	+++	+++	+++
Deep	++	++	++	++	++
Functional	+++	++	+++	+++	++
Replication	+++	++	+++	++	++
Institutional	++	+	+	+	+

2.4.1 Quantitative upscaling

With respect to quantitative upscaling SELCO has provided sustainable energy products and services to more than 100000 households and is in the process of reaching 200000 households soon. SELCO has also supported 110000 rural homes, 2000 institutions and 10000 small business cottage industries. It has installed over 125000 solar home lighting systems since 1995 (Ashoka and Hystra 2009; SELCO India 2005; 2007; 2011; CSTS & AYLLU, 2011). AuroRE has been successful in delivering affordable, reliable renewable energy products and services to more than 80,000 Indians. AuroRE's projects include installing 1025 solar water pump sets to farmers in 11 Indian states such as Punjab, providing solar lanterns to street hawkers in Chennai and coordinating a rural electrification project in Ladakh using 8700 solar home kits and 6000 lanterns (AuroRE India 2004; AuroRE 2009). THRIVE's long term mission is to disseminate 100 million lights all over the world. Till now it has benefited approximately 160000 people, and most of those are poor and tribal people (Ramani 2010; THRIVE 2010). NEST had sold around 78800 solar lanterns till 2008, a gradual increase from 12,100 back in 2002. The number of lanterns sold currently is around 90000, of which 80 % are sold in India and rest 20 % exported. NEST is targeting 1 million solar lanterns in 5-6 years under its unique programmes such as Solar Seeding to contribute towards NEST 's mission of a kerosene-free world (NEST 2005; Solar NEST 2009; Uppal and Mahendra, 2009) D.light Design has sold 1 million solar lanterns in over 30 countries by the end of February 2010. D.light is targeting 50 million people by 2015 and 100 million people by 2020 (D.light 2010; D. light 2011).

2.4.2 Organizational upscaling

As far as organizational upscaling is concerned, SELCO has had a successful growth over the last 14 years, with a turnover of around USD 1.75 million in FY 2009 and estimated USD 3 million in FY 2010. The company made a loss of INR 7.5 million in 2008-9 but returned to profit in the financial year 2009-10, earning INR 3.8 million on revenue of INR 150 million (Ashoka and Hystra 2009; Mukherjee 2011; Pullenkav 2010). SELCO has around 170 employees (four regional sales managers; eight senior managers; 21 branch managers; 32 sales executives; 40 customer support executives and 18 office administrators in addition to members of the projects, finance and innovation departments, including senior management). SELCO's expansion plans include the achievement of an annual turnover of USD 6 million (SELCO 2009; CSTS & AYLLU 2011). AuroRE has quite different plans for organizational upscaling. It is focusing on becoming a knowledge service provider for energy services with core expertise in service provision, consultancy in renewable energy technologies, programme and project management and energy efficient architecture through workshops, demonstrations and site visits. Through its experience in renewable energy technologies AuroRE is also offering its services to European companies in looking to certify and carry filed inspections on renewable energy projects and carbon emission reduction projects and programmes for their Indian clients (Lamba 2009; Shekhar 2009). THRIVE has generated revenues of around USD 2 million till now. THRIVE is developing a renewable energy center outside Hyderabad for training and demonstration projects in renewable energy. It has plans to start new programmes for rural water treatment, rural electrification, rural banks and rural village outlets. THRIVE also has plans to enter into the solar power generation business in line with the National Solar Mission of the Government of India. In addition THRIVE is helping many corporate organizations to implement Corporate Social Responsibility (CSR) programmes in relation to LED lighting (Ramani 2010; THRIVE 2011). NEST is planning to expand its production, warehousing and marketing and sales capabilities through an investment of around INR 60 million. It expects revenues of around INR 543 million by 2014-2015 and is targeting an EBIDTA (Earnings before interests, taxes, depreciation and amortization) of around 25% from the fifth year onwards, i.e. from 2015. Mr. Barki is also planning the manufacturing of solar panels in China to reduce costs (Barki and Barki 2010; Uppal and Mahendra 2009; NEST 2009). D.light Design on the other hand is focused on becoming a truly global company. D.light Design has grown to over 70 employees in three years and has offices in US, India, Tanzania, China and Hong Kong. In 2010 D. light Design centralized its product design and international sales in Hong Kong with plans to move additional corporate functions (D.light 2010; D. light 2011)

2.4.3 Geographical upscaling

With regard to geographical upscaling there are unique patterns that are dependent on the chosen business model. SELCO is focusing on expanding geographically in five Indian states neighboring to Karnataka i.e. Maharashtra, Tamil Nadu, Kerala and Andhra Pradesh. By the end of financial year 2010-2011 it is expected that SELCO would be present in 16 districts of Karnataka, 3 districts of Kerala, 4 districts of Gujarat and 3 districts of states like Maharashtra and Andhra Pradesh (SELCO 2009; SELCO 2010). However, SELCO has found it difficult to expand geographically across different Indian states due to lack of spillover learning across different states and lack of financial institutions whom SELCO can partner with. At the same time SELCO does not want to use the franchise system to sell its products and services, as the reputation of its brand depends on services and it is more difficult to guarantee the same quality of service from franchises. Hence SELCO has decided to only move into a new region if there are good contacts there both for dissemination of information and for providing good services (Mukherji 2011; SELCO 2009; SELCO India 2011). AuroRE has been successful in delivering affordable, reliable renewable energy products and services across 12 Indian states such as Andaman and Nicobar islands, Tamil Nadu, Pondicherry, Karnataka, Kerala, Orissa, Jammu and Kashmir and Gujarat (AuroRE 2004) .THRIVE, NEST and D.light Design are the most internationally oriented of the five cases. THRIVE has established an international geographical reach due to the support from various groups and organizations around the world. At present THRIVE is strongly established in Indian states like Orissa, Andhra Pradesh, Jharkhand, Bihar, Maharashtra, Manipur and countries such as Afghanistan, Cambodia, Bangladesh, Ethiopia and Kenya (Ramani 2010; THRIVE 2011). NEST also has a wide geographical presence in India, with a network of 70 dealers in different states in India. Globally NEST has expanded its operations to countries such as UK, Sudan, Sri Lanka, Japan, Australia, Malaysia, Kenya, Nigeria, Malawi, Tanzania, Fiji, Belize, Bolivia, El Salvador and Puerto Rico. Now NEST has plans to reach other countries such as Nigeria, Somalia, Central America, Pakistan, Australia and China (Barki and Barki 2010; Barnhill et al. 2011; NEST 2009). D.light Design also has developed a strong distribution in around 32 countries and. It has also built additional distribution outlets in places such as South East Asia, Latin America, Pacific Islands and West Africa. D.light Design is planning to expand further in India, Bangladesh and East Africa with the goal of selling millions of lighting products (D. light 2010; D.light 2011; Shukla and Bairiganjan 2011).

2.4.3 Deep upscaling

With respect to deep scaling, it is found that the ventures discussed generally have not been able to reach increasingly poor segments of the population i.e. going deeper down the economic strata in their existing locations, although it has to be said that they have developed rental schemes and special financial mechanisms to reach people at the Base

of Pyramid. The key problem is that commercial approaches, though appropriate in many cases, are unable to reach the extreme poor, i.e., those who cannot be offered loans from rural banks and microfinance institutions due to lack of any kind of assets (Shukla and Bairiganjan 2011). For reaching the very poorest segments of the population there is thus a need for mobilizing more financial support through government grants, carbon finance through the CDM mechanism, and support from international financial institutions (D. light 2009). This constitutes a major challenge for the future.

2.4.4 Functional upscaling

The ventures are generally performing well in terms of functional upscaling. SELCO has created new solar energy related businesses such as PV-powered battery-charging businesses which supply single-lamp systems for both street vendors and poor homes, PV power for sewing machines to increase the productivity of sewing businesses, PV powered soldering irons for TV repair and small PV-powered silk looms. SELCO is also in the process of developing a cheap, improved cook stove for its clients. It is also diversifying into energy services other than solar ones, such as thermal, efficient cooking, biogas provision, and drying, to its existing clients. Thus SELCO is looking to become a complete energy provider, from just a solar lighting provider. In addition SELCO is partnering with two organizations for multiple service based e-kiosks in rural areas of India, which will be run on solar power, and providing solar based power solutions for water purification (Datta 2009; Hande 2010; India Knowledge@Wharton 2010; CSTS & AYLLU 2011). AuroRE is developing new products such as LED/CFL based home lighting lanterns as well as solar powered reverse osmosis systems to purify drinking water. AuroRE is also working on new products such as an improved solar rice cooker, a solar lantern, and solar home lighting kits. In addition AuroRE developed mission TEJAS, which is a platform of exchange and development for solar energy technologies by bringing together lighting designers, product manufacturers, NGOs, administrative bodies, financial institutions and corporate/industrial R&D players (AuroRE 2009; Lamba 2009; Shekhar 2009). THRIVE has introduced additional forms of lights that are useful to the villages, like street lights, task lights, etc., at very economical rates. THRIVE is looking for a major share in niche markets such as street lighting, boarding and institutional lighting (Ramani 2010; THRIVE 2011). Similarly, NEST is planning to increase its product portfolio by developing new solar street lights, solar powered fans, mini solar desk lamps, etc (Barki and Barki 2010; NEST 2009). D.light Design has developed several new products, such as premium solar lantern with four brightness settings; affordable solar lanterns with 360 degree lighting and quality solar task lamps and D.light S1 which is one of the cheapest solar lanterns at a price of around USD 8 (D.light 2011).

2.4.5 Replication

As far as replication is concerned, SELCO is trying to start an incubation system for new entrepreneurs and business associates and aims to have 100 additional business associates. These business associates are rural youths, who would have a chance to create sustainable livelihoods for themselves by providing energy services through SELCO's products and services to poor people through their own business, keeping the SELCO management as board advisors. SELCO has also set up a USD 3 million fund to help new entrepreneurs planning to start new enterprises for energy services in different geographical locations. SELCO has already helped to create more than 25 entrepreneurs who are serving 750 clients by providing solar lighting to street vendors, home based workers and small businesses (Hande 2010; Hande 2011; India Knowledge@Wharton 2009; 2010; Mukherjee 2011; CSTS & AYLLU 2011). AuroRE is also focused on creating solar entrepreneurs. Such ventures can become financially sustainable in different ways, such as hiring out solar lanterns to market traders or supplying and installing solar water pumps to farms. AuroRE is aiming to set up a whole chain of local energy entrepreneurs by effectively providing them with managerial, technical and financial back up. It is also training several people and developing a network of sustainable enterprises among economically deprived communities. This includes training of at least 250 people in installation and maintenance of solar PV systems (AuroRE 2004; AuroRE India 2004). THRIVE is encouraging village entrepreneurship by promoting solar light entrepreneurs and LED based home lighting with the intention to create micro, small and medium energy service enterprises for manufacturing, selling and servicing LED lamps. THRIVE has also proposed alternative energy kiosks in villages in which users can walk and get light charges for a token fee and enjoy continued service and maintenance of light. The kiosks are run by local youth with minimum education like matriculation and basic training in electronics and mobile phone usage (Ramani 2010; THRIVE 2011). NEST is developing small businesses which manufacture charge controllers and plastic works exclusively for NEST. In addition it is developing and supporting entrepreneurs in villages for distribution of its products (Uppal and Mahendra 2009; NEST 2009). D.light Design has built a distribution base of 1500 rural entrepreneurs. Each rural entrepreneur handles around 2000 households who also source products from dealers (Raja 2009).

2.4.6 Institutional upscaling

From the literature review in section 2 it was found that institutional upscaling is generally beyond the scope of individual enterprises, and requires concerted action from a critical mass of entrepreneurs. All enterprises except SELCO score low in this respect. SELCO in the past has lobbied government institutions such as the Reserve Bank of India to reduce the procedural bureaucracy of foreign investment from social investors abroad to firms such as SELCO (Alexander 2009; India Knowledge@Wharton 2010).

All the enterprises discussed found it difficult to involve in institutional upscaling. Some of the key institutional barriers mentioned include high subsidies for fossil fuels and high taxes for solar energy products, lack of consumer finance from financial institutions and other regulative barriers. Most enterprises have advised government officials about, and have even lobbied against high subsidies for fossil fuels but their efforts have not resulted in any major institutional changes. Enterprises have also found it time-consuming to engage in trying to bring in institutional changes since this may make them lose focus from their primary work – the day to day functioning of the enterprise and meeting the needs of their customers (Alexander 2009; Barki and Barki 2010; Lamba 2009; Ramani 2010).

2.5. CONCLUSIONS

On the whole, the discussion of the upscaling achievements of the five solar PV ventures discussed in this paper demonstrates that currently there are indeed several promising experimental activities going on in India that signal a very different way of electricity provision. One striking similarity between the initiatives is that they are conceived and nurtured by visionary people with creative ideas and drive, who have conceived innovative business models that manage to balance societal aims with the exigencies of financial sustainability. At the same time, the way in which the different ventures achieve this balance is found to vary a great deal. The most important issue seems to be that strategy and structure should reflect – and continue to reflect – the particular idiosyncratic vision and mission of the leadership. A broad multidimensional classification of upscaling as used in this paper, which is capable of capturing heterogeneity in performance, strategies, structures and plans, is therefore found to be a suitable research tool for getting a better grip on the 'Loch Ness monster'. It has to be said, though, that a research approach like this one should thus be considered primarily useful for conducting a broad-sweep assessment aimed at mapping upscaling in innovative sustainability-centred activities in particular emerging fields. It is likely to be less useful for a detailed micro-level comparison of different individual cases, because of the inevitable subjectivity involved in translating research data/findings into particular scores in the classification scheme.

The analysis conducted in this paper raises several other pointers for policy and research. Our results indicate that the ventures are generally well on track towards upscaling, but that they lag behind in terms of two crucial – and closely intertwined – dimensions: (a) reaching the poorest of the poor (deep scaling); and (b) effecting broader institutional change (institutional upscaling). Reaching the people at the very Base of the Pyramid is indeed a massive challenge, and it does not help that many western corporations and even major international development organizations are currently advocating the use of for-profit commercial approaches even for this target group. There is very little evidence on the ground that such BoP approaches can actually produce win-win results at the required massive scale (Arora and Romijn 2011). A

better strategy could lie in the facilitation and coordination of non-profit social oriented ventures like the ones considered in this paper, including through making available more financial resources at appropriate conditions from national and international sources, and through encouraging the formation of supportive enterprise networks in which different partners support each other by executing complementary activities (Wheeler et al 2005). However, whether or not that will assist these ventures in actually reaching the poorest of the poor still needs to be seen.

As far as the institutional dimension of upscaling is concerned, it would be particularly useful to complement the type of analysis conducted here with an assessment at a higher analytical level in order to explore the meaning and dynamics of 'collective upscaling' more comprehensively. A 'meso-level' investigation can reveal a more complete picture of pivotal institutional upscaling barriers faced by social entrepreneurs in the conduct of their sustainability experiments, and on the key factors that prevent different actors in an emerging 'innovation system' such as solar PV from acting in concert and achieving the critical mass needed for effecting change in the institutional sphere. Interviews and literature study focused on individual entrepreneurial ventures as conducted for the present paper miss out a substantial part of these issues, because their scope is restricted to the individual entrepreneur's activities, strategies and point of view. In this respect, the adoption of multi-level analytical frameworks (such as used in Strategic Niche Management and some Sectoral Innovation Systems approaches) which set an analysis of innovation dynamics at the level of individual experiments and emerging niches within a broader overarching socio-technical context, would be a useful step in this direction.

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Chapter 3

Collective institutional entrepreneurship and contestations in wind energy in India[3]

Collective institutional entrepreneurship and contestations in wind energy in India

Suyash Jolly, R.P.J.M. Raven

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ABSTRACT

With 21,136 MW of wind energy installed in 2014, India is considered a success story in terms of net installed capacity. Few existing studies on Indian wind energy have highlighted the important role of institutions, and how they stemmed from the work of advocacy groups; studies also tend to focus on short time periods. This paper uses the notion of collective institutional entrepreneurship to analyze Indian wind energy across three time periods (1985–1995, 1995–2003, and 2003–2014). The analysis shows that Indian wind power development was driven by collective efforts of institutional entrepreneurs using two aggregated strategies, that is, supportive techno-economic and socio-political networks and an indigenous innovation infrastructure. The paper highlights setbacks, controversies, and tensions between various entrepreneurial groups and argues that actions must be taken for including actors who have been marginalized.

Key words: wind energy, India, collective institutional entrepreneurship

3.1. INTRODUCTION

Wind energy in India began with just 2 MW of installed, grid-connected power in 1986 [1]. Over the years, wind energy has been supported by several national and regional policies and regulations. In particular, substantial development took place in Tamil Nadu, Gujarat, Maharashtra, Rajasthan, Karnataka, and Andhra Pradesh. Tamil Nadu has been the leading state due to good wind resources, a proactive state government, and supportive captive energy users from the cement and textile industries [2]. Worldwide, India ranks fifth in wind energy production, topped only by China, the US, Germany, and Spain [3]. After rapid growth between 2003 and 2012, problems related to withdrawal of incentives, transmission and evacuation, and regulatory uncertainty became prominent in 2013 and slowed down development of wind energy. With the introduction of the National Wind Energy Mission (NWEM) in 2014, the Government of India is targeting 100 GW of wind energy by 2022 [4].

This study analyzes the long-term development of wind energy in India. This paper develops a narrative encompassing institutional developments and innovations, and also how they occurred. Existing studies have emphasized financial support schemes, technology policies, technical standards, grid-connection rules, industry organizations, and international collaborations [5, 6]. This study adopts the notion that actors are involved in shaping their institutional context and that this is largely a collective effort rather than the result of powerful individuals [7, 8]. Developing novel energy technologies therefore requires not just appropriate policies and regulations, but also collaboration and collective action by researchers, policy makers, political parties, industry organizations, lobbyists, and environmental groups [9]. Furthermore, the emergence of novel innovations is likely to prompt conflicting interests, power relations and political negotiations between stakeholder groups [10].

This paper aims to shed light on institutional changes in the wind energy sector not only by discussing their positive impacts, but also by addressing the controversies and potential barriers implicated by the associated dynamic institutional context. The paper focuses on the very early wind energy developments in the 1980s up to recent developments in 2014 and studies the institutional changes and the role of actors behind those changes by using the notion of "collective institutional entrepreneurship". The notion of collective institutional entrepreneurship is elaborated in the next section.

Based on the literature outlined above, the following research question is asked: How has institutional entrepreneurship shaped the development of wind energy in India during the period 1985–2014 and which controversies and conflicts can be identified? We begin by summarizing key arguments from the literature on collective institutional entrepreneurship in section 2. Section 3 elaborates on the research method used in the study. Then, we describe long-term development of wind energy in India in section 4. Finally, in the concluding section, we answer the research question and summarize the

key conflicts and contestations in the three time periods. We also draw out implications for wind energy development in India.

3.2. COLLECTIVE INSTITUTIONAL ENTREPRENEURSHIP

The concept of institutional entrepreneurship was originally proposed by Paul DiMaggio ([11]) to study to role of "agency" in creating transforming existing institutional arrangements. Institutional entrepreneurs take advantage of uncertainty in existing institutional order and often act strategically to seek institutional change through a political process [12]. Institutional entrepreneurship is defined as, "the activities of actors who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones" [13, p. 657]. To qualify as institutional entrepreneurs, individuals and organizations must change dominant institutional arrangements and institutionalize alternative practices, rules and logics but by being limited by the same institutional arrangements [14, 15]. According to this view, institutions are not just constraining, but are also the very fabric to be used for collective transformational action by a range of actors [16].

Institutional entrepreneurs use various strategies such as legitimizing new ways of working, lobbying, petitioning and advocacy to transform existing arrangements. Institutional entrepreneurs might not necessarily be always proactively transforming institutions through purposeful action, but instead sometimes are reactively acting on opportunities presented to them from a novel innovation [17]. Research has shown that institutional entrepreneurs comprise a broad range of actors and organizations. Examples include executives in firms, profit-oriented entrepreneurs, trade associations, professionals in organizations, regulatory authorities, licensing bodies, scientists, government officials, trade and professional associations, civil servants in governmental agencies, educational institutions, media, consumers, civil society groups and the larger public [18, 19].

The processes through which institutional entrepreneurs exercise their "agency" are characterized by continuous readjustment and learning as their strategies envisioned may seldom result in outcomes without facing any roadblocks [20]. Institutional entrepreneurs may not have the foresight to mobilize large-scale changes with well-defined goals. Their efforts may not be always successful and often result in undesirable outcomes. Collective institutional entrepreneurship is achieved through sustained collaboration among numerous dispersed actors with different frames of reference, tensions and contradictions [21, 22].

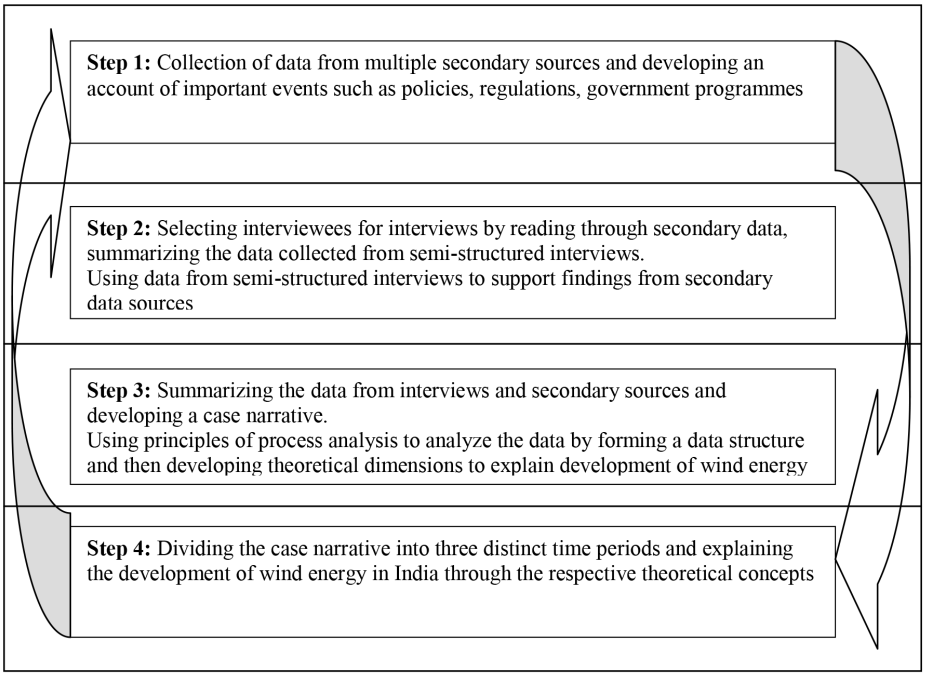
Very few studies have empirically illustrated the role of multiple actors as they transform dominant institutional arrangements. Whereas prior research has examined the role of professional elites [23], fringe actors [24], and ideologically motivated social movements [25], this paper looks at the distributed efforts of multiple actors in transforming institutional arrangements. Furthermore, the role of actors has to be seen

in relation to evolving institutional context over a period of time [26]. The next section discusses how the notion of collective institutional entrepreneurship is used for studying the long-term development of wind energy in India.

3.3. RESEARCH METHOD

The research focused on wind power development in India from 1985–2014 and used a qualitative case study approach to capture detailed accounts often overlooked in quantitative data vis-à-vis emerging phenomena. This approach also demands understanding complexities faced by practitioners and how they endogenously drive institutional change in particular institutional settings [20]. A qualitative case study approach is useful in investigating a phenomenon in detail and revealing complexities in real-world settings [27]. Table 3.1 highlights the approach used for collecting, summarizing, and analyzing the data used for presenting the case narrative.

Table 3.1: Overview of the research approach used for the study



For data collection, we used multiple sources of data. Yin [28] suggests using multiple data sources such as documents, secondary data sources, public records, interviews and direct observations for case study research. For this paper, the data collection started with a preliminary internet and electronic database search for written materials vis-à-vis

the history of the Indian wind energy sector.[4] Analyzing these secondary data sources resulted in multiple opinions and different views on wind energy development in India. We collected additional information to fill in the gaps based on analysis of the summarized data until a stage was reached where no new information was needed to present the case narrative [29].

We reconstructed Indian wind energy development by triangulating these secondary sources and developing a time line of events that included demonstration projects, policies, regulations, entry of important organizations and programs initiated by the government.

We constructed the time lines by focusing on what happened and who was behind the important developments [30]. Next, we identified key actors and organizations in the wind energy sector in India and focused on understanding their involvement and the obstacles they encountered. Based on the data collected, we selected interviewees and carried out a number of semi-structured interviews with a range of wind energy experts (see table 3.2 for details of interviewees).

Table 3.2: List of Interviewees

#	Designation	Location	Type of interview	Date
1	Director, wind energy division, Government of India agency	New Delhi	In person /not recorded	2nd August, 2012
2	Secretary general, wind energy association	Chennai	In person/recorded	24th July, 2012
3	Chief economist, wind energy firm in India	Pune	In person/not recorded	13th July, 2012
4	Director, wind energy division, advocacy research institute	Pune	In person/ recorded	19th June, 2012
5	Group coordinator, civil society organization	Pune	In person/recorded	13th July, 2012
6	Professor, administrative training institute	Hyderabad	In person/recorded	5th July, 2012
7	Independent expert and first chairman, electricity regulatory commission	Bengaluru	In person/recorded	1st June, 2012
8	Chief of bureau, business newspaper	Chennai	In person/ recorded	25th July, 2012

4 These sources included reports by government agencies, documents available from websites of regulatory agencies, publications by wind energy firms, news articles, conference reports and presentations, reports by consultancy organizations, research reports by advocacy organizations, PhD thesis, journal articles, professional magazines, and reports available on the internet.

9	Director, wind energy research institute	Chennai	In person/recorded	7th June, 2012
10	Secretary general and executive, wind energy association	Chennai	In person/not recorded	10th May, 2012
11	Director, consultancy organization	New Delhi/ Chennai	Telephonic interview	26th July, 2012
12	General manager, policy and government relations, wind energy firm	Gurgaon/ Dehradun	Telephonic interview	8th August, 2012

The in-depth, semi-structured interviews were carried out between May 2012 and August 2012. The interviews served to identify key issues and events that had not come up in the first data collection stage. During the interviews, we tried to understand the experiences of the experts by being attentive to their stories and engaging in conversations. The interview respondents were requested to provide details over historical and current developments in the Indian wind power sector, what they were doing to influence the on-going dynamics, and how they were collectively addressing their concerns. This stage was helpful in refining and validating the interpretations developed from the initial data collection process.

The data analysis was carried out by summarizing data from interviews, secondary documents, and field notes and juxtaposing details from all these multiple sources. We used principles of 'process analysis' for analyzing the data. Process analysis focuses on how things change, and aims to identify underlying mechanisms of observed patterns. Process analysis uses a combination of both deductive and inductive approaches iteratively. Process analysis is often messy in nature and requires constant iteration between theoretical concepts, data collection and analysis [31, 32]. For the analysis in this paper, prior literature was used to analyze data collected using content analysis and new data themes were built by combining prior data themes. The themes were further revised and combined to develop relevant theoretical dimensions for explaining the case narrative [33, 34]. These theoretical dimensions represent aggregated strategies of institutional entrepreneurs emphasizing "collective institutional entrepreneurship" [35]. Table 3.3 explains the approach used for organizing the data from interviews and secondary data to data themes and finally the theoretical dimensions for explaining the development of wind energy in India.

Table 3.3: Data structure highlighting relationship between mechanisms identified in the literature and empirical examples from the data collected

No.	Mechanisms in the literature	Empirical examples from the data	Themes in the data	Theoretical dimensions
1	Theorization and creating a vision for change by framing the problems and justifying particular innovations as solutions to the problems [15, 36]	5 year plans by Government of India with likely capacity addition targets for wind energy; renewable energy targets in National Action Plan on Climate Change (NAPCC); targets set by the Low Carbon Group of the Planning Commission; narratives about annual value of investment into the wind sector, energy security, growth of national industry; potential for large number of jobs, economic growth and reduction in green house gas emissions; balancing competing narratives of economic growth, energy security, job creation, climate change and energy access	Creating political vision and framing imaginaries which provide shared meaning over key concerns of energy security, increased energy demand, industrial development and climate change; wind energy framed as a solution to these competing narratives	**Creation of supportive techno-economic and socio-political networks**

2	Using social and political skills to mobilize collective action and co-operation between heterogeneous actors [37, 38]	Expert group on low carbon strategies for inclusive growth; working group on power; various committees/task forces/joint working groups formed at central and state governments for wind energy	Mobilizing political support for the emerging innovation through strategic activities such as lobbying, petitioning and information based strategies; use of evidence based techno-economic reasoning in public hearings and providing testimony for views	**Creation of an indigenous innovation infrastructure**
3	Steering through new regulations and policies such as creating appropriate public incentive structures for the innovation [25, 39]	Regulatory, policy and financing instruments such as feed-in tariffs and accelerated depreciation on investment on capital equipment; generation based incentive; renewable energy certificate mechanism; renewable purchase obligations; guidelines for forecasting and scheduling of wind power and integration of wind energy into the grid		
4	Advocacy for changes in rules, regulations [40]	Requests and recommendations by MNRE to Ministry of Finance, Ministry of Power; representations by wind energy associations to various bureaucrats in ministries (Ministry of New and Renewable Energy, Ministry of Power, Ministry of Industries, Ministry of Finance, Ministry of Micro, Small and Medium Enterprises, Planning Commission).		

5	Framing new business models for exploring the potential of a new technology [41, 42]	Turnkey project development model supported by wind turbine manufacturers in India; Independent Wind Power Producer model supported by large scale investors and focusing on improving efficiency	Creation of supportive business models based on different user segments; balancing competing logics for valuation of wind energy in order to balance multiple objectives such as consumer costs, profits of investors and financial position of energy utilities; R&D for wind mapping, forecasting and micrometeorology modelling for enhancing wind turbine productivity; resolving integration problems of wind energy into the grid by modifying political, economic, material arrangements associated with existing energy infrastructure
6	Designing new market mechanisms, grid infrastructure, regulations and valuation techniques for higher penetration for wind energy [43, 44, 45, 46]	Supporting price discovery through preferential tariff or competitive bidding; grid discipline and grid connection rules; creation of adequate transmission infrastructure for smoother grid integration of wind energy	
7	Generating narratives about the future, preparing collective roadmaps, forecasts and monitoring of technological progress [39, 47]	Projections about potential of wind energy potential in India through techno-economic studies by industry experts; use of modelling techniques and field experiments for measurement of wind energy potential; forecasting capacity addition in form of plans and targets; measurement of wind energy potential and forecasting; development of wind energy atlas and wind mapping programs	

8	Learning through transnational networks and contextualizing into local context [48, 49]	Cooperation programmes with Danish government, assistance from Danish consulting organisations in planning, design and implementation of wind farms; support from international development banks and bilateral donor agencies; encouragement of formation of joint ventures; mergers and acquisitions, ease of rules and guidelines for foreign investment, joint R&D activities; collaboration with EU and other international wind energy networks	Collective learning through transnational linkages and international expert communities; creation of indigenous capabilities by emphasizing localized learning processes; resolving issues of conflict and contestations between different stakeholders in forums
9	Taking action to educate other actors and developing an emerging infrastructure; shaping the beliefs and perceptions of different stakeholders and being committed and motivated to the emerging field [50, 51]	Exchange of information through industry magazines such as Wind Pro, Inwind Chronicle, Indian wind energy outlook by IWTMA; attempts to influence public opinion through media; training and educational programmes by CWET and wind industry associations	

10	Participation in field configuring events and hybrid forums (conferences, trade events, public forums, joint committees, workshops etc.) [39]	Conferences such as Wind Power India organized by Global Wind Energy Council, World Institute of Sustainable Energy and Indian Wind turbine manufacturers association; wind energy stakeholders meetings; regulatory hearings organized by regulatory commissions and Forum of Regulators; events organized by civil society groups for advocating judicious use of public resources for wind energy and involving local communities in planning wind energy projects

Table 3.3 provides details of the aggregated strategies and their relation with the mechanisms identified in the existing literature on institutional entrepreneurship. We defined two distinct kinds of aggregated strategies pursued by institutional entrepreneurs for developing wind energy in India: (1) creation of supportive techno-economic and socio-political networks and (2) creation of an indigenous innovation infrastructure. For describing our findings, we divided our data narrative into three time periods (1985–1995; 1995–2003; 2003–2014) that emphasized when the institutional context for energy changed significantly in India. During 1985–1995, the first set of wind energy demonstration projects with international assistance took place. From 1995–2003, independent regulatory agencies were established for framing regulations and depoliticizing energy decision making processes. Finally, the period 2003–2014 was characterized by the passing of the Indian Electricity Act in 2003, followed by a series of regulatory and policy measures that broadened the role of different actor groups in mobilizing wind energy change. In the next section, we describe the development of wind energy in India in these three time periods and emphasize the role of collective institutional entrepreneurship and the ongoing conflicts and contestations.

3.4. FINDINGS

3.4.1 Early socio-technical experimentation with wind energy in India (1985–1995)

Creation of supportive techno-economic and socio-political networks

Efforts to harness wind energy in India were being made as early as the 1950s with the National Aeronautical Laboratory (NAL) initiating one of the first projects. Prof M.S. Thacker and Dr. P. Nilakatan were particularly involved in these projects and participated in a meeting of the wind power subcommittee of the Council of Scientific and Industrial Research (CSIR) in 1954 in order to develop the first models of wind turbines for rural applications. CSIR developed two prototype wind turbines that were useful for water pumping applications and battery charging in Indian villages. In 1960, a dedicated wind power division of NAL was established in Bangalore [52, 53].

The need for energy self sufficiency and oil crises in the 1970's led to the creation of Commission for Additional Sources of Energy (CASE) in 1981. This commission was responsible for formulating policies, coordinating R&D, and implementing programs for renewable energy [54, 55]. In 1982, the Department of Non-conventional Energy Sources (DNES) was established, which included a technical committee led by J. Gururaja and Ajit Gupta for grid-connected wind energy R&D. The committee's aim was to develop large-scale, grid-connected demonstration projects by reducing costs and designing turbines suitable for Indian conditions. The committee's work contributed to several projects from the Gujarat Energy Development Agency (GEDA) in Veraval under leadership of K.S. Rao [1].

DNES also established financial incentives for grid-quality wind energy during the national five year plans during the time period 1985 to 1990 [6]. MNES initiated a national program focusing on wind resource assessment, implementation of demonstration projects, creation of appropriate policy, and financial initiatives, creating local capacity for manufacturing, increasing involvement of energy utilities, and raising awareness about wind energy [Int1, 56]. In 1987, DNES played a role in establishing the Indian Renewable Energy Development Agency (IREDA), a dedicated financing agency for providing loans for renewable energy projects in India [6].

In 1987, Jami Hossain, while working for The Energy and Resources Institute (TERI) in Delhi, published an influential paper on Indian wind energy that analyzed the experiences with demonstration projects and made recommendations to improve wind farm performance. Most notably, the paper argued for amending the Electricity Act to allow for private wind farming as well as numerous economic recommendations to bring down production costs.[5] Based on recommendations in this paper, the Indian government published new policies in 1990 to encourage private sector investment in wind energy [1]. These developments led to a gradual increase in installed wind energy capacity. Table 3.4 highlights the installed capacity of wind energy in this time period.

Table 3.4: Annual installed capacity of wind energy in period 1[59, p 248]

Year	Installed capacity (MW)
1992-1993	15.575
1993-1994	57.44
1994-1995	256.515
1995-1996	385.04

As a result, MNES introduced various new fiscal and financial incentives to improve wind turbine financial performance. Most notably, these included a 1993 concessional wheeling & banking and accelerated depreciation (AD) to attract private sector investment as well as a specific tariff for purchasing power from wind farms – a novelty at the time in India.[5] Many state governments also encouraged wind energy with additional

5 These recommendations included fixing of purchase rates from wind farms, qualifying investments in wind energy for accelerated depreciation, income tax concessions for wind farms, and exemptions of custom duty for spare parts. Other recommendations included eliminating the tendency for reducing monopolized manufacturing, availability of grid for transmission of wind power by state electricity boards, establishment of test fields, and suitable import and sales tax duties. [1]

6 The tariff was set at INR 2.25/kWh with a 5 percent increase every five years. Other incentives included capital subsidies and tax holidays.

support mechanisms, including concessional land allotment, electricity duty exemption, and schemes for exemption or deferment of sales tax [57, 58, 59]. A key strategy of the Indian government was also to encourage joint ventures and financial and technical collaboration with foreign entities. Although custom duties on wind turbines were imposed, specific components were excluded by providing concessional exemptions [60, 61].

The new institutional setting for wind power resulted in substantial support from industrial firms who used it for captive consumption. These included in particular small cement, smelting, and textile industries. The scheme also attracted investors in energy, steel, and automotive industries who wanted to reduce high power usage charges. The new institutional setting was so successful that MNES was worried that the accelerated depreciation measure could lead to a gold rush situation [62, 63]. Between 1993 and 1999, IREDA and the World Bank implemented the Renewable Resources Development (RRD) project for commercializing wind energy in ways that differed from previous governmental programs [64]. The project, grounded in neo-liberal thinking, tried to attract private investors rather than rely on public support by creating a better understanding of the risks involved in financing wind energy [65].

In 1995, MNES issued guidelines to the private wind developers in order to ensure that incentives provided by the central and state governments were used properly. These guidelines included wind farms' obligation to produce Detailed Project Reports (DPR). These reports contained detailed information about micro-siting (that is, where to place individual wind turbines in a larger wind farm), selection of wind turbine equipment, operation and maintenance data and performance evaluation. Wind power producers were required to submit DPRs together with their reports about annual energy output and generation costs to state energy utilities. The most important reason for these reports was MNES' desire to reduce public finance misuse – an increasingly important critique voiced by several national and international stakeholders.[7] These guidelines also contributed to creating collective awareness and knowledge within and between various stakeholders, such as state electricity boards, nodal agencies, wind turbine manufacturers, developers, and investors, about adequate project planning [Int 1, 59, 66].

7 MNES issued several other procedures including improved rules on performance estimates of projects, getting turbine approval from government agencies, obtaining a "no objection" certificate from state energy utilities, correct site selection, requirement of third-party testing and certification and prohibition on the use of second-hand turbines imported from developed countries

Creation of an indigenous innovation infrastructure

In the early 1960s, the NAL systematically studied data from the India Meteorological Department and prepared a wind map for India[8] [53]. In 1985, an extensive wind resource assessment was carried out by the Field Research Unit for the Indian Institute of Tropical Meteorology (IITM). A wind energy data book was compiled and published on the basis of data available from vast meteorological stations across India. The data, however, had limitations as it was not specifically collected for assessing wind energy [Int 9, 1]. DNES supported efforts in setting up of wind monitoring stations in Indian states. Subsequently the first wind monitoring station was established in Sultanpet in Tamil Nadu [53, 56]. MNES later compiled and published a report with detailed wind mapping of India comprising details of wind monitoring and wind mapping stations [Int 1, 66, 67]. This was followed by attempts to assess the potential for electricity generation by Jami Hossain and K. Raghavan in 1993. They estimated wind energy potential in India to be around 20,000 MW, but the figure was later revised to 45,000 MW [1, 68]. The first grid-connected wind turbine was commissioned in Verawal in Gujarat in 1985. It was privately owned, but financially supported by DNES. Subsequently, DNES initiated demonstration projects as early as in by offering substantial financial and technical support[69]. Wind farms were developed using second hand imported turbines in few locations such as Okha, Mandvi, Devgarh and Tuticorn [6].

The Danish International Development Agency (DANIDA) was the first foreign agency to show an interest in the Indian wind power market. In December 1986, DNES, the Tamil Nadu Electricity Board (TNEB), and the Gujarat Energy Development Agency (GEDA) requested DANIDA to assist in developing demonstration wind farms in India. The governments of Denmark and India established a cooperation program for projects in Gujarat and Tamil Nadu. TNEB and GEDA were responsible for preparing the required infrastructure, which included respective sites, roads, foundations, transmission lines, and substations. An experienced Danish wind energy consulting firm was even involved in planning, designing, and implementation of the project. TNEB and GEDA also contracted two well-established Danish manufacturers to supply and install equipment and work closely with local partners to develop indigenous technical capacity. Experience was gained in wind farm planning, implementation, and management by DNES and the state electricity board staff members [6, 69, 70].

The demonstration projects helped provide details about techno-economic feasibility of wind energy in India and created a knowledge base for turbine development in low wind-speed conditions [Int 2, 66]. The demonstration projects also provided advocacy opportunities and increased private investor participation. The program instigated new

8 Pioneering work by Dr. Anna Mani, Dr. S. Ragarajan and Dr. D. A. Mooley from the NAL made detailed studies on wind speeds by creating wind maps. Dr. Anna Mani was later involved in a comprehensive wind monitoring and mapping program by publishing wind energy resource data books with support from Dr. S.K. Tewari from the NAL [Int 9]

entrepreneurial and industrial activities, including international cooperation to establish turbine production facilities in India [6]. With respect to creation of a domestic industry, the Danish-Indian joint venture NEPC-Micon was established in 1987 as the first wind turbine manufacturer in India [70]. This was followed by Khemka business group, which formed a joint venture with NEPC Micon. Other Danish firms followed and established their subsidiaries in India, with a notable example being a 1987 partnership between the leading Danish firm Vestas and the Indian firm RVV. Domestic manufacturing was further supported by a series of licensing agreements with European firms. Many European wind energy firms even established production facilities in India.[9] [1, 6, 60].

In 1995, Suzlon was started by Tulsi Tanti by diversifying from his old textile business and setting up wind energy business by forming collaboration with German firm Sudwind GmBH Windkrafttanlagen. Suzlon developed the commissioning business model (turnkey project development) in which it sought complete ownership of wind turbine design and technology. In this model, Suzlon created wind energy banks in advance for investors and was responsible for securing land and grid connectivity, as well as the supply of turbine equipment, the erection of turbines, the facilitation of the power-purchase agreement, and lifetime maintenance. Suzlon began providing end-to-end solutions where it offered full services to small-scale investors in terms of identifying sites, and installing, operating, and maintaining turbines [Int 3, 1, 71].

The first 200kW-class wind turbines were installed by Micon in 1989 (250kW), and the first 300kW-class turbines were introduced by Nordtank in 1991. Enercon India began manufacturing and installing 500 kW gearless variable speed turbines from 1995 onwards. The number of wind turbine manufacturers increased steadily in this period. By 1995, many wind turbine manufacturers in India had joint venture or license agreements with foreign manufacturers, which also helped increase wind turbine size and production. During this time, the focus was on indigenous wind turbine development, but the focus soon shifted to a more market-driven approach [59, 72].

Nevertheless, Indian firms were still very dependent on European firms and India had limited indigenous capabilities for planning and operating wind farms. In particular, skills in project planning, site assessment, site development, operation and maintenance were low and caused many project failures in the early and mid-1990s [59, 60]. Wind developers also faced problems with respect to approval from multiple government departments, acquisition of land, the grid, and complicated procedures often leading to high costs. These problems led policy makers to view commercialized wind energy with a high degree of skepticism. Despite increased efforts to develop an indigenous infrastructure for wind energy, there were only few organizations such as

9 This included firms such as NEPC Micon (NEPC India), Vestas RRB, Enercon India, Pioneer Wincon, TTG Husumer, Elecon Engineering with HZM and Turbowind, Suzlon, NEG Micon, GE Wind India, and C-WEL.

TERI and Consolidated Energy Consultants for conducting techno-economic and project feasibility studies during this time period [Int 2, 73].

3.4.2 Wind energy hype and slowdown (1995–2003)

Creation of supportive techno-economic and socio-political networks

Although the wind energy industry developed substantially, several key problems persisted, in particular with regard to a rather bureaucratic approach taken by state energy utilities.[10] In response, MNES developed proposals for organizing a more continual dialogue between state electricity boards, wind developers and MNES through committees of representatives [59, 73]. In its long-term vision plan, MNES also set a target of 10 percent share of total installed capacity by 2012 [74]. MNES also encouraged public power companies such as the National Hydroelectric Corporation, the Rural Electrification Corporation and the National Thermal Power Corporation to include stakeholder meetings when developing wind projects.[11] Despite these efforts, the wind energy industry remained critical regarding MNES's "command and control" approach as it often took decisions without involving other stakeholders [75].

The wind energy sector started organizing via associations. In 1996, wind energy producers collectively organized and established the Indian Wind Power Association (IWPA), which was followed by the Indian Wind Turbine Manufacturers Association (IWTMA) in 1997. A third association, the Indian Wind Energy Association, was established in 2002. These associations over the years have played an integral role in a range of activities, including sharing information between wind power producers and turbine manufacturers and influencing the institutional context for wind energy [Int2, Int10, 2].[12] In 1996, the Confederation of Indian Industry (CII) supported wind energy by organizing an energy summit and proposing national goals for renewable energy. This meeting addressed the need for a more stable investment climate and political commitment for supporting wind power [76]. Industrial groups Tatas and Bajaj, as well as major public sector energy organizations, also started taking an interest in developing wind energy projects [77, 78].[13]

10 Examples of bureaucratic problems are the ways in which producers were allowed to sell wind power to third parties, high wheeling and banking charges for investors interested in captive consumption of wind energy, and energy utilities' refusal to pay wind power producers according to guidelines and buy back rates issued by MNES.

12 Examples are petitioning and fighting cases on behalf of wind energy investors, publishing wind energy generation data, dissemination of information on running of wind farms, conducting training programs for technicians and engineers. Other activities include engaging in policy advocacy with energy utilities, interaction with government bodies and regulatory agencies, publishing wind industry magazines, and translating important lessons learned from other countries.

13 The public sector organizations involved were the Oil and Natural Gas Corporation, the Hindustan Petroleum Corporation, Bharat Petroleum and the National Thermal Power Corporation.

Nevertheless, fluctuations in the Indian wind energy market occurred due to instability. The introduction of a tax system for (previously) non-taxable companies, the so-called Minimum Alternative Tax (MAT), had the wind industry seriously fretting until the government clarified that power infrastructure development would be exempted. IREDA raised interest rates on wind energy investment loans, which slowed development [79]. Speculative investor behavior and misuse of the accelerated depreciation measure also caused serious problems. Higher import duties for wind turbine components and the state energy boards' poor financial condition further resulted in unfavorable conditions for investors [59, 62]. Finally, the Ministry of Finance reduced the tax subsidy given to wind power producers by 50 percent and the accelerated depreciation benefit was reduced from 100 percent to 80 percent in 2002 [79]. Efforts from MNES to recommend policy modifications in customs and excise duties on import of raw materials for manufacturing of blades of wind turbines and to continue the 100 percent accelerated depreciation for renewable energy technologies failed [80]. These developments also led to gradual decrease in wind energy installations in India. Table 3.5 highlights the installed capacity of wind energy in this period.

Table 3.5: Annual installed capacity of wind energy in period 2 [59, p248]

Year	Installed capacity
1996-1997	155. 905
1997-1998	70.536
1998-1999	42.33
1999-2000	132.915
2000-2001	180.89
2001-2002	285.135
2002-2003	239.785

In 1998, in an attempt to reorganize the electricity sector, the Ministry of Power supported the formulation of the Electricity Regulatory Commission Act, which later resulted in the establishment of the Central Electricity Regulatory Commission and various state electricity regulatory commissions. The Ministry of Power also started drafting a comprehensive Electricity Bill to replace all existing energy sector legislation. This new Electricity Bill required states to unbundle the existing electricity boards and establish independent regulatory commissions, meter all electricity supply, remove cross subsidies, and reduce transmission and distribution losses [Int 7, 81, 82]. [14]

14 Within the Indian Parliament, the Lok Sabha Committee on Energy and the Energy Policy Division of the Planning Commission became active for promoting renewable energy in India.

Civil society organizations such as the Prayas Energy Group also started to become prominent by organizing various forums for dialogue and experience-sharing. They focused on articulating and protecting the interests of the general public in power sector reforms and regulatory processes [Int 5, 83]. Overall, however, civil society involvement in wind energy issues was very small, in particular in comparison with leading countries such as Denmark and Germany.

Creation of an indigenous innovation infrastructure

In 1998, a wind turbine test station was developed in Chennai with the support of DANIDA and Risø National Energy Laboratory of Denmark. The main role of this test center, known as the Centre for Wind Energy Technology (CWET), was to develop standards for wind turbines and to test and certify wind generators. CWET also developed activities in wind resource assessment and monitoring, installation of wind mapping stations, preparing a wind atlas for India, designing and developing wind turbine components, technical assistance and training and conducting special technical courses and awareness programs for the general public [Int 9, 84]. CWET developed a scheme to issue grid-connected turbine certifications and became involved in maintaining a national wind resource atlas, conducting micro-siting studies for wind farms, and developing indigenous, low-cost wind turbines for low-wind regimes. It even collaborated with the Risø Laboratory for preparing wind atlas and conducting research and development activities [53, 72].

MNES and IREDA introduced the concept of "Wind Energy Estates", which were joint estate firms between state government and private developers. This model focused on acquiring land, developing necessary infrastructure and grid facilities, obtaining the necessary clearances, and operating and maintaining wind turbines on behalf of the investors. The wind energy estates helped reduce the gestation period of wind projects as well as encourage small-scale investors [59]. MNES even set up an expert committee for wind resource assessment and measurements covering wind monitoring and mapping stations in different Indian states [Int 1]. Furthermore, wind measurement techniques were developed using meso-scale modelling. However, developing a comprehensive wind power density map still remained a challenge during this time period [Int 9, 53].

MNES provided incentives to develop wind turbines suitable for the specific Indian conditions through three models, that is, an industry in-house R&D model, a consortium model, and joint projects between industry and MNES with foreign institutions or research laboratories [63]. With the help of licensing agreements, domestic manufacturing of wind turbines grew with collaborations from Danish and German firms. Starting in the mid-1990s, the Indian firm Suzlon used a technology-licensing strategy to get access to key turbine components [85]. In general, companies were simply

importing turbines and components and assembling them on the sites.[15]During this time, major turbine manufacturers introduced stall-regulated, as well as pitch-regulated, fixed turbines. Limited-range, variable-speed turbines and DFIG models also became quite common [59, 60]. Table 3.6 provides an overview of turbine technologies in this period.

Table 3.6: Overview of some wind turbine manufacturers in India in period 2 (Adapted from [59], p 191)

Turbine manufacturer	Turbine capacity	Power control, rotor speed and generator
CWEL	250 kW	Stall, 2 fixed, WRIG
Suzlon	250 kW- 2 MW	Pitch , 2 fixed, WRIG

Despite MNES' efforts at increasing foreign firm collaboration, many projects failed. Skills in project planning, site assessment and development and micro-siting continued to be limited. Wind power performance was also poor in terms of capacity utilization factor (CUF) due to lack of monitoring. In addition, the fact that investment decisions were based on availing tax incentives, rather than on production incentives, led to installation of low-quality turbines. Malpractices, such as wind investors getting false commissioning certificates, were even quite common [59, 62, 79]. In the late 1990s, wind turbines got destroyed in a cyclone in Gujarat. This event further reduced the image of wind turbines, and revealed the poor installation practices of inexperienced entrepreneurs who were only interested in the subsidies. Wind companies often were not skilled in important issues such as negotiating with local communities, dealing with conflicts with state electricity boards, and attracting sufficiently trained manpower for maintenance and infrastructure [86]. Nevertheless, in some cases local communities did support wind turbines as a result of promises of economic development in rural areas adjacent to wind farms [87].

As a consequence, only a few manufacturers remained active in India at the end of the century. The interest of foreign collaborators subsided due to slow market growth and Indian firms' low technological capabilities [Int 2, 60]. Though there was some improvement, India's knowledge base in wind turbine manufacturing was weak and needed significant push in order to be internationally competitive [6, 88].

15 The dependence on importing wind turbine parts was not reduced substantially, but activities of firms such LM Glasfiber India, Enercon India, and Suzlon helped in developing blade manufacturing technology through R&D activities. Special efforts were made to indigenize wind turbine components such as tower, generator, gearbox, controller and rotor blades, with only a few critical components being imported [59, 62].

State energy utilities continued resisting granting third-party sales to wind power producers as they saw wind energy as a peripheral supply option with little consideration in long-term energy planning. They believed wind energy impinged on the grid, created low network reliability, and caused losses to state energy utilities [59, 62]. In the power sector, which is plagued by reliability issues and structural inefficiencies, issues of grid integration, wind energy forecasting, and scheduling became especially important. With respect to problems of integrating wind energy into the grid, the Risø Laboratory and CWET collaborated on a study of wind power integration in weak grids in India [89].

3.4.3 Towards up-scaling wind energy (2003-2014)

Creation of supportive techno-economic and socio-political networks

In 2002, the International Energy Agency (IEA), MNES, and the Confederation of Indian Industry organized a workshop with different stakeholders to discuss policy goals for accelerating renewable energy deployment in India. This was also one of the first attempts to develop a comprehensive energy policy for India and included provisions in a draft of a new electricity bill [90]. The eventual passing of the Electricity Act in 2003 streamlined and resolved many power sector issues.[16] The Electricity Act led to the introduction of specific provisions for renewable energy sources in India. Subsequently, investor confidence increased and focus shifted from individual sites and small-scale wind farms to wind estates [Int 1, Int 7, Int 8].[17]

The social dynamics in terms of influencing energy decision making also changed as a result of the Electricity Act[18], the provisions of which enabled advocacy and petitions by concerned stakeholders and provided participation guidelines. These guidelines were included on the consultation papers on proposed regulation, which were followed by

16 The development of the Electricity Act was based on the Electricity Regulatory Commission Act of 1998 and was created as a result of a three-year process with many rounds of debates, discussions and drafts.

17 Prior to enacting the 2003 Electricity Act, there were no specific provisions for promoting renewable energy as the issues were left to state electricity boards, state electricity regulatory commissions, and MNES

18 An example is the National Action Plan on Climate Change specifying 15 percent of India's energy needs to stem from renewable energy sources by 2020, while the Integrated Energy Policy by the Planning Commission suggests 5 percent renewable energy in the overall energy mix by 2032 [59]. According to the Low Carbon report of the Planning Commission, renewable energy does not play an important role in overall energy mix with the expert group assuming a moderate target of 30,000MW by 2020, which is even less than the ambitious targets set by National Action Plan on Climate Change (NAPCC) by the PMO. The Working Group on Power constituted by the Planning Commission for the 12th Five-Year plan (2012–2017) suggested greater clarity for wind power in terms of capacity addition of 11,000 MW and meeting renewable energy purchase obligations [91].

public circulation of drafts for receiving comments and discussions. The guidelines also provided for appeals against the orders of the Regulatory Commissions via the Appellate Tribunal of Electricity based in New Delhi [Int 6, 90]. For example, the Renewable Purchase Obligation (RPO), which mandates that utilities purchase renewable energy, was introduced for the first time in Maharashtra due to a petition filed by the director of Maharashtra Energy Development Agency in 2004. The regulatory agency adopted the cost-plus-based approach for setting the tariff in order to ensure decent return on investment; this led to developing guidelines for RPOs in other states [Int 4, 2, 92, 93]. The installation of wind energy also started increasing gradually. Table 3.7 shows the installed capacity of wind energy in this period.

Table 3.7: Total installed capacity of wind energy in period 3 [4, p 59]

Year	Installed capacity (MW)
2003	2125
2004	3000
2005	4430
2006	6270
2007	7845
2008	9655
2009	10926
2010	13065
2011	16084
2012	18421
2013	20150
2014	21136

Despite many MNRE efforts, a major barrier for wind energy in India remained the overall complexity of the electricity sector due to political power being distributed between the national government and state governments as well as between different ministries (in particular the Ministry of Non-conventional Energy Sources, the Ministry of Power and the Ministry of Finance). With respect to advocacy for wind energy, large firms such as Suzlon, Vestas, Gamesa, and Enercon hired dedicated regulatory and policy officers who offered comments on regulatory commission orders, met ministers and policy makers in person to advocate for favorable regulations and policies, deliberated on critical issues, drafted position papers, and expressed industry interests in the media [Int 10, Int 12]. Consultancy organizations and rating agencies became important in

advising policy makers and regulatory agencies on techno-economic issues [Int 11].[17] Advocacy and research organizations also became more prominent in terms of supporting policy makers by conducting techno-economic feasibility studies, disseminating knowledge, and providing advisory services.[20] The industry associations even started playing an important role in influencing policy debates, lobbying for tariff revision, and voicing profitability concerns [Int 2]. Media organizations started highlighting wind industry issues and raising awareness about the possible conflicts between the national government and wind energy investors, as well as the state energy utilities [Int 8].

For example, in 2005, the World Institute for Sustainable Energy (WISE) advocated for the gradual transformation to sustainable energy in India. To mobilize support for a new drafted law, a working group chaired by the influential Dr. Pramod Deo, who was the previous chairman of the Maharashtra Electricity Regulatory Commission (MERC) and chairman of Central Electricity Regulatory Authority (CERC) was formed. In 2007, the draft document was submitted to the Ministry of New and Renewable Energy, which then sent the document for debate in the Indian parliament. Nevertheless, the efforts to introduce the law were not satisfactory as MNRE did not pursue the initiative vigorously enough [Int4, Int12].

In this period, civil society and environmental groups also became more active in policy debates[21] and highlighted concerns over high tariffs for wind energy and undue profits by wind developers, as well as data asymmetry issues with respect to tariff calculations and exclusion of local communities from participation and decision-making processes [Int 5, 94, 95]. International networks,[22] such as the Global Wind Energy Council (GWEC), started playing an increasingly important role in driving policy and regulatory agendas by translating learning experiences in the form of best practice guidelines from other countries [Int 2, 96].

In 2009, the government of India implemented a Generation-Based Incentive (GBI) scheme for grid-connected wind power projects by independent wind power producers (IPPs). The introduction of the GBI was one of the first attempts to change the dominant business model from an investment incentive towards a production

19 Examples of consultant agencies active in the Indian wind energy sector are Price Waterhouse Coopers, KPMG, A.T. Kearny, Ernst and Young, McKinsey, ABPS Infrastructure Advisory Services, AF Mercados EMI, Power Research and Development Consultants, Consolidated Energy Consultants Limited, and Garrad Hassan India. Examples of rating agencies are ICRA and CRISIL Infrastructure services.

20 Examples are WISE World Institute of Sustainable Energy Pune, The Energy and Research Institute New Delhi, Shakti Sustainable Energy Foundation, and CStep Bengaluru.

21 These included Green Peace India, Prayas Energy Group, Center for Science and Environment and People's Monitoring Group on Electricity Regulation.

22 European India Wind Energy Network, Global Wind Energy Council, International Renewable Energy Agency, World Wind Energy Association.

incentive [Int1, 2]. In the past, most of the investments were associated with small-scale investors using the AD benefit as margin money for ordering wind turbines. In this manner, they were able to get low-cost energy for captive use as well as recover the majority of their investment early on [97, 98]. The main motive behind promoting GBI was to produce larger amounts of wind power at reduced costs through improved operation and maintenance of wind farms and competition [Int 2, 2].

The government of India saw the AD incentive as creating major losses in the form of lower tax collection, excessive profits to small-scale investors, and lower efficiency [99]. As a result, the Ministry of Finance refocused their efforts on actual generation-based incentives to support IPPs that could offer better performance of wind turbines in low wind-speed conditions [Int 1, 100]. The issue became contested to such an extent that the government became prejudiced against supporters of the accelerated depreciation benefit [Int 2].

Both the AD and GBI schemes were discontinued on 1 April 2012, which resulted in significant negative impact on capacity addition as well as reduced investor confidence [Int 2]. Removal of these incentives led to subsequent requests, petitions, advocacy, and lobbying efforts from the wind industry associations for their reintroduction. Influential wind energy representatives emphasized accelerated depreciation's role as a tax deferral scheme and not a subsidy. After significant lobbying efforts, both by the MNRE and all industry interest groups were able to convince the government to reinstate the incentives in the form of a direct tax code [101].

The suitability of a feed-in tariff mechanism versus competitive bidding for procurement of wind energy also prompted debate as the latter allowed producing a certain amount of wind energy at a reduced price due to competition. The Forum of Regulators' 2008 report "Policies on Renewables" recommended the Ministry of Power to frame guidelines for renewable power procurement under competitive bidding according to provisions in the Electricity Act 2003 and the National Electricity Policy. The Forum of Regulators recommended introducing competitive bidding on a pilot basis following previous experience in the UK and suggested lowering tariffs but no significant capacity addition [102].

Actors favoring competitive bidding, that is, MNRE, the Ministry of Power, and civil society group Prayas Energy Group, cited reasons such as the limitations of a feed-in mechanism in determining appropriate tariffs, poor financial conditions of energy utilities, reducing the cost burden on consumers, promoting competition, and incentivizing higher generation [Int5, 103]. On the other hand, the wind energy firms and industry associations resisted competitive bidding, citing reasons such as risks associated with unpredictability of wind energy, lack of accurate wind resource assessment data at the project site, difficulties associated with accurate forecasting, land issues, and unpredictability of future grid availability. They also emphasized the lack

of evidence of successful foreign competitive bidding mechanisms for wind energy procurement [Int 12, 104].

Wind energy forecasting and scheduling became another important area of concern. The Central Electricity Authority and Central Electricity Regulatory Commission developed new technical standards and regulations for harnessing fluctuating wind energy and specifications for grid integration. The Renewable Regulatory Fund (RRF) Mechanism established by CERC, under the Indian Electricity Grid Code (IEGC) focused on scheduling and wind energy forecasting and penalizing wind power producers with UI charges in case their grid input was more than 30 percent of their forecast [100, 105]. However, the guidelines were resisted by the wind industry associations, citing operational challenges and lack of technical competence and experience in scheduling and forecasting wind energy. The wind industry demanded implementation in such a way that generators would not be heavily penalized and cause serious impact on wind developers' revenue [Int 12, 100].

Creation of an indigenous innovation infrastructure

The new institutional context helped to create a localized manufacturing base with setting up of joint ventures between Indian and foreign firms and other arrangements such as licensed production and foreign subsidiaries. Indian manufacturers gained some level of manufacturing capabilities for turbines in the range of 225kW to 2,500 kW. Until recently, the Indian turbine industry was dominated by companies such as Suzlon, Enercon, Vestas, and RRB Energy who had focused more on catering to domestic demand than international markets [59, 60]. Suzlon became the dominant manufacturer by using several strategies, such as joint ventures and wholly owned subsidiaries, as well as using license agreements for specific turbine components. Suzlon focused on activities such as R&D collaborations and international and in-house R&D facilities. Other activities included acquisition of foreign companies and overseas investments in firms [89, 106, 107]. Table 3.8 shows the prominent wind turbine manufacturers in India and important turbine technologies in this period.

Due to presence of low-wind regimes in India, wind turbine manufacturers focused on producing Class II and Class III turbines. However, Indian manufacturers were still dependent on their foreign manufacturers for knowledge and complex and high-value wind turbine components, and were unable to compete internationally [Int 9, 2]. During this time period, better site selection of wind turbines, rigorous wind resource assessment and micro-siting became important. Research efforts also went into designing better turbines using aerodynamic techniques, new materials and advanced power electronics in order to improve efficiency of wind turbines [Int 1, 108]. Repowering of old turbines also gained importance in order to improve efficiency [Int 4].

Grid problems continued as existing transmission systems were still not able to cope with the rapid growth of wind energy due to lack of long-term planning [109].

Table 3.8: Overview of some wind turbine manufacturers in India in the period (Adapted from [96], p 25)

Turbine manufacturer	Rating (kW)	Drive, speed and generator	Class
Enercon	800	Gearless, Variable, Synchronous	II-S
Suzlon	1500 /1600	Gear, variable, DFIG	II
Vestas	1650/1800	Gear, Variable, Asynchronous	II-B/ III-A
RRB Energy	1800	Gear, Variable, Asynchronous	II/III
Gamesa	2500	Gear, Variable, Synchronous	II-A/ III-B
Global Wind Power Limited	2500	Gear, Variable, Synchronous	III-A

Energy utilities in India have often used their poor financial position as a means to oppose additional expenditure for wind energy. Despite an obligation to purchase wind energy at tariffs determined by state electricity regulatory commissions, the state energy utilities have often not met their promises. They have not provided the so-called "must run status" for wind energy and often disconnected turbines during high-wind seasons, causing losses to developers [110].

Several proposals were developed to deal with the issue of grid connection. The Working Group on Power recommended several strategies for better integration of wind energy into the existing grids[111]. MNRE and CERC commissioned the Power Grid Corporation of India to study and identify transmission infrastructure for renewable energy capacity addition during the 12th Five Year Plan period. Reports prepared by Power Grid Corporation recommended several measures to facilitate high-wind penetration, such as enabling strong grid interconnections, establishing a new renewable energy management center, providing priority access to wind energy with amendments in the Indian Electricity Grid Code, better forecasting methods, the development of a power balance market, and new pricing mechanisms with funds to develop this infrastructure [112].

3.5. DISCUSSION AND CONCLUSION

The key contribution of this paper is its emphasizing the role of individuals and organizations involved in the development of wind energy in India and its explanation of what happened, how did it happen and who made it happen. This paper moves away from conventional focus on best practices, policies, and regulation, and presents a richer account by emphasizing the role of different actors, their judgment, decisions and failures as well [1]. By using the concept of collective institutional entrepreneurship, this paper highlights the changing identities and frames of reference of multiple actors

engaged in developing wind energy in India and emphasizing complexities faced by them.

The first part of the original research question is answered through presenting the narrative in section 4 in three different time periods. Discussing the changing role of multiple actor groups showed how developing wind energy in India was a collective accomplishment of many actors over the last 30 years, with no single actor controlling the entire process. Furthermore, this account highlights a range of strategies used by multiple and heterogeneous actors to institutionalize wind energy in India.

This paper highlights that locus of agency shifted from visionary scientists, entrepreneurs, experts, government officers in the period from 1985 to 1995 to the role of regulatory agencies and industry associations in the period from 1995 to 2003, followed by a range of actors, such as civil society groups and advocacy organizations in the period from 2003 to 2014 after the passing of the Indian Electricity Act 2003. During each time period, new actors created favorable conditions for wind energy in India and the changing institutional conditions also enabled and constrained collective institutional entrepreneurship. The identified issues during the different periods are summarized in table 3.9.

During the first period, major issues included negotiations of grid access and cost, wheeling and banking arrangements, and third-party sales and feed-in tariffs paid by the state electricity boards. Major problems faced by the wind industry included poor installation practices, lack of project execution skills, lack of repair facilities, grid integration, technical quality and turbine safety, and excessive dependency on imported components without paying attention to use of turbines in low wind-speed conditions. These issues created a negative image of the wind industry in India, which reduced the installed capacity of wind energy.

During the second time period, conflicts and debates occurred over issues such as maintaining grid discipline, and high fees charged by electricity boards for reactive power. The integration of wind energy into weak grids became an important issue, as there were still considerable gaps in turbine capacity and aerodynamic efficiency. Debates also occurred on lack of transparency with the use of imported technologies, the low level of indigenization, and the lack of serious investors. Increased technological complexity further widened the gap between global and Indian wind turbine manufacturers.

During the third time period, debates on how to support wind energy were prominent and addressed balancing tradeoffs between creating a predictable and lucrative environment for investors on the one hand and dealing with the cost burden on consumers and the state on the other [113]. The sudden removal of accelerated depreciation and the generation-based incentive was a major issue. During this time, critical issues with respect to excluding local communities during wind farm planning also increased local conflicts as developers claimed benefits for local communities, but did not meet promises of wider economic and social benefits.

Table 3.9: Overview of the identified solutions in the three phases and solutions taken

Time period	Identified issues	Solutions taken
1985-1995	Problems of grid access, poor project development practices and excessive emphasis to imported turbines from EU; limited understanding of good incentives and policies which focus on generation and not mere installation	Actions taken by MNRE for creating an enabling environment for wind energy; use of committees and forums by MNRE and state governments for resolving ongoing conflicts and controversies between wind industry, energy utilities and government
1995-2003	Problems of buying of wind energy and grid access between energy utilities and wind developers; negative impact of wind turbines as tax incentive machines; continuously increasing difference between capabilities of global and Indian wind turbine manufacturers	Use of institutionalized mechanisms to resolve controversies by setting up of regulatory commissions and government departments; new policies and regulations by based on learning from past failures in early phase of wind energy development
2003-2014	Competing interests between wind industry, government, civil society and consumer groups on developing mechanisms for supporting wind energy; critical debates on negative impact of wind energy on local communities and environment	Mechanisms for balancing multiple stakeholder interest by creation of joint committees, forums and working groups; increasing political support for wind energy by several stakeholder consultations and launching of National Wind Energy Mission

The result of the analysis is that conflicts require adequate representation of laypersons and non-specialists, such as common public consumers, local villagers and tribal people who are not experts on energy matters. However, opportunities for participation in energy policy processes remain quite limited due to their expert-driven nature. Even if public hearings and consultations are conducted, genuine opportunities for effective participation are limited. Final decisions are often made behind closed doors by powerful interests or expert organizations [114]. Improving the situation requires re-conceptualizing the issues in forums wherein viewpoints, identities and interests of different actors are awarded symmetric treatment [115]. It is necessary to be open towards marginalized actors and find ways of justifying genuine participation procedures to include their concerns; future research should look at how these neglected actor groups can become a part of wind energy development in India.

In terms of implications of this research, we suggest that future wind energy development requires focus on targeted support mechanisms, and withdrawing them

when sufficient capability levels have been attained. Policy makers need to be careful about sudden removal of key support mechanisms, policies and regulations as it can have an adverse impact and even promote rent-seeking activities by interest groups. They need to adapt to continuously changing global technological dynamics, and resolve emerging conflicts between different actors while anticipating new conflicts in the future. Furthermore, care has to be taken with respect to mapping the views and perspectives of local communities when planning wind energy projects and not marginalizing their concerns. Finally, one essential limitation of this research is the generalization of findings beyond the context of the wind energy industry in India. We suggest the need for additional research to better understand how findings from this paper can be translated into other institutional contexts.

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Chapter 4

Institutional entrepreneurship in transforming energy systems towards sustainability: wind energy development in Finland and India[23]

Institutional entrepreneurship in transforming energy systems towards sustainability: wind energy development in Finland and India

Suyash Jolly, Petr Spodniak, R.P.J.M. Raven

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ABSTRACT

A growing body of literature has examined the dynamics of wind energy development across different institutional contexts. However, so far only few have paused to reflect on the differences between developed and emerging economies. Building upon the literature on institutional entrepreneurship, this paper compares institutional strategies in wind energy development in Finland and India using the typology of political, technical and cultural work. We highlight the role of institutional approaches in studying sustainable energy transitions in mature and emerging institutional contexts, while being sensitive to issues of inclusion, exclusion and the participation of heterogeneous actors. Our findings offer implications for debates in the institutional entrepreneurship literature by exploring how actors shape their institutional environment in different contexts, and the extent to which emerging institutional contexts provide more opportunities for strategic action and for a transition towards sustainability. Finally, this paper underscores the need for generalized theoretical frameworks that are able to capture institutional entrepreneurship across different institutional contexts.

Keywords: Institutional entrepreneurship, wind, sustainability, Finland, India

4.1 INTRODUCTION

Achieving major transformations in energy systems towards sustainability ('sustainability transitions') is a collective goal that requires action from diverse public and private actors with different interests, influence, and levels of power (Garud & Gehman, 2012; Ferraro et al., 2015). A transition towards sustainability is likely to be full of conflicts and contestations between different actors, with no win-win solutions (Wittneben et al., 2012; Marcus & Van de Ven, 2013); at the same time, such sustainability transitions may vary considerably in different nations according to the institutional context, which configures different needs, priorities, imaginaries and levels of capabilities (Levy & Spicer, 2013). Despite this fact, comparative studies of sustainable energy transitions across different contexts are still limited, posing a challenge to drawing cohesive insights (Sovacool, 2010). In particular, our paper responds to recent debates suggesting that emerging institutional contexts with a lack of well-functioning legal and regulatory systems, high levels of risk and uncertainly are host to substantially more opportunities for strategic action by actors when compared to mature institutional contexts (Tracey & Philips, 2011; Marquis & Raynard, 2015). Our aim in this paper is to empirically illustrate the differences in institutional strategies directed at transforming the incumbent energy system, and to contribute towards cross-cultural comparative research on sustainable energy transitions (Sovacool, 2014).

Building upon these debates, our paper compares wind energy in Finland and India. Particularly, our paper tries to explore the dynamics of sustainability transitions by focusing on differences and similarities in the ways in which actors collectively engage for mainstreaming wind energy development in Finland and India. We focus on wind energy due to its major potential in transforming the energy systems of both case countries, which currently rely mostly on large-scale, centralized energy production. We classify Finland as a mature institutional context due to its formal regulatory framework, well-developed nationwide infrastructures, low GDP growth rate, high human development index and low level of corruption. We categorize India as an emerging institutional context due to its high GDP growth rates, less formally developed regulatory and political frameworks, medium levels of human development index and corruption, and moderate to high levels of government intervention in business affairs (Marquis & Raynard, 2015).

The key research question we explore is: *What are the differences in the ways in which actors have collectively engaged in shaping the institutional context for wind energy development in Finland and India?*

This paper empirically highlights the development of wind energy in Finland and India in response to competing narratives, priorities and interests of diverse actors struggling for the legitimation of wind energy as a reliable source of energy. We note that there are major political, social, economic, cultural and scale differences between India and Finland, which make such a comparison both interesting and challenging. Through

this research, we try to have a deeper look into the debates that suggest that emerging institutional contexts provide more opportunities for strategic action than mature institutional contexts. Whilst we do not aim to generalize the results from our two case studies to all emerging and mature contexts, our paper illustrates that the opportunities and challenges for institutional entrepreneurship in emerging and mature contexts are more nuanced than suggested above. The paper is structured as follows. In section 2 we present the theoretical framework, building on relevant debates in the institutional entrepreneurship literature. Section 3 describes our research methods; this is followed, in chapter 4, by a summary of the key findings of the study, with an overview of wind energy development in Finland and India. The discussion and conclusions are presented in section 5.

4.2 INSTITUTIONAL STRATEGIES IN EMERGING AND DEVELOPED INSTITUTIONAL CONTEXTS

A key aspect in the institutional entrepreneurship literature is how actors change institutions while also being constrained by them. The literature on 'institutional entrepreneurship' is a relatively recent attempt to respond to the paradox of embedded agency, and focuses on the socially embedded actors who create institutional change in spite of being constrained by the existing institutional arrangements (Battilana, Boxenbaum & Leca, 2009). Institutional entrepreneurship involves a range of actors such as firms, industry associations and advocacy groups. The literature suggests that actors are configured by their institutional environment, which they also try to reshape; for instance, by influencing policy and regulatory decision-making processes (Garud, Jain & Kumaraswamy, 2002; Child, Lu & Tsai, 2007). A range of organizations – such as labor unions, political action committees, environmental and public interest groups, trade associations, ad-hoc associations, lobbyists, foundations and think tanks – are involved in shaping their institutional context (Barley, 2010), utilizing strategies that include, among others, cultivating and maintaining relationships with decision makers, lobbying to secure resources and political support, providing information during regulatory hearings and using media to politically highlight their concerns (Child & Rodrigues, 2011; Hiatt & Park, 2013). Complementing the literature, few studies have also looked into the role of environmental social movements in shaping the institutional context for wider-embedding sustainability transitions (Doblinger & Soppe, 2013).

Institutional entrepreneurship is argued to be an act of experimentation and improvisation, in which success is not always guaranteed and contestations in the process can be expected; it involves adapting to unanticipated developments and improvising actions in order to face ongoing uncertainties (Lamberg & Pajunen, 2010). A central argument is that institutional change is accomplished through distributed and uncoordinated actions of dispersed actors with different resources, justification principles, conflicting world views, and abilities to collaborate, compete and contest with each other for supporting institutional change (Hargrave & Van de Ven, 2006).

Because a variety of actors are involved in cooperating and competing with each other and have different levels of power in influencing dominant institutional arrangements, changing institutional contexts includes both collective and contested action (Jolly & Raven, 2015). Furthermore, a proposed solution that is beneficial and novel for one group of actors might have negative consequences for another group of actors (Garud, Van de Ven & Tuertscher, 2013).

Moreover, studies have also emphasized the need for exploring different strategies used by actors in different institutional contexts. Historical and institutional conditions in nations put limitations on the strategic actions of governments, firms or interest groups, but at the same time enable them to take specific actions. This variation in strategic actions of actors across contexts is due to the differences in nation-specific institutional arrangements (Biggart & Guillen, 1999; Fligstein & Zhang, 2011). Therefore, the interests and identities of actors differ according to the contexts in which they are inserted, as such contexts define their actions in a historically situated manner, based on their understanding of existing social norms and power configurations (Jackson, 2009). However, actors need to adapt their strategies and explore new opportunities based on an assessment of the constraints presented by the institutional environment (Suddaby et al., 2010; Jain & Sharma, 2013). Existing research in institutional entrepreneurship literature also suggests that emerging institutional contexts are characterized by relatively weakly enforced and less stabilized institutional arrangements compared to mature institutional contexts. Emerging institutional contexts face constraints such as lack of stable government support, lack of coercive measures for implementation of policies and regulations, rent seeking, exploitation of public resources and limited technological and market infrastructure (Mair, Marti & Ventresca, 2012). Institutional entrepreneurs in these contexts use strategies such as reducing institutional uncertainty, resolving institutional voids and constraints and adapting solutions from other institutional contexts. Nonetheless, institutional entrepreneurs in emerging contexts use a range of different strategies than those used in mature institutional contexts (Tracey & Philips, 2011). Another essential distinction is that actors in emerging institutional contexts are often more politically active in influencing powerful actors by developing personal relationships, engaging in opportunistic behavior and shaping the policies and regulations to their advantage, since the distinction between government, regulatory agencies and business is often blurred (Marquis & Raynard, 2015). Institutional constraints in these contexts both force and enable the actors to develop improvisation capabilities, leading actors to develop innovative solutions when seeking opportunities within the constrained institutional environment (McKague, Ziestma & Oliver, 2015; Khoury et al., 2015; Barin Cruz et al., 2015).

Using relevant insights from the institutional entrepreneurship literature, Perkmann and Spicer (2008) distinguished between political, technical and cultural work aimed at influencing regulative, cognitive and normative dimensions of institutions. Institutional

entrepreneurs use political, technical and cultural tactics to influence dominant institutional arrangements (Gond & Boxenbaum, 2013). Political work is directed at influencing the development of rules and regulations, and is related to political skills that actors use to engage and influence other actors. Technical work focuses on the development of technocratic skills, and cultural work focuses on the belief systems and values for broader institutionalization (Lawrence & Suddaby, 2006; Perkmann & Spicer, 2007). Political work is generally performed by actors such as politicians, governmental organizations, regulatory agencies, professional agencies, industry associations, trade unions, lobbyists and advocacy organizations. Technical work is generally performed by actors with technocratic competences, such as government departments, consultancy organizations, firms, research institutions, universities, standards organizations, independent think tanks, consultants, and professional associations. Cultural work is performed by actors such as media, social movements, consumer groups, civil society, professional associations, public intellectuals and public relations experts (Perkmann & Spicer, 2007; Perkmann & Spicer, 2008). Because institutional change takes a substantial amount of time (Zilber, 2013), the typology of political, technical and cultural work helps in understanding the actions of actors over time, rather than evaluating the success rates of individual initiatives. However, only limited empirical evidence currently exists on the topic of how actors confront these constraints and how the deployed strategies are similar or different in mature and emerging institutional contexts.

Overall, our literature review reveals a strong need for empirical studies uncovering the differences in institutional work in mature and emerging institutional contexts. We adopt the discussed Perkmann and Spicer (2008) typology (political, technical and cultural work) for mapping the institutional strategies actors use to address institutional constraints, and investigate how institutional entrepreneurship is different across the two institutional contexts. This conceptualization is also useful in highlighting the multiple actions of different actors in building political networks and necessary technical capabilities, and culturally framing innovations in different contexts. By drawing on extensive data consisting of secondary data sources and semi-structured interviews, we empirically illustrate the similarities and differences in institutional strategies in mature and emerging institutional contexts, and answer our research question.

4.3 RESEARCH METHOD

The exploratory nature of our research calls for a qualitative approach based on case studies, which we developed for the analysis of wind energy development in Finland and India. Qualitative case studies are useful for studying the emergence of innovations and industries, as well as for understanding interactions between organizations and broader historical, political and economic contexts (Forbes & Kirsch, 2011). Moreover, a qualitative case study approach offers benefits such as being open-ended, flexible and allowing the use of rich data with the exploratory nature of the analysis; it also offers

distinct advantages in capturing the interpretations, motives and lived experiences of actors (Graebner, Martin & Roundy, 2012). Additionally, qualitative approaches are useful in capturing the richness of diverse institutional contexts through in-depth interviews, field visits and participant observations when focusing on the way actors adapt their strategies according to constraints in the institutional environment (Marquis & Raynard, 2015).

The cases selected for analysis are Finland and India. Finland, with almost one hundred years of independence, a parliamentary democracy, legal authority, and open market system is classified as a mature institutional context. India, with ongoing political, social and economic transformations and energy infrastructures in development is classified as an emerging context. Finland and India are interesting cases, as energy generation is dominated by centralized thermal, hydro and nuclear energy, with a limited share of wind energy in the overall energy mix. In both countries, wind energy development is largely driven by energy security concerns and long-term future targets, namely energy independence, job creation and long-term economic benefits. At the same time, the national energy strategies have often been dominated by an economic rationale for low-cost fuels and nuclear energy. Our case study choice is also driven by empirical reasons, namely access to rich data, practical realities of data collection and familiarity of researchers with the institutional contexts.

India and Finland have diverse priorities as well as challenges concerning wind energy development. Finland has acknowledged climate change as an important issue in policy making, by drafting climate strategies such as the National Climate and Energy Strategy. Nevertheless, Finland has not aimed at moving beyond the minimum EU targets, and further barriers have emerged due to its lack of political will and commitment (Kivimaa & Mickwitz, 2011). India has acknowledged the climate change mitigation strategies under the National Action Plan on Climate Change (NAPCC) in order to address multiple concerns, such as continuously increasing energy needs, energy security, energy access for poverty reduction and long-term development and economic growth (Dubash et al., 2013). India's energy policy has been driven by the needs for energy security due to the increasing demand-supply gap, industrialization-led growth, energy access and job creation (Harrison & Kostka, 2014). Wind energy recently received a political support through the National Wind Mission, which aims at meeting India's energy security, climate change and industrialization concerns (Chaudhary, Krishna & Sagar, 2014). Nonetheless, wind and solar energy sources are currently insignificant in the overall energy mix of the two countries, in which the bulk of energy originates from coal, hydro and nuclear sources.

Wind energy in Finland has faced considerable barriers due to bureaucratic, political and local resistance. Finland has also had a tradition of little transparency and inclusion in its policy process (Ratinen & Lund, 2015; Haukkala, 2015). In terms of deployment, India achieved 21692 MW of installed wind capacity at the beginning of

2014 (MNRE, 2014). By contrast, Finland, which has been a laggard in the EU context, reached 447 MW of installed wind capacity at the end of 2013 (VTT, 2013). For an overview, see Figure 1, which depicts absolute wind power capacity installed in India and Finland (right vertical axis) and yearly percentage change (left vertical axis). Despite the significant difference in magnitude (that is, the total wind power capacity installed), both countries have experienced similar growth rates.

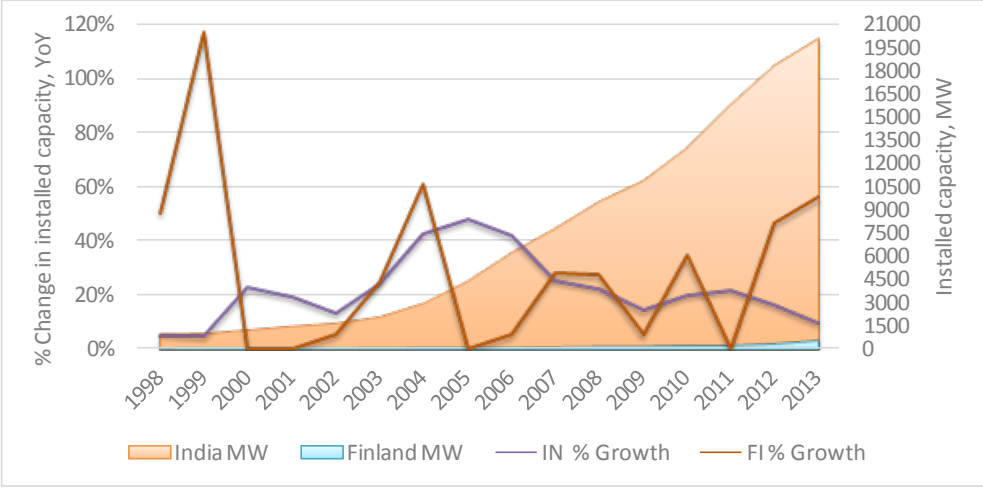

Figure 4.1 Wind Production Capacity in India and Finland, YoY changes

Source: Data provided by thewindpower.net, authors' own depiction

For this study, we adopted a flexible approach for conducting qualitative research. First, we echo Barley's (2010: 779) suggestion that familiarity of researchers with the institutional context is an advantage. We had native researchers from the respective countries carrying out field research in Finland and India; this reduced problems such as language barriers and difficulties in conducting research in an unfamiliar institutional context. Being native to the contexts helped us in using personal and professional networks to obtain access to experts for interviews, as well as in better understanding the local institutional context. This also helped in contextualizing our research, as we were able to capture wind energy development by paying attention to unique institutional conditions both in Finland and India. The studies in Finland and India were independently conducted by the first two authors, with the aim of looking at the institutionalization of wind energy.

4.3.1 Data sources

The study draws from both primary and secondary data sources. The secondary data includes policy and strategy documents (available from the websites of relevant government agencies), regulatory and policy documents, journal articles, presentations

(for example, discussions by experts during conferences and workshops), conference proceedings, reports from industry associations, newspaper articles, media reports, industry reports, company websites, consulting publications and trade magazines. The availability of publicly accessible data made it possible to gather a large quantity of data on wind energy in both cases. We engaged in a snowball procedure by finding new data sources until we reached a stage where we had no new information and possessed sufficient data to develop case summaries. The data collection period was focused on 2010-2014, emphasizing contemporary developments in the field rather than historical issues.

The primary data sources were 26 semi-structured interviews with influential stakeholders in India and Finland. For the interviews, we tried to select expert informants who knew about wind energy in the two countries and viewed the developments from varied perspectives. The interviewees were engaged in wind energy developments and represented regulators, industry associations, policy makers, wind energy firms, policy think tanks, government bodies and academic experts, along with representatives of other organizations and civil society members. Our goal was to uncover the ways in which actors use distinct strategies for supporting innovations by developing new practices, emphasizing new values, shaping regulatory frameworks and markets in negotiation with other actors, in order to support sustainability transitions (Garud & Gehman, 2012). An interview protocol was prepared for conducting the interviews in a way that allowed flexibility for different interviewees. The open-ended interviews lasted between 30 and 60 minutes, depending on the range of issues discussed during the interview. The interviews focused on understanding the concrete activities in which the actors were engaged with respect to wind energy development, such as barriers faced and ways to overcome them, taking risks and mobilizing political support for their causes. Our expert interviews provided an informed perspective on the institutional constraints in the two countries, as well as on the actions taken to challenge the constraints in the wind energy sector. Table 1 provides an overview of the interviewees.

We used a classification scheme to structure and understand the political, technical and cultural work performed by different interviewees (see Table 2). For example, the advocacy and lobbying work by industry associations for favorable policies was coded as political work; the actions of civil society groups, such as highlighting social and aesthetic issues or resisting profit motives of wind energy firms, were considered cultural work. We were sensitive to the fact that most actors' initiatives did not result in rapid institutional changes, which unfold slowly over time. Hence, we distinguished impactful actions transforming institutional arrangements from failed efforts. Most interviewees could provide a 'helicopter-view' of the field, due to significant experience in policy and regulatory processes with respect to wind energy in Finland and India. The majority of interviews were recorded and summarized for case analysis. Due to confidentiality issues, some interviews were not recorded.

Table 4.1: Overview of interviewees from Finland and India

Interview	Organization	Position	Country
1	Legal firm – wind sector	Senior attorney	FI
2	University	Professor	FI
3	Transmission system operator	Manager	FI
4	Environmental organization	Energy campaigner	FI
5	Wind farm developer	Chief executive officer	FI
6	Wind energy firm	Managing director	FI
7	Wind energy firm	Project manager	FI
8	Wind energy firm	Managing director	FI
9	Wind energy association (Indian wind power Association)	Secretary general	IN
10	Wind energy association (Indian wind turbine manufacturer's association)	Secretary general	IN
11	Wind energy firm	General manager	IN
12	Wind energy research institute	Director	IN
13	Advocacy organization	Director	IN
14	Consultancy firm – energy & infrastructure	Director	IN
15	Civil society organization	Group coordinator	IN
16	Civil society organization	Convener	IN
17	Civil society organization	Trustee	IN
18	University	Professor	IN
19	State electricity regulatory commission	Engineering director	IN
20	Renewable energy institution	Director	IN
21	State energy coordination cell	Member secretary	IN
22	State renewable energy nodal agency (Andhra Pradesh)	Deputy general manager	IN
23	State renewable energy agency (Tamil Nadu)	Deputy general manager	IN
24	State transmission corporation	Chief engineer	IN
25	State distribution company	Senior engineer	IN
26	Business newspaper – renewable energy	Chief of bureau	IN

Table 4.2: Classification according to the literature and empirical illustration

	Concept definition*	Empirical examples	Illustrative quotes
Political work	Advocacy and lobbying; formal petitioning and negotiation with influential actors; monitoring of compliance and legislation; networking; drafting new legislations and administrative guidelines; enforcement through regulation	Setting guidelines for grid connectivity and wind power scheduling; making amendments in the regulations for supporting wind energy	*"Such a small-scale energy production does not fit into the picture of some people who are making decisions."* **(Academic, Finland)**
Technical work	Development of plans and publications; harmonization of standards, classification systems and rules; research, training and educational programs; provision of expertise for drafting legislation (academics, expert groups, consultants); exchange of knowledge through discussion (industry conferences, public forums, site visits, joint working groups)	Advocacy via techno-economic studies; focus on indigenous R&D and improvement of industry competitiveness; wind energy assessments; design, testing and wind turbine certifications; grid integration of wind energy	*"The grid was not planned in such a manner. The proper planning of the grid has to take place. They have to concentrate managerially and technically to solve the grid-related problems."* **(Academic, India)**
Cultural work	Mobilization of public discourse and rhetoric (such as discourse around climate change, energy security, energy poverty, green jobs, green industry creation, environmental benefits); scenario and vision building; propagation of professional norms and ideologies	Raising concerns about impacts on local livelihood and flora and fauna; dissemination of information for support or opposition of wind energy; raising concerns against information asymmetry and rent-seeking practices	*"There is some sort of suspicion from the consumers. It is not a transparent process. There is no transparent way land is allocated to wind farm developers. There is no transparency in capital costs [....]. Due to lack of transparency there are doubts over the ways in which wind energy is being promoted."* **(Civil society representative, India)**

*Based on Lawrence & Suddaby, 2006; Perkmann & Spicer, 2008; Sine & David, 2010

1.1

4.3.2 Data analysis

The first step in our data analysis involved developing narratives of wind energy development in each country for the period 2010–2014. We gathered our field notes, summarized interviews and encapsulated secondary data in order to develop a deeper understanding of wind energy development in Finland and India. We also complemented these accounts with quotes from expert interviewees in order to enrich our data with personal stories and insights. In the second step, we used content analysis to map instances of political, technical and cultural work, which allowed us to identify patterns within the data (Fischlein et al., 2010).

Building upon the interpretive research tradition, we gave emphasis to interviewees' views, opinions and experiences in order to comprehend the institutional work performed by them. We were sensitive to the experiences of actors, as they were engaged in day-to-day actions for the transformation of institutional arrangements (Lawrence, Leca & Zilber, 2013). During the analysis, we were also sensitive to conflicts between the different actors, such as power dynamics between regulatory agencies, firms and civil society groups. We looked for alternative interpretations of data wherever required, and our analysis involved repeated cycling between theoretical concepts and data for highlighting our contribution (Tracey, Philips & Jarvis, 2011). In the third step, we compared and contrasted the narratives on wind energy development in Finland and India. To compare the cases, the authors first identified differences in the two countries by focusing on actions of different actors being constrained and enabled by the dominant institutional arrangements in the two contexts (Waldorff et al., 2013). However, we did not explicitly examine the form of institutional work (that is, political, technical or cultural) that is more prevalent or influential in both emerging and mature contexts. To compare the two cases, we engaged in data reanalysis, focusing on the differences between political, technical and cultural work in the two contexts. We then jointly compared and crosschecked the interpretations of the differences in institutional strategies. Throughout the data analysis, we took measures to ensure the trustworthiness of our research procedures, by jointly reviewing accounts from Finland as well as India multiple times. Differences in interpretations were resolved through author discussions and data revisits until the authors reached common ground and ambiguities were clarified.

4.4 FINDINGS

This section synthesizes our main findings by discussing political, technical and cultural work in Finland and India. The purpose of this section is not to provide an exhaustive description of wind energy development in Finland and India, for which limited space is available and which have been published elsewhere (Spodniak & Viljainen, 2011; Jolly & Raven, 2015). Instead, we specifically focus on the identification of cultural, political and technical work in each country.

4.4.1 Wind energy in Finland

From a *political work* perspective, until the early 1990s, Finland's energy system has historically been under the control of state monopolies. In Finland, the historical intertwinement of state and energy-intensive industries (mining, chemicals, pulp and paper) via a quasi-state ownership has tied together the interests of energy incumbents and political elites. After market liberalization and unbundling, an important concern has been to keep energy prices low, in order to protect the interests of the industry and taxpayers in Finland (Kivimaa & Mickwitz, 2011; Salo, 2011). Despite the EU's political influence and power, Finnish energy policy has been driven by national ministries, large energy producing companies, the Confederation of Finnish Industries (EK) and the Technical Research Centre of Finland (VTT) (Ruostetsaari, 2010; Mickwitz et al., 2011). This was highlighted by one of the expert interviewees:

"*The energy policy in Finland has been such that we are investing in very big power plants. And somehow political decision makers seem not to bring renewable energy in Finland [....]. And the new players are, for example, the wind farm owners and investors, who are disturbing the existing market. Of course they are, […]. It is said that Finland is not a corrupted country, but the corruption […] style is different. It is more polite, it is somehow polished, and it looks like very legal, like brothers are making decisions together. In Finland it is called hyvä veli -järjästelmä – a good brotherhood system. Maybe something like that is also involved, it is in every country, and also in Finland. And somehow the counter force against this energy cluster is missing in Finland. Somebody who would change the game.* " (Academic, Finland)

The Ministry of Environment has also taken a central role in setting up a working group of experts that addressed one of the largest current obstacles in wind power institutionalization in Finland: wind farm noise regulation (Interview 6). The members of the working group included individuals from ministries (Environment; Economy and Employment; Finance; Social Affairs; and Health) and associations (the Association of Finnish Local and Regional Authorities; Finnish Energy Industries (ET); the Finnish Association for Nature Conservation (FANC); and the Finnish Wind Power Association (TVKY)). Additional experts came from the Finnish Institute of Occupational Health, VTT (Technical Research Centre of Finland), the financial group Taaleritehdas and the consulting companies Pöyry and Aula Research. Despite the working group's propositions, the lack of cooperation among regional governments, municipalities and ministries has resulted in slow wind energy development in Finland (Interview 1).

Particular for the Finnish political work is the so-called "hyvä veli –järjestelmä": a form of cronyism where influential decisions on national energy strategies are formed without real influence of newcomers such as wind farm developers (Interview 2). Even though general industry associations in Finland have been active in lobbying for renewable energy, they have become weaker due to heterogeneity of interests, and there are very few issues where all associations have acted collectively (Ruostetsaari, 2010).

Furthermore, there have been no independent renewable energy lobbying groups for wind energy in Finland; all boards of wind power associations have members from the nuclear energy and combined heat and power (CHP) industries. This may be one of the reasons behind the limited support for wind energy in Finland (Interview 1).

From a technical work perspective, the Finnish government has actively supported the growth of the domestic wind turbine industry in order to generate export income and jobs. The support is often channeled to R&D of specialized wind turbine components, in order to raise Finland's competitive advantage in international markets (Varho, 2005). Technological development has been very important for the growth of wind energy in Finland, with R&D focusing on arctic innovations (such as design blade technology to fit cold, icing and sea conditions in the Arctic region) and important components such as generators, gearboxes, blade materials, steel plates for towers, and large castings (Holttinen, Peltola & Tuhkanen, 2002; Suominen & Megum, 2010). The transmission system operator (TSO) in Finland is responsible for advising municipalities in creating wind farm zones, developing transmission infrastructure for wind power, ensuring the overall functioning of the electricity market, developing grid codes and setting the grid access fees (Basrec, 2011).

In Finland, regions with high wind potential have lacked access to grids due to low population density, resulting in limited chances of investment recovery for the gird operators. Furthermore, connection procedures to the grid depend very much on informal negotiations and talks between grid and plant operators, which also pose challenges for grid operators (Tepp, et al., 2012; Interview 2). Moreover, technological progress is to be supported by government programs for new technologies that are suitable for Baltic-Arctic conditions (Interview 7). Consultants have been influential in policy circles due to the long-term connections with the government, for whom they often produce information according to clients' interests (McDermott, 2011). For instance, influential consultant Lauri Tarasti was hired by the Ministry of Employment and the Economy (TEM) in 2012 to assess the opportunities, challenges and barriers in the Finnish wind sector.

With respect to cultural work, the Finnish Association for Nature Conservation (FANC) established a certification system for wind energy (Borup et al., 2008). The same association was also involved in granting the eco-label 'Norppa' for electricity produced from renewable energy sources; it also suggested excluding travel, leisure and nesting areas during spatial planning for wind energy (Fränti, 2009). The organization Totuus tuulivoimasta ('Truth about wind power') has often criticized the selection practices for wind turbine sites, the placement of turbines and aesthetic issues due to a negative impact on the natural landscape (Varho, 2007). The World Wide Fund for Nature (WWF) raised concerns on the effects of offshore wind energy and its eventual impact on the natural flora and fauna (Koskinen & Laitinen, 2010). Some of these concerns were illustrated by one of the interviewees:

" *People don't want the windmills very near their summer cottages. It is a visual change and I think they are afraid of the noise. [….] the issue is that people believe that the effects are going to be much stronger that they in reality are. This is a new phenomenon in Finland and it's quite unfamiliar, there are not many people in Finland who have seen those working. I think it is quite surprising how people oppose those. Even if you make studies about the projects, and show how the noise pollution is going to be, they don't believe those results.*" (Attorney, Finland)

Issues such as visual impact and impact on wildlife (such as the collision risk for birds and bats) have become prominent in Finland while planning the siting of wind turbines (Nordvind, 2011). Unlike Germany and Denmark, one important reason for this lower local acceptance has been the lack of incentives for local ownership in Finland, and a lack of institutionalized mechanisms for involving local people from the early stages of the planning process. Local involvement often leads to benefits in the form of shorter handling times and speedier administrative processes (Häkli, 2013).

Local communities have become more accustomed to the use of their rights of appeal during the public consultations of wind farm projects (that is, of commenting on approved zone plans) (Interview 6; Interview 8). However, unlike the situation in other Scandinavian countries, the impact of Finnish civil society groups on energy policy making is marginal. Despite the frequent public hearings, consultations and meetings, the public's views have not been highly influential (Interview 4). This issue is highlighted by one of the expert interviewees:

"*We are often invited to the governmental hearings and writing statements. And we would like to increase our own lobby work. Make it a little bit more stable, not appearing only when some decision is coming up.*" (Energy activist, Finland)

Consumers exert influence primarily through their consumption choices; for instance, by reducing energy consumption from fossil fuels or showing greater interest in electricity prices. Environmental issues and the promotion of renewable energy are viewed as secondary (Ruostetsaari, 2013). Some of the major reasons behind a reluctant public attitude towards wind energy include the lack of demonstration and experience with wind power, the public administration's ambiguous stance on the matter, and variations in individual preferences (Interview 5).

4.4.2 Wind energy in India

Focusing first on political work, the Ministry of New and Renewable Energy (MNRE) and the Indian Renewable Energy and Development Agency (IREDA) have played an important role in shaping policy and securing resources for wind energy in India. However, they have often faced coordination issues with the State Nodal Agencies (SNAs), mainly in the following: channelizing central government subsidies to Indian states, initiating suitable policies at the state level, executing demonstration projects, carrying out technical and resource assessments and providing assistance to project

developers (Interview 22, Interview 23). The Ministry of New and Renewable Energy has lacked the political, administrative and financial authority to make essential decisions in shaping the future of renewable energy in India. The recommendations of MNRE are not binding to the Ministry of Power (MOP), and it is not mandated to include them in decision-making processes (Newell, Philips & Purohit, 2011; Philips & Newell, 2013). Until 2014, the dominant view within the Government of India was that the wind energy sector had become mature and did not need additional policy and regulatory support. This was remarked by some expert interviewees, as seen below:

"The future development of wind energy in India requires political will and strong legislative backing. " (Wind energy advocate, India)

" *What the planners and thinkers think […] 'you know that wind industry is all useless [....] that these fellows produce power when we do not want; when we want they are not able to produce power.* " (Wind energy association representative, India)

However, this perception has recently changed, and the government launched the National Wind Energy Mission for the long-term development of wind energy in India, with the involvement of all important stakeholders (Ganesan et al., 2014).

Regulatory agencies in India – such as the Central Electricity Regulatory Commission (CERC), the State Electricity Regulatory Commissions (SERC's) and the Forum of Regulators (FOR) – have tried to balance the conflicting interests of consumers, civil society groups, wind turbine manufacturers, energy utilities and other concerned groups by conducting public hearings (Interview 19; Dubash & Rao, 2008). Financially bankrupt energy utilities have been reluctant in investing in transmission and evacuation infrastructure for wind energy, because they have often considered wind energy as unreliable due to its inherent intermittency, or at best, as a backup energy source. Due to their poor financial status, utilities have caused significant financial losses to wind developers by not meeting payment obligations imposed by the state electricity regulatory commission (Interview 24; Interview 25; Jones, 2012).

In particular, the state energy utilities have avoided meeting their Renewable Purchase Obligations (RPO) and the terms of Power Purchase Agreements (PPA) by using their financial burden as a justification. Some interviewees argued that the real problem is not the financial situation of the state energy utilities, but the political interference they suffer from regional political parties, as they have often resorted to populist practices such as vast subsidies for free electricity and the distribution of unmetered agricultural pump sets to farmers during elections (Interview 18; Interview 22; Chaudhary et al., 2014). In a number of cases, the decisions of the regulatory agencies have been challenged by state energy utilities by going to State High Court and to the Appellate Tribunal for Electricity, based in New Delhi. According to some

interviewees, the judiciary as such has also played an important role in resolving disputes between the wind energy stakeholders (Interview, 18; Interview 19).

In the Indian context, lobbying has a negative connotation and does not have a legal status like in other countries. Nevertheless, actors adopt various advocacy measures for shaping decision-making processes (Never, 2012). Wind energy firms and industry associations have generally used five major forms of advocacy: 1) utilizing formal procedures (meeting concerned ministers and policy makers, requesting supportive policies and regulations by writing letters and appeals); 2) presenting detailed clarifications and amendments in existing regulations and policies during public hearings organized by regulatory agencies; 3) discussing critical policy and regulatory issues in public forums; 4) engaging in debates and discussions in roundtable forums and working groups; and 5) raising awareness through media. On the one hand, large wind energy firms in India (such as Suzlon, Vestas India, Gamesa India and Enercon) have appointed dedicated regulatory and policy officers, who keep track of various policies and regulations while advocating for favorable regulations on wind energy, although their efforts are limited to business interests of individual firms. On the other hand, smaller wind energy firms have relied on industry associations for advocating and raising their concerns (Interview 9; Interview 10; Interview 11). Media organizations have played an important role in highlighting the concerns of the industry before the government and policy makers (Interview 26).

Over the years, voluntary wind industry associations – such as the Indian Wind Power Association (IWPA), the Indian Wind Turbine Manufacturers Association (IWTMA) and the Indian Wind Energy Association (InWEA) – have become particularly influential regarding political work in India. These associations are representing the collective interests of the wind industry before policy makers and regulatory agencies (Interview 9; Sovacool & Ratan, 2012). For instance, IWTMA put in dedicated efforts to reintroduce two critical incentives withdrawn by the government in 2012: AD (accelerated depreciation) and GBI (generation-based incentive). The association has systematically disseminated concerns in the media and stressed the need for incentives and for a long-term vision of wind energy in India (Interview 10). To put momentum behind these efforts, in August of 2012 the three industry associations formed the Indian Wind Energy Alliance to collectively represent the interests of the Indian wind industry before policy makers during the MNRE roundtable on wind energy. However, the Wind Independent Power Producer's Association (WIPPA), which was formed in 2013, actively opposed the reintroduction of these support mechanisms and instead argued for an alternative –competitive bidding for wind energy –, also highlighting the need for strictly enforcing renewable purchase obligations (RPOs) (Ramesh, 2013). The lack of collective action among these associations has caused difficulties to national planners, policy makers and regulatory agencies in understanding the common concerns and major barriers of the wind industry in India.

With respect to technical work, India has always had a weaker position when compared to other countries. After series of failures, the Indian government developed a national certification program for wind turbines, learning from international testing and certification standards, in which CWET (Centre for Wind Energy Technology) played an instrumental role (Lewis, 2011). There has been a limited focus on new product development and a lack of adequate investments in R&D by the Indian wind turbine manufacturers, who have mostly relied on foreign technology, placing relatively limited focus on indigenous research and development (Interview 12; Interview 20). Such lack of adequate research and development was highlighted as a concern by one of the expert interviewees:

"*As a developing country our R&D input is for namesake [....]. We are mostly working on foreign ideas, intellectual property rights [.....]. Design, drawings come from elsewhere. Main intelligence comes from elsewhere. We only produce using our cheap engineering labor. That has been the status of development in the wind sector.* "(Wind energy expert, India)
Although India has distinct advantages in terms of its low manufacturing costs of wind turbines, challenges still exist with respect to wind turbine design capabilities in low wind speed conditions, reliance on technological know-how from European manufacturers and overreliance on imported wind turbine components. This results in a lack of indigenous capabilities (Walz & Delgado, 2012; Rai, Schultz & Funkhouser, 2013). In recent years, consultancy organizations have become influential in advising policy makers, government bodies and regulatory agencies in India. These organizations have played a crucial role in carrying out techno-economic studies, providing a research base for decision making, disseminating knowledge through public platforms and publications, as well as advocating for suitable policies and regulations (Interview 13; Interview 14).

With respect to cultural work, the rapid development of wind energy in India also had negative impacts. For instance, the installation of wind turbines affected the livelihood of local people, flora and fauna. Additional concerns include visual and aesthetic impacts on surrounding areas, noise from wind turbines, health impacts and the marginalization of local residents (Gambhir, 2006). Land acquisition for wind energy projects has become a tedious process, which is further escalated by corruption and political influences from rural elites and local political leaders (Ghosh & Sahu, 2011). The procedures for changing the status of land from agriculture, forest and tribal to land that is suitable for wind energy projects have been wearisome, often requiring multiple levels of clearances at different administrative levels, leading to project delays (Bhushan, Hamberg & Agrawal, 2013).

Wind energy project developers in India have largely benefitted from the rapid development of wind energy industry without properly compensating the local communities through meeting the promises of job creation or land revenue. This has sparked tensions and conflicts between wind firms and local communities. The

developers have often not paid adequate attention to the consultation process with the local population, village panchayat, and local Gram-Sabha before initiating wind energy projects. Moreover, the wind industry has suggested loosening the environmental norms even further for environmental impact assessments, arguing that the current norms are not compulsory even for the large-scale coal power plants (Ganesan et al., 2014). On the one hand, developers discuss whether villagers have the adequate expertise and capacity to judge the local impacts of wind energy projects (Singh, 2012; Srinivasan, 2012); on the other hand, developers face unanticipated challenges concerning organized crime, such as the theft of wind turbine components (Tripathy, Bhatia & Parmar, 2013).

Not many civil society groups have exclusively supported wind energy in India. Provisions in the Electricity Act of 2003 allowed civil society members to shape energy policies through cooperative engagement with regulatory agencies; such engagement could be in the form of raising concerns in public hearings or presenting concerns in committees. Civil society groups have pointed to information asymmetry between firms and state government during the feed-in tariff determination process, which could lead to the misuse of public subsidies. These issues were highlighted by expert interviewees:

"*There is some sort of suspicion from the consumers. It is not a transparent process. There is no transparent way land is allocated to wind farm developers. There is no transparency in capital costs [....]. Due to lack of transparency there are doubts over the ways in which wind energy is being promoted.*" (Civil society representative, India)

"*At least there needs to be a competitive bidding process for renewable energy projects [....] so that it will bring out the real costs of renewable energy projects. then in several cases we will start observing that those projects are anyway becoming competitive with conventional projects."* (Civil society representative)

Other issues brought to the public attention by civil society groups include inadequate procedures for monitoring actual performance of wind energy projects, lack of consultation of affected rural and tribal communities during project planning, malpractices associated with land acquisition in rural and forest areas, and rent-seeking practices of wind energy firms (Interview 15; Interview 16; Jamwal & Lakhanpal, 2008). Participatory avenues (such as public hearings, stakeholder forums and working groups) have only created limited opportunities for public input and consultation. This is mainly due to policy makers' and regulatory agencies' lack of serious consideration towards civil societies' views (Nakhooda et al., 2007; Prayas, 2010).

4.5 DISCUSSION AND CONCLUSION

This paper responds to calls for more nuanced approaches to understanding how actors shape institutional arrangements in mature and emerging institutional contexts. In our research. we paid attention to the strategies and actions of heterogeneous actors, by being sensitive to their respective institutional context. Our findings unfold the categories of political, technical and cultural work for the institutionalization of wind

energy in Finland and India. Our empirical analysis also illustrates the interplay between political, technical and cultural work, and accounts for multiplicity of actors, their interests, and conflicts between them, which were otherwise difficult to recognize. The paper finds that: 1) political work to support wind energy in Finland and India has found resistance due to conflicting interests and lack of collective action; 2) Finland has a stronger position than India in technical work due to the significant research and development across the value chain of wind energy technology; 3) in terms of cultural work, the dominant focus of civil and environmental groups in India has been more focused on social justice and equity issues, while in Finland the emphasis has been on planning, environmental concerns and aesthetic issues. In our account, we also show that actors engaged in political and technical work are in contradiction with those engaged in cultural work, thereby leading to conflicts in both contexts. Political and technical work aimed at institutionalizing wind energy have often led to unanticipated impacts that marginalize some actors; this marginalization has further increased the resistance of cultural-work actors against the unanticipated negative impacts and their initiators.

Next, we answer our research question in detail. The key research question we explore in this paper is: *What are the differences in the ways in which actors have collectively engaged in shaping the institutional context for wind energy development in Finland and India?* The paper answers this question by looking at the differences between political, technical and cultural work in Finland and India.

First, our cases show that political work in both countries has been hampered by conflicting interests, incumbent energy actors and the lack of collective action of actors with varied motivations. Finland has a rigorous legal framework defining strict measures and monitoring mechanisms, which sometimes even impedes the development of wind power. Conversely, India lacks thorough enforcement and implementation mechanisms to implement wind power policies and regulations, due to the government's and regulatory agencies' weak political autonomy. In the emerging institutional context of India, with weakly enforced institutional arrangements, uncertain institutional environment political work is focused more on improvisation and adaptive strategies to work within – and challenge – the dominant institutional constraints. Another significant difference lies in the lack of independent wind energy lobbying groups in Finland, and the presence of too many lobbying groups in India, which reduces their collective action and finds limited success with respect to creating supportive institutional conditions for wind energy. Both Finland and India have limited opportunities for public hearings and forums, and consequently, limited opportunities to hear the voices of non-elites and the common public due to the power of political elites and experts.

Second, there are differences in the technical work in both countries. Finland has dominantly focused on creating a wind technology cluster that supports export opportunities, jobs, national income and national competitiveness. Finland recognizes the strategic importance of the domestic wind industry, whereas India has limited

aspirations for global wind energy competitiveness and mostly focuses on large-scale domestic deployment. India has relied on imported wind power technologies and lacked indigenous R&D capabilities. Most wind turbine research in India has focused on low wind speed and low electricity quality in the country. In contrast, Finnish R&D programs have focused on the development of indigenous research on arctic and off-shore conditions. At the same time, the local wind power deployment is still limited in Finland; in contrast, India has not been successful in developing an indigenous wind turbine industry or in creating export opportunities, except for a few prominent firms such as Suzlon. Due to its intermittency and grid integration challenges, wind energy is still considered a 'troublemaker' and as a backup source of energy in India.

Third, there are differences in cultural work. In India, the cultural work has been dominated by civil and environmental groups emphasizing social justice, equity issues, land grabbing, access to clean energy, fair distribution of subsidies and encouraging participatory procedures while setting up wind energy projects. In Finland, the emphasis has been on planning, environmental concerns in coastal and forest regions, landscape constraints and aesthetic issues. Finnish civil society groups have campaigned for wind energy mainly on ideological and environmental grounds, while Indian civil society groups have promoted wind energy on economic and societal grounds, stressing its impacts on ordinary consumers and rural populations. However, civil society groups in both countries have had a limited influence on the actual decision-making processes that deal with wind energy, and face the challenge of moving from mere consultation and participation in public forums organized by government and regulatory agencies to having an actual impact. The differences between the two countries in this research suggest that more reflection is needed on the different challenges and opportunities in institutional entrepreneurship across different geographical contexts.

Finally, this article advances research on institutional entrepreneurship by empirically illustrating differences in institutional strategies in mature and emerging contexts, which has caught only a limited amount of attention from scholars working on institutional entrepreneurship so far. As such, our approach illustrates the differences in institutional entrepreneurship, and explores this through case studies in mature and emerging institutional contexts (Aldrich, 2009; Zald & Lounsbury, 2010). Our study also responded to the debates that institutional entrepreneurship in emerging institutional contexts involves a different set of strategies than mature institutional contexts due to the high levels of uncertainties in these contexts (Philips & Tracey, 2011).

Although existing research has emphasized the role of institutional uncertainty in creating opportunities for strategic change in emerging institutional contexts, our research is slightly critical about such claims. By examining variations across India and Finland in our research, we suggest that both mature and emerging institutional contexts create challenges for institutional entrepreneurship. Furthermore, there are several similarities

in the nature of institutional constraints in both mature and emerging institutional contexts, as highlighted in the study. Therefore, it might not be appropriate to suggest that an emerging institutional context provides more opportunities than a mature institutional context. Hence, our research suggests that there is a need for a deeper look into the claim that emerging contexts provide more opportunities for institutional entrepreneurship. However, we cannot offer a decisive theoretical argument on this complex issue, as making inferences on institutional strategies in different institutional contexts remains challenging.

There are several limitations in our research. We believe that this study has produced important insights about differences in institutional entrepreneurship in mature and emerging institutional context, but the context-specific nature of our findings suggests the need for further research in order to extend the findings. First, our study is a comparative analysis between two specific national contexts in a particular time span, and it is difficult to generalize across other mature and emerging institutional contexts. It is important to acknowledge that our observations are based on interactions based on a limited set of actors in both countries, as it was not possible to map all kinds of linkages between actors engaged in political, technical and cultural work. We did not map how actors implement and modify their strategies in real time, thereby leading to limited insights on their complex decision-making processes. There are inherent limitations to the collected data from the cases studies. Since Finland is relatively behind the most-developed nations in the deployment of wind energy, our study presents relatively fewer primary data inputs on Finland. With continuous deployment and experience with wind power in Finland, further studies will benefit from an increased number of expert interviews, which may provide further first-hand evidence and greater in-depth analysis. While we recognize that there are substantial differences between mature and emerging institutional contexts, our study points to the need for developing typologies of institutional strategies that are generalizable across both mature and emerging institutional contexts.

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Chapter 5

The role of institutional entrepreneurship in the creation of regional solar PV energy markets: Contrasting developments in Gujarat and West Bengal[24]

The role of institutional entrepreneurship in the creation of regional solar PV energy markets: Contrasting developments in Gujarat and West Bengal

Suyash Jolly

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ABSTRACT

With political initiatives such as the National Solar Mission by Government of India, rapid development of grid connected solar PV energy in India has occurred in the recent times. However, an interesting puzzle is with respect to significant regional differences in Indian states despite similar levels of solar radiation, government support and regional level policy and regulatory initiatives in the states. The paper discusses the implementation of grid-connected solar PV in two Indian states – Gujarat and West Bengal – under the national-level program Jawaharlal Nehru National Solar Mission by the government of India. The paper offers empirical insights into implementation barriers involved in regional sustainable energy initiatives by using insights from the institutional entrepreneurship literature. The study concludes by describing the reasons for successful implementation in Gujarat and less successful implementation in West Bengal by discussing regional similarities and differences of institutional entrepreneurship of three key actors: government officials within regional government, regional regulatory agencies and regional industry associations.

Key words: Regional, institutional entrepreneurship, implementation, solar PV, Gujarat, West Bengal

5.1. INTRODUCTION

The purpose of this study is to shed light on regional differences in sustainable energy initiatives at the sub-national level in India. In particular, the paper focuses on differences in implementation of grid connected solar PV energy in Indian states under the Indian National Solar Mission launched in 2009. Existing research has shown that in a large country like India, with diverse economic and political dynamics, the central government has a limited role in affecting the decisions of sub- national governments in influencing sustainability initiatives. Historically, Indian states have had significant differences in economic and industrial growth patterns due to different political, economic and social pre-conditions, pressure from national government and influence of regional political parties and leaders (Sinha, 2003; Sinha, 2005; Beale & Noronha, 2014). Indian states have competed with one another to attract national and international investment through several measures, such as lobbying to the national government for resources, becoming business- and investment-friendly, reducing bureaucracy and providing incentives in order to embark on rapid growth trajectories. While some states have had the ability to develop their own policy mandates by being autonomous and not following the mandates from the central government, other Indian states have relied on the central government for policy direction and political support for their initiatives (Kennedy, Robin & Zamuner, 2013; Sud, 2014a).

In the case of Solar PV, after the launch of the Jawaharlal Nehru National Solar Mission (JNNSM) [under the National Action Plan on Climate Change], the Government of India gradually started framing solar PV as a solution to chronic energy shortages, increasing import dependence on oil, concerns of energy security, energy access and industrialization through the creation of a domestic industry. Before the National Solar Mission, the development of solar PV energy in India was limited to demonstration projects supported by the government, social enterprise models and initiatives by various international organizations (Chaudhary et al., 2014; Quitzow, 2015). Several regional initiatives operating within the framework of the National Solar Mission appeared in Indian states such as Gujarat, Karnataka, Maharashtra, Kerala, Rajasthan, Tamil Nadu and Andhra Pradesh. Due to the concurrent nature of India's energy system, Indian states were also free to devise their own policy and regulatory initiatives, taking into account regional socio-political concerns, availability of adequate solar resources, energy situation in the state and other relevant concerns (Bhushan & Hamberg, 2012).

Thus, Indian states came out with their own policies, regulatory mechanisms and incentives for promoting solar energy. Gujarat continued to be the leading Indian state, with 860.4 MW out of the total installed capacity of 2753 MW in India in 2014. West Bengal was once the leading Indian state with respect to the deployment of solar PV energy. In fact, India's first grid-connected solar PV project was developed and installed in 2009 in Jamuria, Asansol, West Bengal by West Bengal Green Energy Development Corporation Limited, and financed by Power Finance Corporation of

India Ltd. After the announcement of the National Solar Mission in 2010 and the change in the state government (from CPI (M) to All India Trinamool Congress), the growth of grid-connected solar PV energy nearly stagnated in West Bengal between 2009 and 2013, when other Indian states were rapidly deploying solar energy. In 2013, West Bengal only had 7.05 MW of grid-connected solar PV installed, and Gujarat went far ahead in terms of deploying grid -connected solar PV energy (Bhushan & Hamberg, 2012). This leads to the main research question of the paper : *How and why was implementation of grid connected solar PV different in Gujarat than in West Bengal ?*

Several existing studies have looked into the role of a large number of factors influencing regional sustainable energy transitions, such as natural resource endowments in the region, regional income level, structure of electricity markets and consumer profile, political discourses around renewable energy, presence of ideologically motivated citizens and regional economic growth. Other factors include mismatch between consumer demand and available technical potential, access to transmission and grid infrastructure, availability of land, and regulatory and policy instruments initiated by the government (such as renewable purchase obligations, power purchase agreements, feed in tariffs, financial incentives, tax benefits, permitting and planning procedures, etc.) to encourage the development of sustainable energy technologies (e.g., Fischlein et al., 2010; Delmas & Montes-Sancho, 2010; Fergusson & Hill, 2011; Holburn, 2012; Sawhney & Rahul, 2014).

Research in this domain suggests that while indeed a number of broader environmental, social, economic, political and technical factors can lead to significant regional differences in the implementation of sustainable energy programs, public policy plays a crucial role in attracting investment into the regions (Holburn, 2012). Moreover, the success of public policies depends, to a large extent, on the collective action between various regional stakeholders during the implementation of policies and requires coordinated efforts from multiple stakeholders, despite the presence of legal mandates for implementing them (Fremeth & Marcus, 2011). Furthermore, implementation of policies and regulations faces resistance from opposing regional political coalitions and requires continuously adapting policies as a result of ongoing rapid technological changes (Stokes, 2013).

This research question in this chapter is therefore answered using insights from *institutional entrepreneurship literature in regional context*. This is a relevant and recent stream of literature that puts the strategic institutional work of regional collective actors centre stage. Institutional entrepreneurship in regional context focuses on strategic action of actors for shaping regional institutional environment (Sotarauta, 2015). In this paper I suggest that the notion of institutional entrepreneurship is useful for the analysis of regional sustainable energy initiatives and offers insights for empirically examining the differences in regional sustainable energy initiatives. One of the recent insights in the literature is the need for examining the ways by which

institutional entrepreneurship involves improvisation and mobilizing constraints as a basis for shaping regional institutional arrangements. Particularly, in this paper I am interested in examining the strategies of regional actors in stimulating regional sustainable energy initiatives while experiencing setbacks and failures and at the same time challenging dominant institutional arrangements. In answering the key research question, I try to offer insights into institutional entrepreneurship in regional context and reflect on its usefulness for explaining differences in the two Indian states.

This paper is organized as follows. First I discuss the relevant literature on institutional entrepreneurship in regional context in section 5.2. This is followed by describing the research methods used for the study in section 5.3. I then discuss the role of institutional entrepreneurship in the implementation of grid-connected solar PV in Gujarat and West Bengal in section 5.4. Finally, in section 5.5, the paper concludes by answering the research question, discussing relevant empirical insights from the study and relevance for institutional entrepreneurship literature.

5.2. THEORETICAL BACKGROUND: INSTITUTIONAL ENTREPRENEURSHIP IN REGIONAL CONTEXT

Institutional entrepreneurship literature has essentially focused on the manner in which actors can create new institutional arrangements or transform existing ones. Institutional entrepreneurs can be individuals, groups of individuals, organizations and a range of different actors such as commercial entrepreneurs, scientists, regulatory agencies, governments and others who are involved in shaping the development of a new field (Battilana et al., 2009; Kaplan & Murray, 2010). In attempting to change the institutional environment, actors act collectively in order to gain socio-political legitimacy and to drive the institutional transformation process (Wijen & Ansari, 2007; Aldrich, 2011).

Existing literature has shown that institutional entrepreneurship is experimental and iterative in nature and involves considerable time, commitment, imagination and risk-taking behavior from actors, as they need to make continuous decisions about confirming and challenging the institutional environment (Jain & George, 2007). Furthermore, institutional scholars have suggested that institutional entrepreneurship has unintended consequences, and that institutional entrepreneurs who begin challenging institutional structures may not reap the benefits of their efforts, eventually failing in creating changes (Etzion & Ferraro, 2010; Tracey, Philips & Jarvis, 2011). Studies have shown that institutional entrepreneurship involves challenging the institutional environment by improvising solutions through creative efforts and probing the future without having a clear idea of the successes and failures of the initiatives taken (Henfridssson & Yoo, 2013; Gurses & Ozcan, 2014). Furthermore, recent research has shown that institutional entrepreneurship involves actively experimenting and learning while tackling unexpected and unanticipated changes created due to the institutional environment. The process

of institutional entrepreneurship therefore involves an iterative process of learning while confronting ongoing bottlenecks, experiencing uncertainties and simultaneously challenging dominant institutional arrangements (Alvarez et al, 2015; Suddaby et al, 2015).

A recent stream of literature has looked into role of institutional entrepreneurship in the regional context. This literature has focused on examining the manner in which different regional actors influence the course of events and challenge institutional arrangements and illustrate the different strategies used by them (Sotarauta, 2009; Sotarauta & Pulkkinen, 2011). For instance studies have emphasized the role of regional development officers in influencing regional development trajectories by networking and mobilizing political support for regional initiatives (Sotarauta, 2010). A range of studies has even shown that multiple actors (e.g. regional governments, government officials, research institutions, scientists, regulatory agencies, industry associations etc) in regional context use a range of strategies, such as articulating new visions and logics, awareness building, creating new alliances, lobbying, combining new institutional elements with existing local elements, mobilization of resources and creating legitimacy for shaping regional institutional arrangements (e.g., Robinson, Rip & Mangematin, 2007; Ritavala & Kleymann, 2012; Schneiberg, 2013). Other strategies include creating novel opportunities by developing good relationships with local government officials, nominating in political parties, becoming rooted in local contexts and developing harmonious relationships with local people (Cao et al., 2014). Building upon these discussions in the literature, recent studies have indicated that challenging the regional institutional context involves resolving bottlenecks, muddling through a series of decision-making processes about the emergent future, making continuous adjustment in institutional strategies due to surprises caused by changes in the institutional environment and learning through ongoing failures (Sotarauta & Mustikkamäki, 2015; Sotarauta, 2015).

Furthermore scholars have found significant differences in regional development patterns by examining the role of heterogeneous actors (that is, the many actors involved in design, regulation, production, evaluation, use, advocacy, etc.), and have shown that the actions of multiple actors have a significant impact on shaping regional institutional arrangements (Andersen & Drejer, 2008; Garud, Gehman & Giuliani, 2014; Autio et al., 2014). Based on these insights from the existing literature, I focus on examining the strategies of different regional actors in stimulating regional sustainable energy initiatives while experiencing setbacks, failures from the institutional environment and challenging institutional constraints. By answering the key research question (How and why was implementation of grid connected solar PV different in Gujarat than in West Bengal?*)*, I try to offer insights into role of institutional entrepreneurship in shaping regional institutional arrangements and reflect on its usefulness. I now discuss the research method used for the study.

5.3. RESEARCH METHOD

This section describes the research setting – highlighting the historical context of the chosen case studies (Gujarat and West Bengal) – and the data collection and data analysis procedures used to answer the research question. I examine the development of solar PV energy in Gujarat and West Bengal, up to recent developments in 2014. The chosen cases help to answer the key research question as they were pioneer cases in initiating grid-connected solar PV energy in India. Whereas West Bengal was successful in establishing the first grid-connected solar plant in India, it was Gujarat that was responsible for implementing it on a large scale.

This paper uses a qualitative case study approach, as it has advantages regarding collecting rich data on the phenomenon under investigation; additionally, it better captures the experiences of practitioners, in a manner that is also sensitive to contextual details (Langley & Abdallah, 2011; Gioia, Corey & Hamilton, 2013). Qualitative case studies are useful for the collection of variety of data sources such as archival records, official policy documents, reports from consultants, committee papers, media reports, newspaper articles and expert interviews all of which provide data for rich description and analytic generalization. By combining insights from multiple data sources, it is easy to understand the contextual nature of the regional adaptation of national-level mandates and the barriers faced by regional actors in implementing them (Vogel & Henstra, 2015).

In order to collect data for this study, a comprehensive search was carried out by focusing on prior academic articles, policy documents by state governments, position papers by the regulatory agencies, regulatory orders, policy documents, expert studies, newspaper articles and proceedings of public hearings conducted by regulatory agencies (GERC & WBERC – Gujarat Electricity Regulatory Commission and West Bengal Electricity Regulatory Commission). Thus, I gathered all kinds of empirical data through publically available sources on solar PV developments in the states and also gained access to scholarly publications on similar issues. In addition to these data sources, industry publications (such as Bridge to India), reports from solar PV industry associations, documents by Indian solar PV experts, report and blogs by consultants and websites of different stakeholders in the states were also consulted.

To find additional data sources, I used a snowball procedure, in which news articles, new industry reports and blogs were regularly tracked for looking at new developments. For example, I used insights from popular newspapers and media outlets such as Hindu Business Line, Times of India, Economic Times, Business standard and Energy Next to develop an understanding of ongoing debates in the states for solar PV energy. The process of data collection was carried out until no new additional data sources were found that helped in obtaining a rich understanding of the dynamics that unfolded in the states. Additional efforts were made towards looking at distributed action by different actors such as government, regulators, activists, industry associations, firms and users, and the negotiations and contestations between them (Garud & Gehman,

2012). In addition to the archival data sources, semi-structured interviews were also conducted for data collection. For the selection of experts, field research was carried out in Gujarat and West Bengal between July and November of 2013. The experts were chosen in a way that ensured that they covered different positions in the industry and that they provided both an insider and an outsider perspective on policy and regulatory implementation processes. Among the experts interviewed, a few were directly involved in the policy and regulatory process while others had experience in directly observing the developments in different capacities (see Table 5.1 for interviewees' details).

Table 5.1: Details of interviewees in Gujarat and West Bengal

Number	Interviewee	Stakeholder category
1	Principal secretary, Energy Department, Government of Gujarat, Gandhinagar	Policy maker/ Government
2	Member, Finance, Gujarat State Electricity Regulatory Commission, Gandhinagar	Regulatory agency
3	Research Scientist, Gujarat Energy Research Management Institute, Gandhinagar	Academic scientist
4	President, Solar Association of Gujarat, Ahmedabad	Industry association
5	Head, Consumer Education and Research Society, Ahmedabad	Civil society
6	Director, Movya consulting, Ahmedabad	Consultancy organization
7	Senior Executive Projects, Gujarat Petrochemical Corporation Limited, Gandhinagar	State energy utility
8	Past Principal Secretary, Energy Department, Government of West Bengal, Kolkatta	Policy maker/ Government
9	Past Director, West Bengal Renewable Energy Development Agency, Kolkatta	Policy maker/ Government/ Independent renewable energy expert
10	Director, West Bengal Renewable Energy Development Agency and West Bengal Green Energy Development Corporation Limited, Kolkatta	Policy maker/ Government
11	Adviser Engineering, West Bengal Electricity Regulatory Commission, Kolkatta	Regulatory agency
12	Regional Manager, East India, European Business Technology Center, Kolkatta	Knowledge transfer organization
13	Center head, CUTS Kolkatta resource center, Kolkatta	Civil society

The semi-structured interviews were conducted with expert interviewees and lasted between 30 minutes and two hours. The interviews were customized to fit the background and expertise of the concerned stakeholder; nonetheless, they also followed a general guideline in many instances. The interviews focused on understanding the policy and regulatory processes from the interviewees' perspective, important barriers faced by them, their role in the implementation of grid-connected solar PV energy and the key learning points from their experiences so far. I focused on mapping the key institutional barriers faced by them and the different strategies used by interviewees to overcome them, as well as the successes and failures of their initiatives. The interviewees were also asked to reflect on how they dealt with multiple and conflicting interests with other stakeholders. All interviewees were given ample space to express their own experiences and assessments of ongoing developments based on their personal experiences. In a few instances, interviews were not recorded if the interviewees were not comfortable with it due to reasons of confidentiality. In these particular cases, interview accounts were summarized by making notes instead of tape-recording them. As it was not possible to record all interviews, I could only rely on a few interviews for rich quotes from the interviewees. In addition to the semi-structured interviews, observations were also made at two stakeholder forums organized by the Centre for Science and Environment in Gandhinagar and by the CUTS resource center in Kolkatta. The combination of multiple data sources such as interviews, secondary data and observations offered different perspectives on key actors and events, and helped in obtaining a rich understanding of the developments in the two Indian states.

The initial analysis of the summarized data was mainly descriptive, involving selective quotes from the interviewees as well as secondary documents capturing the actions of different regional actors. For the data analysis, a qualitative content analysis of the summarized data was carried out for describing a theoretically informed account sensitive to the regional institutional context. The analysis was performed manually, by reading the summarized data and then identifying relevant differences in strategies of regional actors in implementation of grid connected solar PV energy. While analyzing the action of different regional actors, care was taken to focus on role of different actors and strategies used by them for resolving locally specific institutional bottlenecks (Rodríguez-Pose, 2013). The focus was on understanding the distributed actions of different actors such as regional government agencies, regulatory agencies, industry associations in shaping regional institutional arrangements by paying equal attention to successful as well as less successful efforts (Karnøe & Garud, 2012).

The data analysis revealed crucial role of three key regional actors which shaped differences in implementation of grid connected solar PV energy in steering regional sustainable energy initiatives in the two case studies: (1) government officials within regional government; (2) regional regulatory agencies and (3) regional industry associations. The findings section discusses solar PV energy deployment in the two

Indian states of Gujarat and West Bengal focusing on similarities and differences in the institutional work of these three actors.

5.4. FINDINGS

5.4.1. Role of regional government officials

The case of Gujarat

The chief minister of Gujarat, Narendra Modi, became interested in solar energy due to the tremendous potential of solar PV energy and available natural resource conditions in Gujarat. His intent to promote solar PV energy was also due to his commitment towards climate change as well as to resolve energy crises in the state. Through his strong social and political skills, Narendra Modi used his public speeches to highlight Gujarat's achievements as an Indian state committed to addressing climate change issues; additionally, he dedicated significant budgets for the deployment of renewable energy in the state. These public speeches and stories helped to legitimize the potential of solar PV in Gujarat and attempted to mobilize stakeholder support, create credibility and develop a regional investment-friendly identity in order to attract investors. In one of his public speeches he remarked

" When *we started the price per unit was 15 rupees, today it came down to 8.5 rupees. This is the greatest contribution to India also. Now even other states will be able to take risk and initiative because they will count that now slowly how cheap the solar power can be. This is the greatest contribution of Gujarat to our great country [....]. Today Gujarat will show the rest of the world in solar energy [....]. Still the Gujarat government is spending huge amount on renewable energy, more than 2000 crores rupees per year. We are doing this mainly to contribute against the war against global warming and global climate change. We have a long term vision and want to leave green footprint in whatever we do* [...] " (Narendra Modi)

In order to implement his vision, Narendra Modi – along with Minister of Energy and Petrochemical Department Saurabh, Bhai Patel, and Principal Secretary, Energy Department D.J. Pandian – collectively showed visionary leadership and execution capabilities for implementing grid-connected solar PV energy in Gujarat (Interview 1; Interview 6). This vision was translated into the Gujarat Solar Power Policy, which came out in January of 2009, before the announcement of the National Solar Mission by the Government of India. Gujarat Energy Development Agency (GEDA) and Gujarat Petrochemical Energy Limited (GPCL) were designated as relevant nodal agencies for the Gujarat solar policy (GEDA, 2009). The policy was aimed at large-scale deployment of grid-connected solar PV, promoting R&D and local manufacturing, reducing the negative impact of climate change and creating local employment opportunities (Interview 1). The Gujarat policy had several features of a lucrative policy for investors in terms of assured high returns (preferential fixed tariff), instead of the reverse bidding process used in the National Solar Mission and other Indian states for determining price for solar PV energy (Interview 4; Interview 6). An important

aspect of the Gujarat solar policy was that it did not mandate the use of crystalline solar PV modules as suggested in the guidelines of the National Solar mission. The policy was technologically neutral, which enabled project developers to access low-cost solar PV modules internationally and complete projects faster. Most developers preferred thin film technology supplied from First Solar (US) due to its performance and the cheap availability of low-cost finance from the US Exim Bank (Project development handbook, Bridge to India, 2012; RESolve Energy Consultants, 2013).

The Gujarat government received tremendous responses to its solar policy from various project developers and investors due to the attractive feed in tariffs, higher return on investment, good financial position of the utilities and availability of transmission and evacuation infrastructure through GETCO (Gujarat Energy Transmission Corporation) and Gujarat State Load Dispatch Centre (SLDC) (Bhushan & Hamberg, 2012; Kasture et al., 2013; RESolve Energy Consultants, 2013). In order to attract potential investors, the guidelines for the completion of solar PV projects were not strict in the beginning of the policy implementation. However, depending on the progress and real-time experiences, the conditions for project completion were made stricter over time, including, for instance, penalties for delays in project execution (Interview 1; Interview 6; Yenneti, 2014). As remarked by one of the interviewees

" The government of Gujarat did not stop at making the policy. They further went to take proactive action. The government of Gujarat agencies like GEDA, GUVNL, GPCL, GETCO all of them gave excellent cooperation to the developers unlike what people face elsewhere in the country." (Interview 4).

Over the years, Gujarat has emerged as an attractive destination for private investment by creating a business-friendly policy environment (Murali, 2010). Measures taken under the leadership of past chief ministers and Narendra Modi helped to reduce bureaucratic bottlenecks for private investment, also simplifying procedures for setting up industries, creating single-window mechanisms for investors, facilitating faster allocation of land for projects and creating new infrastructure (Dholakia, 2002; Roy, 2011; Debroy, 2012). Another significant reason for the business-friendly environment in Gujarat has been related to limited political interference in government bureaucrats attracting private investments and facilitating projects in the state (Sud, 2014a; Sud, 2014b). The Vibrant Gujarat (VGGIS: Vibrant Gujarat Global Investors Summit), organized by the Government of Gujarat, promoted the state as an investment-friendly destination among national and international investors, leading to greater investment for solar PV projects. The Vibrant summits conducted by the Government of Gujarat provided opportunities for developing a future roadmap for sustainable energy development in the state.

These events were useful in promoting solar PV energy through workshops and networking sessions between various industry members, providing platforms for the latest technological trends and sharing knowledge about best practices. In addition

to the Vibrant Gujarat summit, the India Solar Investment and Technology Summit held in Gandhinagar helped to stimulate linkages between different PV manufacturers, solar PV project developers, equipment suppliers, government officials, consultancies, investors and policy makers, also highlighting emerging opportunities and critical challenges the industry would face. Networking sessions in the summit played an important role in facilitating joint ventures, mergers and acquisitions, as well as providing access to relevant finance knowledge due to the presence of several international firms and investors (Indian Solar, 2013). These events played a critical role in stimulating interactive learning between heterogeneous actors and even provided platforms for policy initiatives. In addition, such events provided opportunities for actors to gain specific tacit knowledge, learn about new technological trends, build trust and develop new relationships. These multiple events, organized by multiple bodies and involving heterogeneous stakeholders, stimulated regional collective action in Gujarat. Moreover, the summit created opportunities for government officials from other Indian states to learn from Gujarat's experiences and apply some lessons to their respective states.

A state-level selection committee was created to scrutinize project proposals from developers, based on their financial and technical capabilities and past track record in developing solar PV projects. The Energy and Petrochemical Department also demanded financial guarantees from project developers for the allotment of projects (Interview 1; Interview 6). Government bureaucrats such as D.J. Pandian, the Principal Secretary of the Energy and Petrochemical Department, Government of Gujarat, played an instrumental part in implementing the Gujarat Solar Policy through his personal commitment and motivation. He remarks on the initiatives taken by him for mobilizing finance for implementation of grid connected solar PV in Gujarat despite facing several constraints

"*I was fully personally involved, committed. Because I worked in the World Bank, so I knew some officials there. I knew IFC. I used all my diplomatic skills [...]. It is talking, convincing them [....]. I understand the language of international bankers [....]. It took more than a year [...]. It is an individual officer's commitment supported by government policies and government support. If the government is not supportive, we do not want solar, it is very costly, and then my skills are of no use. Or if the government is ready to support and if the officers do not take it forward, then also it is a failure. It is both administrative skills and political will both together [....]. I created the solar park in record time, I took the land, I developed the land, I put up the evacuation system. Then I called review meetings with developers and I understood their problems [...]. Then I talk to collectors, I wrote to all the collectors. I personally monitored everything.*" (Interview 1)

He also remarks on the initiatives taken by him for mobilizing finance by drawing on international linkages and support from global financial institutions

"The developers after getting the LOI (Letter of intention) were reluctant to sign power purchase agreements (PPA). I called a meeting of all the bankers. They said no one body is

financing. Solar was not financeable. It is a risky item [....]. I arranged two three round table conferences of various bankers [....]. I went to Washington, I talked to World Bank, I talked to US Exim Bank, I talked to IFC, I went to Philippines, I went to ADB. I met all these international bankers. It is a dialogue process. Then they are also convinced. They see our commitment that the Government of Gujarat is committed to buy this power and to go ahead in solar. They prepared some PPA. Then some international legal experts came. They wanted to change certain clauses. We amended. So we made a robust bankable PPA (Power Purchase agreement) [....]. " (Interview 1)

The actions of the head of the energy department were also supported by the Gujarat state government. This was possible because government bureaucrats in Gujarat faced limited political interference in allocating land for projects, issuing licenses and facilitating corporate investment, developing international linkages and facilitating private investment in the state (Sud, 2014a; Sud, 2014b). Over the years, Gujarat became popular for its business friendly nature. As remarked by one of the interviewees

" *People are efficient here [....]. See what happens in other states, the Minister is not ready to take any decision, because if he takes a decision, he might go against his popularity, so people are afraid to take a decision. Here whoever is the minister is not afraid for taking a decision because they are not doing anything illegal. See in other states doing even legitimate things, they have to wait, they don't take decisions [....]. Here it does not happen like that [....]. They have a cabinet meeting [....] C.M. meets with all the ministers and all the principal secretaries are always there. So all the questions are raised there [....]. The bureaucracy is very fast here, very fast.*" (Interview 6)

Through the efforts of principal energy secretary, the Government of Gujarat was able to mobilize international linkages for accessing external knowledge, expertise and financial resources through organizations such as IFC (International Finance Corporation) and ADB (Asian Development Bank). The principal energy secretary played an instrumental role in resolving ongoing problems and bottlenecks for the implementation of the policy by organizing several forums (for example, forums including bankers and entrepreneurs) and committee meetings, monitoring progress and finding solutions to ongoing issues and challenges faced by project developers (Interview 1).

The case of West Bengal

In comparison to Gujarat which was ruled by the BJP (Bhartiya Janta Party), West Bengal had a different socio-political background: between 1977 and 2011, West Bengal was ruled by CPI (M) (i.e. Communist Party of India (Marxist)), which won consecutive assembly elections due to its pro-poor regulations and political priorities for rural masses in the state. The Communist Party of India (Marxist) (CPM) maintained its dominance over the state and controlled all social affairs until the mid-90s. By being concerned about reducing investments in the state, CPI (M) feared that it had to change its focus

on industrial growth and development and create conditions conducive to private investment (Ray, 2011; Chakravarthy & Bose, 2011; Das, 2013). The government of West Bengal took initiatives for improving its investment-friendly identity by setting up government-industry coordination committees and organizing partnership summits to facilitate private investment in the state. After the rule of CPI (M) leaders such as Jyoti Basu and Bhuddhadev Bhattacharyya, the new government shifted to the hands of Mamta Banerjee, from the Trinamool Congress, in 2011. The new government tried to change its image from the older CPI (M) regime, in which slow industrial growth was quite common; it started reforms with setting single-window clearance mechanisms for attracting industry and reducing inefficiencies in administrative procedures (Sud, 2014 b).

During the 1980s and 1990s, Chief Minister Jyoti Basu politically supported Dr. Gon Chaudhari in developing solar energy in West Bengal. Since the late 1980s, Dr. S.P. Gon Chaudhari was at the forefront of promoting solar PV energy in West Bengal,. In fact, he was among the first in India to develop solar energy solutions, conducting work in the Indian state of Tripura. He was also instrumental in developing knowledge about technical specifications and regulations regarding solar energy in India, by developing small-scale solar solutions such as solar pumps, solar lanterns and solar mini-grids. Dr. S.P. Gon Chaudhari advocated the use of solar energy to various ministries and planning commission in India. Based on his field experiences, the government of India started remote village electrification programs. Dr. Gon Chaudhari then took charge of the West Bengal Renewable Energy Development Agency (WBREDA) and became the face of renewable energy in West Bengal through his dynamic leadership (Interview 9). Dr. Gon Chaudhari became an instrumental advocate for solar PV energy in West Bengal, influencing government policies and regulations in the state (Harrison & Kostka, 2012). He also remarks on the initiatives taken by him

" In 2009 I commissioned the first 2 MW plant. 2 MW plant commissioning grid-connected means regulation, rules. It is 2 MW, 11000 V supply system, nobody thought. It was so difficult for me to make the first tender of the country for a grid-connected system […]. Now everything is common. Nobody knows how I struggled for developing the main tender document for the grid-connected system, regulations, the safety, security." (Interview 9).

Under his leadership, WBREDA gained considerable experience in setting up solar mini-grids and solar hybrid mini-grid projects in different villages in Sunderbans between 1996 and 2010. The West Bengal Renewable Energy Development Agency took care of negotiating with local leaders and villagers, setting the tariffs with mutual consultation with local villagers, holding information meetings, channeling subsidies and carrying out surveys, maintenance and inspection of the systems. These initiatives also resulted in the installation of India's first solar mini-grid system (Ulsrud et al., 2011). Over the years, WBREDA was successful in implementing the largest number of off-grid solar programs in India (Interview 10). The idea of setting up the first MW

grid-connected solar PV project was formulated by Dr. S.P. Gon Chaudhari, who was also instrumental in setting up the first grid-connected solar PV project in India. As remarked by Dr. S.P. Gon Chaudhary

"*West Bengal was the only state where you know really I was doing this photovoltaic program in a serious manner, and I realized that this was a potential area. That was the reason that West Bengal became a model in the country in the 1990s (1993 onwards) and it continued up to 2009–2010, almost for 15 years. By the time other states, also seen, learn [....]. The main point is Gujarat was lagging at that time [....]. Gujarat is leading in grid-connected, off-grid is still West Bengal is highest in the country [....]. West Bengal was really giving the ideas, the concepts everything. During that period maybe all the other states were learning how West Bengal is doing that.* '' (Interview 9)

Dr. S.P. Gon Chaudhary also remarks on other initiatives taken by him for promoting grid connected solar PV in the West Bengal.

" As managing director of the corporation, I executed India's first MW-level solar PV project and connected the same with DVC grid in September, 2009. I also solarized the first Rajbhavan of the country in Kolkata with a grid-connected solar PV power plant which was inaugurated by President Pratibha Patil in 2010. A solar farm (40 MW) in the Purulia district of West Bengal was also initiated by me. WBGEDCL prepared the Solar Energy Vision Plan of ONGC under my leadership. The Energy Infrastructure Plan of Sundarbans was also prepared under my leadership with funding from the World Bank. During my tenure in the Ministry of Power, the Indian government sanctioned a major DDG project for Sundarbans with a new concept, which is currently under execution." (S.P. Gon Chaudhari, Energy Next)

This project was difficult to execute due to lack of awareness of solar energy during that time in India, in addition to a lack of past experiences in setting tariffs and power purchase agreements, financing, operation and maintenance. The project was successful in demonstrating that large-scale grid-connected solar PV projects were possible in India (Interview 9; Gon Chaudhari, 2008). Although Dr. S.P Gon Chaudhary took several measures to promote grid-connected solar PV energy in West Bengal, the momentum was lost after his retirement in 2010, which led to a void in terms of creating political space for solar PV energy in the state. These issues are highlighted by a news expert

"*According to experts, what is unfortunate is the fact that other states followed the model that was first introduced in Bengal and went ahead to promote solar power. But due to the lack of a policy and proper initiative, West Bengal gradually fell behind. The picture, however, could have been different if the government had carried forward the initiatives that were taken a long time back. It was in Bankura way back in 1992 that the country's first off-grid solar power plant was installed. The country launched a national program based on the concept.*" (Chakraborti, 2015)

Administrative problems occurred in WBREDA and the organization lost its innovative capabilities to further develop solar initiatives in West Bengal (Interview 9). After the first grid-connected project in Asansol, several project proposals came out in places such as Durgapur and Purulia, but none of the proposals materialized. The state lost investment opportunities from firms such as Astonfield Renewable Resources, Videocon and Reliance Power for grid-connected solar energy projects, which resulted in a further decline in investment plans for grid-connected solar PV projects in the state; subsequent efforts to improve the situation were not well received by the state government or by the MNRE (Ministry of New and Renewable Energy) (Bhushan & Hamberg, 2012).

Differences between Gujarat and West Bengal

These differences between Gujarat and West Bengal suggest that regional government officers working in regional governments are crucial, as they mobilize support for legitimizing the sustainable energy transition due to their personal interest and motivations or due to a consideration for larger public interest and regional benefits. Motivated individuals within the state government – such as D.J. Pandian and Dr. S.P. Gon Chaudhary – worked towards implementing solar PV despite institutional constraints and ongoing uncertainties; they did so because of their high level of personal motivation and commitment towards mainstreaming solar PV energy. In the case of Gujarat, D.J. Pandian occupied a key social position in terms of formal authority and political resources, and employed several tactics to act on emergent opportunities. His position in the state government enabled him to coordinate the actions of different actors, broker information and mobilize political support with the state's chief minister and other bureaucrats for implementing solar PV in Gujarat. His efforts were adequately supported by the state government, which gave him ample political support for his initiatives without creating bureaucratic constraints.

In West Bengal, however, despite the motivated efforts and vast experience of Dr. S.P. Gon Chaudhary, the state lost momentum after his retirement, as his efforts were not collectively supported by the state government or by related government agencies, resulting in limited implementation of grid-connected solar PV in the state. While the efforts of D.J. Pandian were adequately supported by the state government and other agencies, it was difficult for this kind of collective action to take place in West Bengal. It is important to realize that motivated government officers within a regional government engaging in institutional entrepreneurship and the role of regional government are equally important and both are necessary for successful implementation and complement each other.

5.4.2 Role of regional regulatory agencies

The case of Gujarat

The Gujarat Electricity Regulatory Commission (GERC) took initiatives in becoming the first regulatory commission in India to develop a regulatory tariff order specific to solar PV energy through its regulatory orders (GERC, 2009). The commission used several measures for making the process of determining the feed in tariffs transparent, such as producing a discussion paper and inviting comments from different stakeholders, posting position papers on websites, conducting public hearings and carrying out brainstorming sessions with experts. Through a new regulatory order based on the latest technological trends, GERC updated the tariffs (GERC, 2010; GERC, 2012); moreover, it took a different approach while setting tariffs for solar PV energy and did not follow the competitive bidding approach or the reverse auction approach that was used in the National Solar Mission and followed by other Indian states. This different approach focused on a generic, levelized tariff based on the cost-plus approach of tariff determination (Interview 2; Altenburg & Engelmeir, 2013). The different approach taken by the regulatory agency in Gujarat proved to be successful. As remarked by one of the interviewees

" There was no bidding in Gujarat [....]. If they would have done bidding nobody would have come at all [....]. Nobody was interested [....]. See you are adding complexity. There is no market place, there is no industry, you are trying to put up the industry, now you put competitiveness, it is not possible. Any industry or technology to speed up has to come up without regulations. It should come simple like what happened in Gujarat [....]. In the first place, you cannot do regulation you have to open up [....]. " (Interview 6)

Unlike the National Solar Mission where a reverse bidding process was followed, GERC used a fixed, levelized feed in tariff (that is, the average of a fixed amount for the first 12 years and a lower amount for the last 13 years). As mentioned in the commission's regulatory order

" The Commission unveiled attractive tariffs levelized at 12.54 and 9.29 per kWh for solar photovoltaic and solar thermal projects, respectively, for 25 years. GERC further divided these tariffs for two sub-periods for the first 12 and the subsequent 13 years as follows: 15 per kWh for the first 12 years and 5 per kWh for the next 13 years for solar photovoltaic projects. This tariff is a single-part, generic levelized tariff determined on a cost-plus basis." (as directly quoted in GERC tariff order, 2012)

This approach was created in order to bring more clarity for investors and reduce risks due to excessive bidding from inexperienced project developers that would result in poor-quality projects (Interview, India solar handbook, Bridge to India, 2012; Bridge to India, 2012). The Gujarat Electricity Regulatory Commission (GERC) instituted mechanisms for regular interaction and learning and strong information sharing by conducting regular regulatory hearings and meetings with the state advisory committee, along with coordinating forums with different stakeholders in the state. This was carried

out by consultation with a variety of stakeholders in order to obtain a multitude of views during public hearings. These forums provided opportunities for various stakeholders to meet and interact on critical issues such as the setting of feed in tariffs through a consultative process by considering the views of different stakeholders, monitoring renewable purchase obligations (RPO's) and discussing guidelines for power purchase agreements. Discussions in these forums also helped to resolve ongoing regulatory issues, assess the impact of changing technological developments and modify regulations based on ongoing technological developments (Interview 2).

The Gujarat Electricity Regulatory Commission was adequately supported by research and academic institutions – such as Pandit Deen Dayal Petroleum University (PDPU) and Gujarat Energy Management Institute (GERMI) – in reducing problems associated with inadequate and asymmetric information while determining the feed in tariffs (Interview 3). The commission re-determined the feed in tariffs in subsequent years; the new tariffs were lower than the previous ones, based on ongoing technological developments in solar PV (GERC, 2010; GERC, 2012). The tariffs were re-determined by carefully balancing the tension between investor stability concerns and the impact of tariffs on consumers based both on practical experience and regular consultations with different stakeholders (Interview 2). The Gujarat Electricity Regulatory Commission took strict measures for commissioning projects, such as imposing strict financial penalties on projects for missing the deadlines and even rejecting petitions for deadline extensions (Bhushan & Hamberg, 2012; Altenburg & Engelmeier, 2013).

Civil society organizations in Gujarat – such as Consumer Education Research Society (CERS) – were critical about the impact of solar energy prices on consumers in the state and about the windfall benefits being given to project developers without much scrutiny (Interview 5). Subsequently, a controversy emerged in the state when Gujarat Urja Vikas Nigam Ltd (GUVNL) filed a petition for a reduction in the levelized tariff set by the Gujarat Electricity Regulatory Commission (GERC); GUVNL had an opinion that the feed in tariff set by GERC did not account for actual project development costs, and that it was giving unnecessary profits to project developers. It also claimed that the developers supplied the high capital costs of solar PV plants while submitting their comments during the public hearing by GERC, but ultimately carried out the projects at much lower costs. Because the extra costs would ultimately burden the consumers in the state as well as its limited budget support for a costly solar PV energy, GUVNL requested GERC to reduce the tariffs (GERC, 2013).

In response to the claim by GUVNL, the project developers claimed that the project costs assumed by GERC during the tariff determination process was based on past installations in India, and the decrease in the cost of solar PV equipment was taken into account during the process. Moreover, the tariff set was lower than the tariffs determined by the reverse bidding mechanism used in the National Solar Mission in 2010. The project developers responded that the Government of Gujarat should have

allocated enough budget for solar PV energy in Gujarat to fulfill obligations, as laid out in power purchase agreement. They felt that a retrospective cut in feed in tariffs would affect future solar investments in the state and lead to a loss of investor confidence (Interview 2; Interview 6). Accordingly, GERC dismissed GUVNL's petition on several reasons. The main argument used by GERC for dismissing the petition was that the petition had been filed three years after the release of GERC's regulatory order, and that according to regulation 72(3) of the GERC (Conduct of Business) Regulations, 2004, the time allowed for such petitions was generally 60 days from the release of the order. GERC felt that the petition was based on financial and technical data from only a few project developers, and therefore did not represent project development concerns from all project developers (Interview 2).

In its argument, GERC also suggested that the power purchase agreements were signed by GUVNL, which implicates considering the impact of the tariffs on consumers in the state. In other words, GUVNL must have thought about the necessary impact on its finances while signing the power purchase agreements. GERC felt that, renegotiating the agreements might hamper investors' trust in the government of Gujarat. The commission suggested that a retrospective cut in tariffs would adversely affect future investments and create a negative perception about the rights of investors in the state. Instead, GERC suggested that it did not have the regulatory and legal power to reopen the terms of the power purchase agreement and re-determine the feed in tariff (GERC, 2013). GERC dismissed the petition, but suggested that GUVNL appeal to the Appellate Tribunal for Electricity (APTEL) for reconsideration of the case, which indeed it did.

This issue brought considerable uncertainty about the future of solar investors in Gujarat. Consequently, GUVNL resisted future solar policy initiatives, fearing becoming unprofitable and further burdening the consumers in Gujarat. The state energy utilities felt that they had little incentive in buying costly solar energy beyond the Renewable Purchase Obligations as stipulated by GERC (India solar handbook, Bridge to India, 2013; Interview 6). Due to limited mechanisms for selling excess grid-connected solar PV energy outside Gujarat and legal limitations for selling bundled solar energy with thermal energy, as done in JNNSM, the Government of Gujarat started exploring new business models apart from earlier initiatives such as grid-connected solar plants, solar parks, canal-top PV, and others (Interview 1; Interview 7). Despite this change of pace due to the conflict over retrospective cuts, Gujarat was still successful in seizing emerging opportunities and transforming itself into an international hub for the large-scale deployment of grid-connected solar PV energy in a relatively short period of time.

The case of West Bengal

The West Bengal Electricity Regulatory Commission (WBERC) was careful about the impact of solar PV energy on the finances of distribution utilities as well as about the eventual impact on consumers in the state. Therefore, it ordered that the procurement

of solar energy should not increase the average cost to consumers in the state by a certain margin (Interview 11). The tariff order of WBERC clearly showed the regulatory commission's intention to protect the interests of the state energy utilities and to reduce the impact of purchasing solar energy on consumer prices, rather than supporting the interests of solar energy investors (Interview 11). The regulatory commission's order stated

" The price for the purchase of electricity from cogeneration and/or renewable sources shall be agreed mutually by the licensees and the suppliers at a level not above the price cap indicated by the Commission in these regulations [.....]. The PPA will become effective only after getting the approval. However, the licensee shall not decline to purchase energy from such sources within the specified capped price as per these regulations from the existing units which have already covered the validity period of the capped price as was indicated in the earlier Regulations of the Commission until the minimum target RPO is achieved each year provided that connectivity and all other conditions are consistent with these regulations. Notwithstanding anything contained contrary to any other regulations, the solar power shall be purchased through competitive bidding only." (as directly quoted in WBERC Tariff order, 2013)

Due to the low interest from project developers in West Bengal for grid-connected solar PV projects, WBERC set moderate solar purchase obligations, as it felt that setting excessively high obligations would result in a limited number of prospective project developers selling solar PV energy to the distribution utilities in the state (Interview 11; WBERC, 2013). Lack of regulatory enforcement in West Bengal was a major concern. As remarked by one of the interviewees

" The role of a regulator is enforcing, that they are not doing [....]. Nothing will happen. CESC knows nothing will happen. DVC knows nothing will happen. WBSEB knows nothing will happen. Those people who want to invest in solar, they sit outside the room of the directors, and they beg but they don't get any good positive response. They go away, there is no investment." (Interview 9)

The commission did not adequately enforce regulations, and did not create an investment-friendly regulatory environment conducive for project developers to sell their power to distribution licensees in the state. As remarked by one of the interviewees, WBERC was conservative in its measures, as it followed guidelines from the central government under JNSNM in order to reduce rent-seeking activities and financial burdens on state-distribution utilities. However, the commission ignored the interests of investors, which reduced the interest of project developers in setting up grid-connected PV projects in West Bengal. Only a few public hearings were organized by WBERC in order to consider the views of different stakeholders regarding tariff determination, thereby limiting stakeholder interaction (Interview 11). The Department of Power and Non-conventional Energy Resources in West Bengal felt that an urgent approach to deploy large-scale grid-connected solar PV might bankrupt the energy utilities in the

state, as the cost of setting up solar PV plants was continuously decreasing over the years due to grid parity. The Department felt that a slow and steady approach would be better in the long run (Interview 8).

Differences between Gujarat and West Bengal

Despite political pressures, GERC (Gujarat Electricity Regulatory Commission) supported solar PV in Gujarat by acting autonomously from the regional state government, without being influenced by their political decisions, acting on windows of opportunity and creating an ambitious tariff design to attract investors. The commission used adequate strategies that included designing tariffs that offered higher remuneration in the early years for ensuring predictable cash flow, setting tariffs that took into account rapid technological changes and obtaining input from a regional university in this regard, helping investors repay their loans at an early stage and reducing investment risks. GERC was also successful in following administrative procedures such as conducting public hearings for setting tariffs and drafting regulations, allowing different stakeholders to present their comments on draft regulatory documents, listening to the concerns of stakeholders and providing stable regulatory guidelines despite the high cost of solar PV. Furthermore, GERC did not succumb to pressure when a petition was filed by the state energy utility GUVNL for reducing the feed in tariffs due to the high cost for consumers. Instead, GERC maintained regulatory support and looked at the long-term interests of project developers and investors. On the other hand, WBERC did not successfully manage to balance multiple trade-offs and did not reduce risks for solar PV investors, as it took a wait-and-see approach for solar PV costs to further decrease before implementing solar PV on a large scale. While the regulatory agency and the state energy department were confident about the potential of solar PV in meeting future energy needs, they created uncertainty by suggesting that they were not ready for a large-scale investment due to its significant financial impact.

Contrary to the approach taken by GERC, WBERC was conservative, as it followed guidelines from the central government under JNSNM for promoting solar PV energy and devising complex procedures for incentivizing project developers and investors. The regulatory agency in West Bengal issued regulatory orders for grid-connected solar PV energy in West Bengal; however, it failed to devise processes for implementing them. It also continued to support the incumbent energy utilities, by mobilizing arguments such as uncertainty about the rapidly decreasing solar PV prices and the cost pressure on utilities and its eventual impact on consumer prices. These insights suggest that the role of regulatory agencies is complex and can vary considerably. Regulatory agencies like GERC played a critical role in facilitating investors by working around political and economic constraints imposed by the state energy utilities while WBERC was less successful in doing so.

5.4.3 Role of regional industry association

The case of Gujarat

The government of Gujarat was aware of the possibility of inexperienced investors – with no prior expertise and motivated by profits – rushing in and misusing the government subsidies. The government took proactive measures by designing adequate mechanisms for monitoring projects and assisting the developers with constraints, along with setting strict measures regarding failure to finish projects on time (Interview 1; Interview 6). In spite of these measures by the state government and nodal agencies, project developers still faced several constraints.

The financing of projects was a major challenge, as banking and financial institutions did not had adequate data (and expertise?) to verify the claims made by project developers; distribution utilities were also considered risky due to their poor financial performance (Dasgupta & Syiem, 2010; Project development handbook, Bridge to India, 2012). Although the nodal agency GEDA was responsible for obtaining clearances for developers, project developers still had to negotiate with many government departments for obtaining all the necessary clearances for their projects. For example, project developers in Gujarat faced several problems, such as approvals and clearances from multiple agencies, lack of access to project sites, infrastructure problems and floods on project sites. Another important reason for delays was that many project developers delayed their projects to benefit from rapidly reducing prices of solar PV equipment. This did not prove to be a good strategy, as it resulted in delays in the completion of projects (Bhushan & Hamberg, 2012; Mehta, 2013; Interview 6).

These bottlenecks concerning the implementation of projects were resolved by the Solar Association of Gujarat, who helped in creating a collective action between disorganized solar PV project developers, manufacturers, EPC contractors, service providers in Gujarat and both small- and large-scale companies. The association organized several group meetings between project developers and financing institutions, sponsored multiple educational seminars and carried out many studies and surveys on behalf of project developers; additionally, through arranging group meetings, preparing reports, setting up forums and offering expert advice, the association collectively mobilized project developers and investors in the state and helped them resolve ongoing policy and regulatory issues, obtaining clearances from government agencies and helping project implementation. As remarked by one of the interviewees who was instrumental in starting the regional industry association

" *I created a new platform where people can come together [....]. Main problems were expected in the area of land and finance. So our first seminar was on availability of land in Gujarat so that people can really get help as to how to go about acquiring land. Next immediate thing was arranging a seminar for finance [....]. We decided to hold one seminar in which we invited the state bank of India, we invited IDBI, we invited IREDA [....]. Fortunately we received fantastic response not only from the solar developers but also from*

bankers [...]. I have brought bankers to your doorstep [....]. That dialogue ultimately helped in breaking the ice [....]. That greatly helped [....]. Banks were not ready to finance [...]. We could give them comfort and helped elsewhere how banks have financed [....]. I have believed in dreams coming true but you have to work for your dreams [....]. Our objective was very clear: making Gujarat number one in the country in the field of solar energy." (Interview 4)

The association was instrumental in resolving ongoing concerns related to financing and land allocation, as well as reducing bottlenecks while practically implementing projects. Facilitating linkages between the banking and financial institutions and project developers, in spite of the risks and uncertainties associated with financing solar PV projects. Without such assistance, projects would not have been financed in Gujarat. The solar association of Gujarat created the National Solar Federation of India – which was similar to EUROSOLAR – for creating an enabling environment for solar energy in India and for collectively advocating it to the Government of India (Mehta, 2012; Mehta 2013; Mehta, 2013; Interview 4).

The solar association in Gujarat also played an important role in mobilizing collective action among solar PV project developers and investors. Networking events organized by the association were useful for funding projects in Gujarat, as they facilitated linkages between solar PV project developers and financial institutions. The association also represented project developers in Gujarat in industry forums such as SolarCon India, Inter Solar and even public hearings conducted by GERC, the regulatory agency. Particularly, the association helped the project developers in preparing their petitions and claims during regulatory hearings conducted by the regulatory commission GERC. The Solar Association of Gujarat asked the different investor members to set aside their personal differences and work collectively for promoting grid-connected solar PV in Gujarat (Interview 4).

The case of West Bengal

In 2012, after rounds of deliberation and discussions between different stakeholders, the West Bengal Government announced a renewable energy policy to improve the situation in the state. While the government displayed its intentions of promoting solar PV in the state, it lacked measures for implementing projects, with little coordination between the different implementing agencies (Department of Power & Nonconventional Energy Sources, Govt. of West Bengal, 2012). To increase the investment in grid-connected renewable energy in the state, the West Bengal Green Energy Development Corporation Limited (WBGEDCL) was created. The role of WBGEDCL was focused on assisting project developers in obtaining incentives and clearances for projects, signing power purchase agreements (PPA) with energy utilities, setting the arrangement of power evacuation, executing demonstration projects, monitoring and reviewing projects and obtaining single-window clearances for project developers in coordination with different state agencies (WBGEDCL, 2010; West Bengal Green Energy Development

Corporation Ltd, 2012; Department Of Power & Nonconventional Energy Sources, Govt. of West Bengal, 2012). The state nodal agency for renewable energy did not play an essential role in facilitating projects.

As remarked by one of the interviewees

" *The initiative of the state nodal agency should be at least being much more aggressive; otherwise also nothing will come here […]. The corporation when you form that should have some initial capital, they should have a vision [....], this is the initial infrastructure we will develop, then we will call the investors, then we give them assurance about selling of their power or signing of PPAs but that corporation, nobody listens to the corporation. The corporation unfortunately has not taken any initiative also and nobody listens [....]. The corporation can do some work if there is a demand [....]. If they pursue also they know the corporation can't do anything as they do not have power.*" (Interview 9)

West Bengal also faced problems in implementation of grid connected solar PV projects due to limited capabilities of the implementing agencies WBREDA and WBGEDCL in facilitating the required infrastructure for project developers. WBGEDCL took an approach that focused on screening project developers on having strong technical and financial capabilities, setting rigorous project deadlines and proposal assessment, along with a two-round evaluation process (WBGEDCL, 2012). The project development responsibilities – such as land allocation, financing, setting power purchase agreements and obtaining clearances for projects – were given to the project developers, without the instrumental facilitation from WBGEDCL (Interview 9). These measures increased the complexity of projects and for investors in the state. West Bengal had no counterpart – such as the Solar Association in Gujarat – that could mobilize collective action and address the concerns of project developers.

In contrast to Gujarat, forums for collective action, discussions on policy options and the reduction of implementation barriers were limited, with only a few networking events being organized by the Bengal Chamber of Commerce and the civil society group (CUTS resource center, Kolkata). For instance, events organized by the Bengal Chamber of Commerce and Industry deliberated on the relatively low deployment of grid-connected solar PV energy in West Bengal despite its good solar potential, with inputs from different stakeholders in the state (Interview 12; Interview 13). Civil society groups such as CUTS Calcutta resource center organized meetings and discussion forums on capacity building so that consumer groups could engage in advocating for renewable energy, along with developing the capabilities of government institutions and identifying challenges with the implementation of suitable policies and regulations in the state (Interview 13; CUTS 2011; CUTS, 2013).

Differences between Gujarat and West Bengal

In the case of Gujarat, the industry association complemented the function of the state nodal agency GEDA (Gujarat Energy Development Agency) and other government agencies for implementing solar PV energy projects. This is not to suggest that grid-connected solar PV would not have developed without the collective action from the industry association, but it certainly helped shape ongoing developments by acting as a key institutional agent in connecting different stakeholders and complementing the functions of government organizations involved in the implementation process. On the other hand, a limited number of organizations were present in West Bengal for reducing implementation barriers. However, future research is still necessary to understand the presence of such organizations in different regions and the differences of their impact in different regions, as well as the extent to which they are successful.

5.5. CONCLUSION

The paper describes failed efforts in West Bengal with respect to implementation of grid connected solar PV energy compared to successful efforts in Gujarat. Our study looked to answer the following research question: *How and why was implementation of grid connected solar PV different in Gujarat than in West Bengal?* The paper answers the research question by uncovering the role of various regional actors and the collective strategies used by them to address the institutional challenges associated with implementing grid-connected solar PV energy. The following conclusions can now be drawn.

First, the findings highlight the importance of regional government officials and state government engaging in institutional entrepreneurship. Existing studies have pointed at the critical role of state governments in engaging in institutional entrepreneurship by creating opportunities for economic development, attracting international entrepreneurial linkages, creating infrastructure and implementing reforms for the removal of bureaucratic constraints (Nashra & Dacin, 2010). However, studies have also indicated that state governments can fail in terms of the actual implementation of policy initiatives in practice, despite possessing considerable power. Many policy and regulatory initiatives are delayed due to resistance from vested interests within the state machinery, lack of political power and assertiveness to drive implementation of initiatives, and presence of actors with competing ideologies and logics (Jain & Sharma, 2013). This study confirms the role of regional state government in creating necessary political conditions for implementation of desired initiatives. I demonstrated the work of motivated and engaged efforts of the principal energy secretary of Gujarat, D.J. Pandian as he played an essential role in mainstreaming solar PV in the state despite facing resource and political constraints. In West Bengal, in spite of motivated efforts and vast experience of Dr. S.P. Gon Chaudhary the state lost momentum as his efforts were not collectively supported by regional government in West Bengal. While the efforts of D.J. Pandian were adequately supported by the Gujarat state government and other

agencies in, it was difficult for this kind of collective action to take place in West Bengal. This finding suggests the need for developing an integrated perspective on regional institutional entrepreneurship, by focusing on the role of motivated individuals within the government and the extent to which their actions are supported by the regional government.

Second, the analysis offer insights into the work of regional regulatory agencies in stimulating entrepreneurial action. Previous research has discussed a number of roles of regulatory actors– such as exercising coercive pressure on entrepreneurs by mandating strict regulations, resisting change by maintaining strong connection with incumbent actors and preserving their status quo, and creating investment opportunities by devising regulatory orders which guarantee regulatory support and reduce investment risk in the long term (Holburn, 2012; Gurses & Ozcan, 2014; Weigelt & Shittu, 2015). Regulatory agencies face legitimacy risks, as they have to protect the interests of diverse stakeholders as well as their autonomy, along with playing an essential role in the implementation of regulations (Hiatt & Park, 2013).

In this study, I showed that it was difficult – in both states – for regulatory agencies to counteract the arguments of incumbent utilities regarding the cost pressure and impacts on consumer tariffs due to the high costs of solar PV energy. The analysis finds that regulatory agencies have a critical role in facilitating investors and implementation of regulations by working around economic and political constraints. Regulatory agencies such as GERC played an important role in balancing multiple and contradictory interests such as protection of consumers from high prices, ensuring profitability and long term predictability for investors and minimizing negative impact on financial position of energy utilities. GERC facilitated investment in Gujarat as it worked around cost and political constraints and managed to support solar PV investors despite resistance from the state energy utility GUVNL. WBERC on the other hand focused more on supporting the incumbent energy utilities in the state, by mobilizing arguments such as uncertainty about the rapidly decreasing solar PV prices, cost pressure on utilities and its eventual impact on consumer prices.

Third, the analysis offer insights in the role of industry associations in stimulating collective action in regional context. Literature has emphasized the role of professional and trade associations as powerful institutional actors influencing entrepreneurial choices and promoting new agendas, enacting and enforcing laws, lobbying for specific policies and regulations, providing inputs to the government and advocating for modifying draft policy documents, seeking political support for their members while balancing collective and individual interests (see Gertler & Vindorai, 2009; Pacheco et al, 2010; Khestri & Dholakia, 2009; Hiatt, 2010; Pinske & Groot, 2015). The analysis confirms insights from existing studies but also suggest the need to look at a range of other activities such as local capacity building, encouraging collective learning, fulfilling functions of other organizations and resolving critical institutional bottlenecks.

Finally this study contributes to the institutional entrepreneurship literature in regional context by empirically illustrating regional differences in implementation of national political mandates and developing an overview of the institutional entrepreneurial work of three key actors as highlighted before. The study contributes to recent discussions on the manner in which actors challenge institutional arrangements in a regional context (Ritvala & Kleymann 2012; Sotarauta & Mustikkamäki, 2015; Sotarauta, 2015) by empirically investigating the strategies they use and the manner in which they exercise their influence. By building upon insights in this paper, future studies can focus on studying the development of solar PV energy in other Indian states or in different institutional contexts.

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Chapter 6

Field Configuring Events shaping sustainability transitions? The case of solar PV in India[25]

Field Configuring Events shaping sustainability transitions? The case of solar PV in India

Suyash Jolly, R.P.J.M. Raven

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ABSTRACT

The sustainability transitions literature has emphasized the analytical challenges in understanding the trade-offs in protecting niche innovations. This paper builds on an emerging body of literature that argues that the concept of Field-Configuring Events (FCE) is useful for understanding such trade-offs. We explore how this concept can be fruitful for analysis of niche protection in solar PV technology in India. The paper finds two important focal points of debate: (1) supporting domestic capabilities to improve competitiveness; and (2) using public financial mechanisms efficiently. Our research suggests that, whilst FCEs indeed seem an appropriate venue for investigating on-going debates in niche protection, it is challenging to develop causal relationships between these events and their wider, field-level influence. As such, the paper reflects conceptually on the usefulness of the notion of FCEs as temporally and spatially bounded venues for analysis of emerging niche trajectories and their politics.

Key words: sustainability transitions, field configuring events, India, solar PV

6.1. INTRODUCTION

Technology advocates need to mobilize resources and political support for developing low-carbon innovations while conforming to existing, often hostile institutional arrangements that developed around conventional technological systems. There are many challenges to convincing political actors. For instance, political actors may have a low perception of the legitimacy of these innovations depending on broader socio-political contexts (Jain & George, 2007; Raven et al., 2015). Even if policy makers are interested in supporting low-carbon innovations, they might find it difficult to develop and implement appropriate measures, for example due to problems of information asymmetry, technological uncertainties and rent seeking behavior of interest groups (Schmitz et al., 2013). Political ambitions for supporting low-carbon innovations might also contradict with global-trade interests and even spark new international trade disputes (Kuntze and Moerenhout, 2013). Another challenge is the removal or reshaping of political and financial support for innovations if socio-technical performance does not match the intended expectations (Hallegate et al., 2013; Rodrik, 2013), or when unintended social consequences come to stage suggesting political actors need to strike a new balances between plural social interests. This implies quite a challenge; policy actors find it difficult to be proactive in resolving emerging problems and conflicts in the context of high levels of uncertainty. They need to adapt their strategies in order to solve new sets of challenges arising from previous policy interventions (Flanagan et al., 2011; Hoppmann et al., 2014; Quitzow, 2015).

Such topics have been debated in the sustainability transitions literature (Markard et al., 2012). This literature has highlighted the complex choices and difficult dilemmas involved in creating, maintaining and removing 'protections' for path-breaking low-carbon technologies (Schot and Geels, 2008). Smith and Raven (2012) and Smith et al. (2014) have argued that securing and withdrawing niche protection is highly political as niche protection rests in multiple actors with different power positions negotiating access to resources and institutional reforms. Such questions are even more pressing in developing countries where multiple trades-offs between competing social, economic and ecological objectives are omnipresent. For example, vested interest groups may misuse protective measures designed to ensure energy access for the poor for strengthening their own position, without putting in sustained efforts in long-term sustainable development, capacity building measures and industrial competitiveness (Romijn and Caniels, 2011a; Romijn and Caniels, 2011b; Byrne et al., 2014).

Many niche-based analyses studying protective space dynamics have taken a long-term, retrospective perspective. Whilst this has led to substantial theorizing on the dynamics of transitions and niche development, the literature has been criticized that retrospective cases tend to 'forget about the politics', and fail to engage with tougher questions regarding governance in the context of far-reaching complexity and ambiguities (Shove and Walker, 2007; Newig et al, 2007). This paper proposes to build

upon the relatively young literature on field-configuring events, which is part of a wider recent stream of sociological approaches in institutional theory such as institutional entrepreneurship (Garud et al., 2007), institutional logics (Thornton et al., 2012) and institutional work (Lawrence et al., 2013). We believe that crossovers between these literatures are quite promising (see also Funfschilling and Truffer, 2014). The literature rests in nuanced understandings of relations between structure and agency - a long-standing debate in the social sciences - and its recent theoretical developments have become interested in grasping fundamental change processes in real-time (Garud and Gehman, 2012). This is very relevant in the context of transitions, because structures such as regulatory institutions are changing, whilst at the same time actors have to make long-term commitments to those changes under conditions of deep uncertainty and ambiguity. Whereas dominant transitions frameworks such as the multi-level perspective (Geels, 2002) or technological innovation systems (Hekkert et al., 2007) have limited conceptual power to grasp these dynamics in real-time, we believe that these recent sociological approaches in institutional theory are better equipped for the task.

Hence, this paper turns attention to ongoing, temporarily and spatially situated events. In particular, the paper builds upon the concept of 'Field Configuring Events' (FCEs). This literature suggests that FCEs are important, because they bring together stakeholders in a certain organizational field, which enables intense interactions among them and, *potentially*, decision-making processes that changes the direction in which a field develops, for instance through re-shaping the socio-political legitimacy of the field through media exposure, or agreeing on new industry standards, or deriving policy lessons that are picked up in political debates informing new regulations or support incentives (Lampel and Meyer, 2008; Schüßler et al., 2015). This paper applies the notion of FCEs to reflect if and how FCEs can be a useful analytical category for analysis of politics aspects of niche protection dynamics in socio-technical transition studies – an agenda that has received increasing attention in the literature (Smith and Raven, 2012; Boon et al., 2014; Raven et al., 2015; Ratinen and Lund, 2015). More generally, the paper aims to make a contribution to the debates on the role of micro-level dynamics in shaping more systemic patterns and processes (Farla et al., 2012; Pesch, 2015).

Empirically this paper looks at recent developments around the Jawahar Lal Nehru National Solar Mission (JNNSM) that promotes solar photovoltaic (PV) energy development in recent years in India. The total amount of installed solar PV in India has climbed to 2208.36 MW in 2014 – ranking just outside of the top 10 countries deploying PV (MNRE, 2014a). Until 2009 the development of solar PV energy in India was limited to government-sponsored programs related to lanterns, cookers, mini grids and solar home systems with little political support for manufacturing and R&D activities (Chaurey, 2001; Sharma et al., 2012). This changed when in 2010 the Indian government launched their National Solar Mission under the National Action Plan on Climate Change (NAPCC). This mission has boosted solar PV niche development

in India, for instance in terms of deployment rates, regulatory and policy support, industrial dynamics and new knowledge development.

Recent political support for solar PV, however, has not only sparked rapid growth rates, but also debates on conflicting issues (Spratt et al., 2014; Quitzow, 2015). In particular this paper is concerned with a key issue of debate, i.e. how the mission can be advanced for achieving multiple public goals whilst at the same time maximizing efficient use of 'niche protection' through providing public financial resources, which are typically scarce for emerging economies like India. The paper investigates two recent multi-stakeholder events and explores how these events shape and are shaped by field-level debates, i.e. to what extend they acted as Field-Configuring Events. As such, the paper addresses the following research question: What lessons can be drawn from analysis of selected solar PV events in India about the usefulness of the notion of Field-Configuring Events for the study of niche protection in sustainability transitions?

This paper is structured as follows. The relevant theoretical literature on niche protection and field configuring events is discussed in section 2. Section 3 discusses the research strategy. Subsequently sections 4-6 presents the results of the analysis. Section 7 concludes.

6.2. Niche protection and field-configuring events

In the sustainability transitions literature, the rationale for niche protection is that path-breaking innovations are facing a disadvantage selection environment hostile to the far-reaching changes necessary for those path-breaking innovations to mainstream. Niche protection measures often include public measures such as R&D funds, regulations, tariffs, taxes, investment subsidies or government procurement (Kemp et al., 1998). Others have suggested that niches can exist inside firms as well, e.g. in the form of strategic R&D programs shielding 'hopeful monstrosities' from short-term decision-making (Van den Belt and Rip, 1987), or in more 'passive' forms such as environmentally concerned user groups or places away from incumbent infrastructures and institutions such as remote islands (Verbong et al., 2010).

Successful niche development (i.e. positive feedback loops between niche development processes of expectations, networking and learning) attracts political support and shapes legitimacy for emerging niches. As socio-technical performances improve, protections can be gradually phased out (Kemp et al., 2001) or they institutionalize as part of a new, reconfigured socio-technical regime (Smith and Raven, 2012). From a public policy perspective, removing protections is a major challenge. Abandoning protection measures too soon might result in premature selection against the niche whilst maintaining (high levels) of protection too long might be detrimental for improving the sociotechnical performance of the niche (Ulmanen et al., 2009). Removing protection might also result in resistance and protest from different interest groups – something that policy actors are in particular sensitive to when those groups represent interests of major

political relevance such as jobs, economic growth or a large number of votes. This may result in protectionism and hinder niche development in the longer run (Caniels and Romijn, 2008). Hence, navigating plural social interests in practice is key to successfully governing niche protection. Another important condition is that policy actors need to have real-time information on socio-technical performance of the technology and develop arrangements for continuous monitoring of niche (Nill and Kemp, 2009).

Events such as public hearings, industrial conferences, trade shows and professional conferences are suggested to act as important temporarily and spatially demarcated sites where these social interests are negotiated. When such events shape the wider qualitative or quantitative developments of the niche, these events may be termed Field-Configuring Events (FCEs) (Lampel and Meyer, 2008). FCEs are suggested to play an important role in policy and regulatory modulation for steering sustainability transitions (Garud, 2011; Garud and Gehman, 2012), because they allow heterogeneous actors to come together and reformulate sociotechnical controversies, take up important matters of concerns and create opportunities for collective learning and decision-making. Depending on the type of event, these actors may include experts (e.g. regulators, policy makers, firms, technical experts, consultants, advocacy experts, research institutes, industry associations, investors etc.) and laypersons (e.g. users, consumers, tax payers, citizen groups). As such, FCEs may not only help formal decision making, but also enable redefining issues in qualitative ways by providing a stage to groups relatively outside to formal policy arrangements to express their concerns (Rip, 2003; Callon et al., 2009; Garud et al., 2014).

FCEs are defined as collective settings in which actors with diverse interests deliberately assemble together for shaping the development of an organizational field (Meyer et al., 2005). The term organizational field denotes a "community of organizations often having a common meaning system and interacting frequently for common purposes" (Wooten and Hoffman, 2008; pp 131). Organization studies scholars have given increasing attention to FCEs and how they might change the direction of organizational fields. The argument goes that FCEs brings together actors from different backgrounds and perspectives in a single location for a limited time period and provide opportunities for unconnected and diverse actors to interact on selected topics, develop shared narratives, build trustful relationships and develop new networks (Hoffman and Ocasio, 2001; Lampel and Meyer, 2008). Different actors engage with each other to makes sense of ongoing developments, focus on complimentary interests, and resolve conflicts while reflecting on on-going changes within the field (Anand and Watson, 2004; Anand and Jones, 2008; Garud, 2008). Actors in FCEs may use different strategies to shape the developments in the field according to their motives and interests and try to convince powerful actors to accept their claims and visions as field level accounts (McInerney, 2008).

Literature highlights there are different types of FCEs. Some FCEs have an explicit ambition to have a powerful influence on the development of a field, for

example in terms of shaping new industry standards. Other events have a more general purpose, are rather unstructured and with less of an explicit agenda to change field-level structures (Lampel and Meyer, 2008; Lampel, 2013). For example, trade fairs are events where firms and industry participants meet for exchanging and gaining tacit knowledge, identifying new market trends and develop trustful relations for new business partnerships. Yet in hindsight some of those events can have field configuring implications too, e.g. when the outcomes of these events through media exposure reshape field-level discourses (Bathelt and Gibson, 2015).

FCEs are often strategically organized with hidden agendas. For instance, event organizers try to create legitimacy for themselves and design the event according to their own interests (Dobusch and Schüßler, 2014). They design and organize the agendas of the events by deciding on the key sessions, presentations, keynote speeches and topics to be discussed during the events. These are as much processes of inclusion as they are of exclusion, e.g. when certain actors are not allowed to participate or when topics are excluded from sessions. Organizers are nevertheless also limited in terms of their strategic influence, for example, because decision-making takes place in other social and political forums too that they do not control (Schüßler and Sydow, 2015).

The literature on FCEs emphasizes how actors skillfully use stories during FCEs to maintain a delicate balance between envisioning particular trajectories of the future as well as sensemaking of the past in order to advance their interests (Zilber, 2007). Actors propagate their narratives in challenge to competing narratives of other actors present during the event. Presentations made by key actors during the plenary sessions, for instance, may offer more general reflections on field developments and identify current crises, but they do not necessarily highlight the struggles or interests of other actors. Narrative work at FCEs also includes producing, sharing, consuming and distributing different types of 'texts' such as reports, press statements, speeches, positioning papers, brochures, pamphlets, scientific papers and roadmaps. Texts circulated during FCEs may be subject to multiple interpretations, and are subsequently used, retold and transferred into order arenas in various ways (Hardy and Maguire, 2010; Zilber, 2011; Mische, 2014).

FCEs are not always about shared enthusiasm about the future and consensus between participants. Events, for instance, serve the purpose of negotiating future regulatory and policy directions and, as such, outcomes of events can be of strategic relevance to businesses, nongovernmental organizations and policymakers (Dobusch and Schüßler, 2014). Conflicts and contestations between actors with different views are an essential aspect of FCEs (Garud, 2008; Garud, 2011). Though event organizers may design them with field-configuring purposes in mind, outcomes are inherently unpredictable in the sense that there is limited control over subsequent use of event outcomes. Events that were designed to be field-configuring events can also become sites of field maintenance without resulting in institutional change (Hardy and Maguire, 2010; Schüßler et al., 2014).

Existing studies have focused on analyzing series of field configuring events (e.g. Dobusch and Schüßler, 2014, Garud, 2008; Glynn, 2008; Zilber, 2011) as well as single events (e.g. Zilber, 2007; Hardy and Maguire, 2010; Mollering, 2010). The latter suggest that single or isolated events may have significant impact in terms of post event field-level changes such as policy and regulatory changes. Recent research suggests, however, that more attention needs to be paid to how events are embedded in an ongoing stream of activities and developments in the field before and after an event (Garud, 2008; Mair and Hehenberger, 2014).

We believe that the notion of field-configuring events holds promise for analysis of the dynamics and politics of niche protection. It potentially offers a conceptualization of temporarily and spatially demarcated sites for empirical research on the ways in which negotiations between multiple stakeholders are evolving in the context of emerging niche innovations. Particularly, we are interested in whether these events are fruitful for grasping on-going debates on the ways in which niche technologies should be protected through public support. The literature on FCEs suggest that whether or not an event becomes an FCEs is an empirical challenge, as the wider implications of an event often only becomes apparent when the event is over. The literature also suggests that analysis of events needs to be embedded in an understanding of on-going debates before and after the events. Finally, the literature emphasizes the importance of discursive processes in the ways in which these events shape future dynamics of niche protection. We will reflect on these assumptions in the concluding section. The next section discusses our research strategy for investigating these dynamics in the context of two solar PV events in India.

6.3. RESEARCH METHOD

This paper examines two field-configuring events related to solar PV in India, i.e. 'SOLARCON India' and 'Future of Solar Energy', which were held in August and September 2013 in Bengaluru and Gandhinagar respectively. The 'SOLARCON India' event is an annual conference on solar energy in India organized by SEMI India from 2009 onwards. The "Future of Solar Energy" event was organized by Centre for Science and Environment (CSE) and Gujarat Energy Management Research Institute (GERMI) in 2013 for the first time.

These events attracted attention from a large number of knowledgeable actors as panelists, speakers and participants. The organizers circulated agendas of the two events well before the events in order to attract attention. Participants included government officials, policy makers, manufacturers, project developers, industry associations, standardization bodies, scientists, civil society organizations, financial organizations, consultants and media representatives.

Organizers designed the events to deliberately shape the developments in the field in response to a perceived crisis in the Indian solar PV niche. The National Solar Mission

started with a lot of enthusiasm in 2010, but faced severe bottlenecks in the subsequent years in 2012 and 2013 due to contradictory interests of various actors, problems related to international trade disputes and regulatory and policy uncertainties. Although there are several solar PV conferences in India (e.g. Intersolar India, REENERGY, Indian solar summit and exhibition), the timing and intended purposes to reshape public support for the Indian PV sector makes them potentially a case in point to study the role of field configuring events in niche protection.

The events differed in terms of their organization. SOLARCON India is a PV exhibition/industry platform to present new products and solutions across the solar PV value chain in India with exclusive plenary sessions focusing on policy, regulatory and technology issues. It also had trade exhibition showcasing different parts of the PV value chain, hosted a workshop on PV standards as well as panel discussions. The event ''Future of Solar energy in India" on the other hand was mainly an event focused on developing a roadmap for the solar PV industry to generate specific policy recommendations, in particular for phase 2 of National Solar Mission. Notably, after our participation in both events, as we will show, the SOLARCON 2013 event turned out to be the last in its series, signaling a reduced legitimacy of the event series in shaping field-configuring dynamics despite its intentions to serve as one. In the empirical section we will elaborate on the different traces each of these events left in the wider niche of Indian solar PV development.

6.3.1 Data collection

Primary data collection was done in field visits to Bengaluru in August 2013 and to Gandhinagar in September 2013, in order to attend these events as well as conduct interviews before and after the events. Collecting data in field configuring events involves observations during the events, informal interviews, collection of conference proceedings and complementing them with primary and secondary data such as retrospective interviews, official event reports as well as media reports (Zilber, 2014; Delgado and Cruz, 2014). During the events data collection initially focused on capturing the atmosphere in the events, grasping which actors attended them and the different roles they played at these events. We attempted to participate in as many sessions as possible within practical limitations. The selection of sessions to attend was made on the basis of grasping as much diversity of the issues debated at the events on the basis of session titles, session participants and 'buzz' at the conferences. We attended a variety of sessions including inaugural and keynote speeches, parallel sessions and the trade exhibition. This was complemented by informal conversations with conference participants about current issues and challenges in the Indian solar PV niche. Finally, data collection at the conference included documents, pamphlets, positioning papers, the conference agenda and advertisement material provided by the organizers and other participants during the conference.

The debates at the events were captured by observing and taking notes of the interactions between different actors, listening to debates in the plenary sessions and being sensitive to different coalitions of interests and power dynamics between various actors (Banerjee, 2012). Observations and notes focused on the content of the presentations given by conference speakers, questions directed and responses to the questions as well as follow up discussions. These questions and answer rounds allowed maximum possibility to learn about important issues and when different participants had different opinions. Whenever appropriate photographs were taken during the plenary sessions and video recordings were made to capture important discussions.

For each event relevant secondary data was collected such as newspaper articles, websites of the events, government and industry reports, existing academic articles, presentations and reports by industry experts, and proceedings and records of other conferences. Furthermore official reports of the events published by the organizers and their appearances in the media were collected to identify the organizers' perspective they wished to communicate to the outside world. Conference summaries and media reporting in newspapers by others were also collected, which provided further background information about the events as well as helped synthesizing discussions into two key-themes. Our analytical strategy to arrive at these themes is discussed in the next section.

6.3.2 Data analysis

For the data analysis, first all the field notes made during the events and secondary data were compiled in order to get a general impression of the events. Data analysis began by coding the material in terms of proposals and arguments made about the ways in which public policy could protect PV development and deployment in India, or failed to do so. Following the interpretavist research tradition (Stake, 2010), we coded all data in a grounded theory fashion recursively identifying core topics of debate (Zilber, 2014).

Analysis of stories and arguments at the events were embedded in analysis of data collected before and after the events. This served the purposes of identifying the ways in which these events were instrumental in shaping on-going niche dynamics. For instance, we were careful in looking at the effectiveness of the events in terms of whether important lessons derived from the events were subsequently debated again in new phases of the National Solar Mission.

The following core categorical themes have been identified in the analysis: (1) *Stimulating domestic capabilities to improve competitiveness*; and (2) *Using public financial mechanisms efficiently*. The first theme focuses on development of an indigenous manufacturing ecosystem in India by protecting the interests of PV manufacturers for supporting domestic manufacturing to improve competitiveness. The second theme relates to new and innovative ways of financing solar PV and being cautious in terms

of not repeating previous mistakes of using capital-intensive subsidy models that were popular before. The next section discusses the main results of our analysis.

6.4. DEVELOPMENTS UNDER THE NATIONAL SOLAR MISSION BEFORE THE EVENTS

The National Solar Mission (NSM) launched in 2010 with a target of deploying 20000 MW of solar PV energy in India by 2022. The aim was to put solar energy into the mainstream political agenda in India. This required balancing multiple and conflicting policy objectives: national energy security, enhancing energy access, job creation, stimulating a vibrant local manufacturing ecosystem, increasing international competitiveness and reducing GHG emissions (Deshmukh et al., 2012). The mission was divided into three main phases and several batches. It was believed that in this way adjustments to the program could be made based on learning in previous phases. Indian states were required to develop and implement their own policies and regulations for promoting solar PV (CEEW and NRDC, 2012).

Stimulating domestic capabilities to improve competitiveness

In the first phase of National Solar Mission a domestic content requirement mandated project developers to use domestically manufactured solar PV crystalline modules and cells. The US government criticized the Indian domestic content requirement suggesting violations of WTO (World Trade Organization) rules and discrimination of foreign producers of crystalline models. However, the Government of India maintained that the beneficial position of Indian crystalline module manufacturers was a case of government procurement and not a violation of WTO rules (Stephenson, 2013; Lewis, 2014). Thin film PV cells, nevertheless, were exempted due to a lack of domestic manufacturing capacity for these cells in India. It turned out that Indian PV project developers preferred thin film models, in particular imported from the US, supported by low cost finance provided by the U.S. Exim bank and the Overseas Private Investment Corporation (OPIC) (Johnson, 2013). Consequently, during the first phase of the mission Indian solar manufacturers of crystalline modules experienced major difficulties due to overcapacity problems, a lack of low cost financing and a lack of skilled workforce (Bhushan and Hamberg, 2012; Johnson, 2013), which caused many of the manufacturers to stop producing.

Debates occurred on the necessity of the domestic content requirement for supporting Indian solar PV manufacturers. Some questioned if the clause was useful in helping them capturing learning dynamics, gaining relevant capabilities and become globally competitive. Domestic content requirements were also considered problematic in terms of denying Indian project developers access to the latest technologies and instead providing benefits to a few domestic manufacturers (Ghosh and Gangania, 2012; Ganesan et al., 2014). Domestic solar PV manufacturers in India, represented

by Indian Solar Manufacturers Association (ISMA), complained against dumping of cheap cells and modules by manufacturers from countries such as Taiwan, Malaysia, China and U.S.A. The association filed a complaint to the Directorate General of Anti-dumping Duties (DGAD) within the Ministry of Commerce. However, project developers resisted these complaints as they risked increasing cost of PV projects and slowing down rapid deployment (Bridge to India, 2013).

Using public financial mechanisms efficiently

The first phase introduced a 'reverse auction mechanism' to stimulate project development. Under this scheme, solar PV developers offered a bid on tariffs set by the Central Electricity Regulatory Commission (CERC) and, when winning the bid, signed a Power Purchase Agreements (PPAs) with the nodal agency NTPC Vidyut Vyapar Nigam (NVVN). NVVN bundled the power bought from solar projects and then sold it to state distribution utilities. This mechanism was useful in driving down the costs substantially and limiting the financial impact on state distribution utilities and consumers (Altenburg & Engelmeier, 2013).

The Ministry of New and Renewable Energy (MNRE) introduced a new financial model in the first batch of the second phase of the NSM, a so-called Viability Gap Funding model (VGF). Solar Energy Corporation of India Limited (SECI) became responsible for the VGF model. Together with MNRE, SECI advocated the VGF model where a fixed feed-in tariff was set and then developers were asked to bid for the lowest amount of complementary capital subsidy required to make their projects financially feasible. The project developers were then required to sell the power to state distribution utilities in India and other obligated entities (CEEW and NRDC, 2014).

Many industry experts, civil society groups and project developers' considered the viability gap funding mechanism risky. They feared the VGF model might shift the focus of project developers from long-term performance of the projects to gaining short-term subsidies by bidding unrealistic low prices to get contracts during the auction process. They believed that a generation-based incentive (GBI) would be more useful in incentivizing project developers instead of a short-term capital subsidy model like VGF (Paliwal, 2013; CSE, 2013a). In counterargument to the claims made regarding problems with VGF, MNRE and SECI argued that VGF actually was useful in encouraging private sector investment, with the government providing more financial assistance initially in order to reduce risks for investors, whilst allowing investor to recover their investment during later phases of the project. They also considered VGF important for mitigating risks for financially bankrupt distribution utilities in India, which had to purchase high cost solar energy from the developers. A GBI model was considered more risky in the sense that the government would have to support project developers for a fixed and long period of time and would end up still providing subsidies even when solar PV would reach grid parity in the coming years. MNRE and SECI tried to convince VGF

skeptics by implementing additional mechanisms such as distribution of subsidies in time intervals and checks for performance and execution to ensure VGF works well on the ground (Bridge to India, 2012; World Bank, 2013).

6.5. ANALYSIS OF THE EVENTS

6.5.1 Background context of the events

SOLARCON India is the annual event of the Indian solar PV industry from 2009 onwards for discussing critical issues facing the industry and raising a common voice for the industry. It is organized by the industry association SEMI India PV, the Indian part of the global industry association SEMI. SEMI India focuses on developing the Indian solar PV ecosystem by organizing seminars and conferences, training workshops, providing platforms for discussion and information exchange between industry members and lobbying with central and state level governments. SEMI India PV also supports the development of new standards, products and services and facilitating new business collaborations and the Indian PV industry more generally. SOLARCON India is SEMI's main vehicle to promote latest technologies, discuss trends and disseminate the latest technical information and best practices.

SOLARCON India was organized together with Intersolar India for the first time in 2009 in Hyderabad. This was the first event in India where the entire Indian PV industry value chain came together. Subsequent events were held in Bengaluru in 2010, 2011, 2012 and 2013. The SOLARCON events quickly became a key site for discussing solar PV in India. For instance, the events helped shaping a white paper on solar industry in India, a solar directory and a PV technology roadmap in India. SOLARCON India received political and technological support from the Government of India, the European Photovoltaic Industry Association (EPIA) as well as from state governments of Andhra Pradesh and Tamil Nadu. SOLARCON India 2013 hosted special sessions on new policy initiatives in the context of the national solar mission, including representatives from MNRE (Ministry of New and Renewable Energy) and SECI (Solar Energy Corporation of India Ltd). The sessions in the events were thought to allow participants to engage in a direct correspondence with government representatives and CEO's of Indian PV firms.

The event "Future of Solar Energy in India" was organized for the first time by CSE (Centre for Science and Environment) and GERMI (Gujarat Energy Management Institute) in 2013. The organizers explicitly referred back to past accomplishments and failures in phase 1 of the National Solar Mission and aimed at using lessons learned to develop a roadmap for the future. The agenda of this event highlighted that development of solar PV energy in India stagnated and needed new policy and regulatory intervention for phase 2 of the National Solar Mission. The event organizers invited a range of stakeholders for finding solutions to current issues. The conference concept note highlighted:

"We intend to bring together key stakeholders of solar industry, government officials, developers, equipment manufacturers, social entrepreneurs, NGO's, academia and R&D professionals to discuss and deliberate on the critical issues, develop a comprehensive and effective strategy for developing the Indian solar sector and arrive at policy recommendations to give a new direction to solar industry." (CSE, 2013b)

The event attracted participants that were concerned about the current state of policy and regulatory uncertainty and a perceived lack of funds for supporting the next phases of the mission despite emerging market opportunities.

6.5.2 Discussions during the events

Stimulating domestic capabilities to improve competitiveness

The 2013 SOLARCON India conference focused on complementing a rapid growth of solar PV with domestic manufacturing as the industry faced deep crises, in particular the domestic manufacturers. Solar cell imports into India had increased substantially, which lead to a loss of domestic manufacturing jobs, financial losses and bankruptcy of Indian manufacturers. Many countries including the U.S.A., European countries and China were supporting their domestic industry. There were discussions on the role of China in global solar PV manufacturing and 'illegal' subsidization of solar PV industry by the Chinese Government. This of course created a problematic situation for domestic manufacturers. At the same time there was optimism that betters times might come for the industry.

Participants raised arguments about promoting innovation in order to reduce the need for surviving on government subsidies. One invited expert criticized the industry for not developing new business models: *"In a meeting in Delhi in the MNRE office, it was a sad meeting for me [….]. I saw all so-called industry captains pleading, begging. Please save us. These are the three words: Please save us."* The expert questioned the current moves by the industry for looking for subsidies from the government and not really innovating. The discussion shifted to the need for the Indian PV industry to become globally competitive and gain respectability in terms of indigenous R&D. Another expert commented: *"The solar industry is now at a level where just simply going to the government and saying 'give us subsidies' to survive should definitely not be the norm. This is an industry which has matured to a level where industry needs to start innovating, industry needs to come together, innovate and create market opportunities".*

During a discussion session on the state of domestic manufacturing a participant commented on the poor competitiveness of Indian solar PV manufacturers in international markets:

"How competitive are Indian module manufacturers in world markets and will they ever compete? Basically as this crystalline solar technology comes around, I do not foresee any significant competitiveness for Indian manufacturers in the international market. They do not have access to the whole chain. If you were to see a manufacturer in China who is

into GW of scale, he controls his policies, he controls his vapor manufacturing, he makes his own cells and then he makes his own modules. All costs are totally controlled and he is manufacturing the full scale/cycle of his product. But when it comes to India it is fragmented, we have independent cell manufactures, and we have independent module manufacturers [....]. It is about building an Indian ecosystem."

This was a critical concern debated at both events. Even government officials commented on crises in the industry and accepted that very few concrete measures were being taken to improve the situation. They suggested that it would be an ideal situation to have an entire solar PV manufacturing ecosystem in India, but this has not happened due to international factors and problems of domestic manufacturers in India. The government felt that manufacturers needed some level of protection to survive the current crises and it was helping them by trying to remove duties and imports so that costs of manufacturing modules and cells would decrease. One of the government representative commented:

"On manufacturing we know that cell manufacturers are suffering quite a lot [....]. We would like it very much if everything from silicon to modules is made in India and that they are competitive and that the modules are sold here. But somehow things have not worked because of international factors. New capacities are not added and whatever is added is not sold. This is a problem all over the world [....]. We are trying to give some protection to cell manufacturers [....]. We are working on removing duties on all types of inputs so that cost of manufacturing goes down further."

The government representative accepted that they had not been successful in supporting domestic manufacturers. They felt that it was a struggle for everyone and they need to hold hands to move forward together. The discussions focused on the reasons why Indian PV manufacturers were not becoming internationally competitive despite government subsidies. The imposition of anti-dumping duties, i.e. additional fees charged for foreign PV cells in order to support domestic manufacturers, were also discussed. One of the participants remarked:

"It is a fairly well established process. Dumping is not unique to the solar industry. Domestic manufacturers are well within their rights to bring on an anti-dumping case. The case should be looked at on the merits and evidence"

Another participant, however, commented that trade disputes on solar PV are most likely to help fossil fuel industry and not help the industry anyway. He highlighted flawed assumptions of the anti-dumping rules such as that the share of renewable energy markets globally are likely to remain small and a few countries will always be in a competitive position in the future.

Similarly in the event 'Future for Solar Energy in India' concerns were raised about the viability of the domestic content requirement. The argument that was articulated was that this requirement might lead to higher costs for project developers, create a

stagnant and protectionist industry and increase prices of solar energy thereby impacting consumer tariffs. Concerns were raised through statements such as:

"However, any domestic content requirement mandating developers to buy Indian modules and cells will not only lead to higher costs for developers, and thereby higher solar electricity tariffs but may also encourage a stagnant and protectionist industry with little incentive to invest in improving their product. There is also the risk of any domestic content requirement being circumvented through re-branding imported cells and modules and forging documentation" (CSE, 2013c). One participant during the event remarked:

"Solar power sector in India is clearly divided into two camps over the government policy on manufacturing. While manufacturers say they are running out of business because of dumping by foreign manufacturers, project developers criticize the domestic content requirement policy. Developers want to import at zero duty that they say will lead to large solar installations which, in turn, will lead to quick development of the sector, while manufacturers demand a level-playing field with the global industry. India must decide today what it wants—a purely import-driven solar power industry that compromises energy security, or a robust domestic manufacturing base"

In sum, debates during the event centered on conflicts between domestic manufacturers and solar PV project developers over imposition of anti-dumping duties as well as domestic content requirements. These measures were considered risky in terms of increasing solar electricity tariffs, encouraging a protectionist industry as well as creating risks of rebranding of foreign cells and modules without developing indigenous capabilities. Discussions centered on the ways in which the government could balance these multiple interests between manufacturers and project developers.

Using public financial mechanisms efficiently

The appropriateness of the Viability Gap Funding (VGF) and its associated risks and uncertainties were discussed at SOLARCON India. A governmental expert tried to clarify by suggesting that VGF needs to be experimented with in order to tap its vast potential and trigger the market. He considered the VGF mechanism useful in reducing the initial financial burden for project developers and their need to look for selling the power through new business models. This implies the VGF would need to be monitored closely to ensure successful development:

"On the VGF front you know it depends on what is available to you [....]. These funds are coming to the Ministry in bulk. It can't go on for 10 years. Budgetary support is not expected to continue for such a long time. We had experienced this in earlier RPS and GBI schemes. For 25 years you cannot get budgetary support. You have to find ways. What best you can do? [....]. What are you giving through VGF? Maybe 20 % or 30 % of the cost. The rest of the cost has to come from selling the power. So it is in interest of the developer that he keeps doing the project."

Also in the Future of Solar Energy India event, debates took place on the Viability Gap Funding model (VGF). As the organizers remarked:

"*CSE believes that incentivizing only capital expenditure might lead to the deployment of inefficient or unproven technologies that may not contribute much in terms of electricity generation or the life of the project*" (CSE, 2013c)

The participants discussed that although VGF was useful in making projects financially viable early on and reduce risks for investment, it would also result in bad project development practices, because of the risk of bidding for lowest costs in order to get the required viability gap funding. According to experts and participants, a generation-based incentive (GBI) on the other hand would incentivize development of better and efficient projects and incentivize long-term operation and maintenance. The organizers remarked in this regard:

"CSE believes that incentivizing only capital expenditure might lead to deployment of inefficient or unproven technologies that may not contribute much in terms of electricity generation or the life of the project." (CSE, 2013c).

The speakers and participants also discussed critical issues related to addressing long term structural constraints for financing solar PV in India. During the discussion a participant commented:

"Solar projects should be granted a 'priority lending' status for banks to allocate funds specifically to solar plants. In addition to this, takeout finance should be established like in the case of infrastructure projects that addresses issues that might arise from the long-term debt financing of projects." (Thakkar, 2013).

Collectively participants and organizers agreed on developing measures for bringing an enabling environment for financing solar PV, lowering the interest rate for financing PV project development and enabling long term financing mechanisms by introducing commercial lending mechanisms and advocating banks and financial institutions for granting priority sector lending for solar PV energy (CSE, 2013c).

6.6. DEVELOPMENTS IN THE NATIONAL SOLAR MISSION AFTER THE EVENTS

The conference organizers summarized the outcome of the events in the form of official conference summaries and appearances in various media. Media took up the discussions in the events and trade-press directly by presenting what happened in the event and showcasing comments provided by different participants through headlines and quotes.

In terms of outcome of the events, SOLARCON India 2013 turned out to be the last of the event in the series. The industry participants and organizers were not in favor of continuing the event further despite being a prominent event from 2009 onwards. During past events, the panel discussions, trade exhibition and standard workshops attracted a lot of national and international participants and the organizers expected further growth of solar PV manufacturing in coming years despite current state of crises.

However this year the event had received lukewarm response as indicated by a significant drop in the number of exhibitors and participants compared with previous years. Too many competing industry events and conferences also diverted industry participants to other events. In response to the feedback received from the solar PV industry, SEMI India decided to discontinue SOLARCON India. SEMI India decided to shift its focus and attention on providing technological courses, conducting seminars, developing technology roadmaps and standards and providing a collective industry voice towards the government. Nevertheless, the discussions during the events were summarized by SEMI India and reported in industry media and trade press and prominent newspapers such as Economic times and the Times of India and other outlets such as ElectronicsB2B.

In the event Future of Solar Energy in India the organizers prepared a post conference press note highlighting the important policy recommendations arising from the event. The press note emphasized the need for policy and regulatory intervention with the headline: *"Future of solar energy seems bleak if sector reforms do not pull through"* and emphasized the need for bringing in more clarity for next phases of the mission. The event was well reported in prominent media outlets (e.g. Times of India, DNA, Economic Times, Indian Express and Central Chronicle) with headlines such as *"Solar energy sector needs reforms", "Call for reforms to boost solar power sector"* to attract attention. Important recommendations from the event included the implementation of tax exemptions, exemptions from import and export duties, R&D measures for supporting domestic manufacturers to become competitive. With respect to improving efficiency of public financing mechanisms, recommendations included facilitating low interest loans through domestic financial institutions and promoting commercial lending mechanisms in order to reduce dependence on government subsidies in the longer run.

Stimulating domestic capabilities to improve competitiveness

After the events, the National Solar Mission's second phase guidelines were released in October 2013 after significant delay due to trade disputes regarding domestic content requirements and anti-dumping issues. The second phase of the National Solar Mission still continued a clause of procurement through domestic content requirement (both PV crystalline and thin film cells and modules) in order to promote localized solar PV manufacturing (MNRE, 2014 b). The Directorate General of Anti-Dumping and Allied Duties in the Ministry of Commerce and Industry initially recommended imposing anti-dumping duty on solar cells imported from Taiwan, US, China, and Malaysia in order to address grievances of domestic manufacturers and address distortions in the market. The imposed antidumping duties were suggested to be restricted to an amount necessary for redressing losses caused to domestic manufacturers (Balachander, 2014).

Before the Ministry of Commerce took the final decision on the anti-dumping issue, the National Solar Energy Federation of India (NSEFI), The Associated Chamber of Commerce and Industry of India (ASSOCHAM) recommended against imposition

of duties. They suggested that Indian domestic manufacturers did not have adequate capacity to supply PV modules and cells of the required quality and cost for the phase two of the mission and imposing anti-dumping duties might increase the cost of projects further. Furthermore cells and modules could be imported from other countries such as South Korea, Singapore, Philippines and Japan thereby creating no difference (Woods, 2014). According to them the domestic industry needed to be supported through creation of long term indigenous capabilities through R&D. Focus should be on reducing cost of solar PV by being open to sourcing high quality PV cells and modules from international manufacturers at the moment and developing the domestic manufacturing capacity gradually (Balachander, 2014).The Ministry of New and Renewable Energy, the Ministry of Finance, and the Department of Commerce remained in opposition over the anti-dumping issue, which, according to them, created a great deal of uncertainty for investors and project developers. In August 2014, the Directorate General of Anti-dumping and Allied Duties, Ministry of Finance took decision on the case and finalized the decision of not imposing anti-dumping duties. This decision led to relief for the PV project developers in India (Woods, 2014).

The decision not to impose anti-dumping measures was not further challenged by the domestic manufacturers. The same domestic manufacturers, who had argued for imposition of anti-dumping duties through narratives of supporting domestic industry, creation of jobs and indigenous manufacturing, accepted that imposition of duties might not be the right step at the moment. One of the main reasons of this dramatic change of position was that in order to protect the interests of domestic manufacturers, MNRE promised domestic orders from government public sector units in order to support domestic manufacturers (Sen & Mishra, 2014). After a final decision of this controversy, the government considered revamping the National Solar Mission designed by the previous government and making the mission more ambitious (Bridge to India, 2014).

Using public financial mechanisms efficiently

The draft guidelines for Phase 2, Batch 2 of the mission were released by MNRE in July 2014. The reverse auction and bundling scheme used in phase 1 of the mission were reintroduced after criticism on the use of the VGF mechanism. MNRE responded to the feedback received from the phase 2, batch 1 of the mission and appointed NTPC Vidyut Vyapar Nigam Limited (NVVN) as nodal authority for the purchase of power from developers and sale to distribution utilities. NVVN was appointed for implementation of projects in phase 2, batch 2 of the mission due to its good track record in phase 1 of the mission and concerns associated with use of VGF mechanism and role of SECI (MNRE, 2014b).

6.7. CONCLUSIONS

This paper has developed an account of on-going debates on protecting solar PV development and deployment in India. It did so by focusing analyses on two particular events embedded in an on-going stream of developments in the National Solar Mission in India. Given the organizers' ambitions, and building upon a recent stream of literature in sociological approaches to field-level institutional dynamics, we conceptualized these events as *potentially* field-configuring events. The paper started with the question what lessens can be drawn from this analysis for the study of niche protection in sustainability transitions. The following conclusions can now be drawn.

First, this paper shows how these events can indeed provide a useful research site for capturing the multiple stories and arguments that are present within a field at a certain moment of time. In our case we focused analyses on debates associated with the ways in which public policies should (or should not) protect solar PV in India. In our case we found two specific themes discussed at the events, i.e. (1) Stimulating domestic capabilities to improve competitiveness; and (2) Using public financial mechanisms efficiently. Specifically we highlighted narratives about the need to create a domestic ecosystem for manufacturing by advocating implementation of domestic content regulations and anti-dumping duties, and counter narratives in the field emphasizing their limitations. With respect to the theme related to using public financing mechanism efficiently, the debates on VGF and GBI mechanisms were centered on the need to devise low cost financing mechanisms that are sustainable in the long term instead of short-term capital subsidy models. Analyses of the material collected before and after the events confirm that the themes we identified during the events reflected on-going field level developments. All this suggests that field-configuring events are potentially a useful research site for identifying the core of on-going debates on protection of an innovation niche such as solar PV in India.

Second, our research also suggests the relevance of potential field-configuring events for investigating not just the *content* of the debates, but also probing the *political* dynamics of protective space (Smith and Raven, 2012). Whereas previous research in this area has focused primarily on long-term political dynamics of protective space in retrospect, our analysis attempted to grasp narratives and counter-narratives *in real-time*. Whereas retrospective analysis has the benefit of hindsight, ongoing debates on niche protection have not yet left traces in historical sources. Field-configuring events can be a fruitful site for transition scholars to engage with the politics of innovation and public support in real-time.

Third, this paper was interested in exploring if and how potential field-configuring events can have wider, field level implications. Indeed, the events were attended by high-profile industry and government representatives, received substantial attention from various non-expert stakeholders, were well reported in the media, and raised critical issues for shaping policy and regulatory agendas for the next phases of the mission. The

causal impact of these events in terms of real policy changes is, however, more difficult to establish on the basis of event participation, interviews at these events and analysis of secondary material alone. We did find some traces of evidence in which policy and industry actors referred back to debates at these events when announcing decisions. However, establishing strong causal relationships is more challenging deserving further methodological developments. For instance, this would require a lot more micro-data about where participants and organizers of these events go before and after the events, whom they meet, what they discuss and what is decided. Such meetings and decisions, however, may not leave traces to be found by scholars, implying for instance longer-term ethnographic engagements in an institutional field. Moreover, it remains challenging, if not impossible, to know beforehand whether a *potential* field-configuring event turns out to be really field-configuring, and many events turn out to be field-reproducing rather than field-configuring (Henn and Bathelt, 2015). Based on the cases studied here, we suggest primarily that FCEs are useful objects of study in grasping critical debates and actor positions regarding these debates within a certain field, but that their actual field-configuring impact is an empirical question rather than an analytical point of departure.

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Chapter 7

Conclusion

7.1 INTRODUCTION

This concluding chapter first summarizes the findings of the five papers of this dissertation in section 7.2, with the aim of deriving a typology of collective institutional strategies in sustainability transitions. The research questions are answered in section 7.3. Section 7.4 reflects on the theoretical and methodological approach used in this dissertation. In Section 7.5, I focus on the practical and policy implications of this research. Section 7.6 concludes the dissertation by discussing avenues for future research.

7.2 SUMMARY OF FINDINGS

In **chapter 2**, I emphasized the role of promising business-model experiments by social enterprises offering off-grid solar PV energy solutions, and the role they play in transforming the dominant socio-technical energy system. The chapter connected the sustainability transitions literature with literature on social business models and development studies. Building on these streams of literature, it developed a broad classification of different upscaling dimensions and emphasized the importance of institutional innovation for sustainability transitions. The five promising social enterprises discussed in this chapter developed business models as innovative solutions to a resource-constrained environment imposed by dominant institutional arrangements in India. The chapter focused on the unique differences in the enterprises' motivations and visions, business models and the manner in which they balance the tensions associated with commercial and social objectives. Moreover, it discussed that these promising social enterprises engage in institutional entrepreneurship for the purpose of institutionalizing alternative rules to serve the needs of the poor. However, the chapter also suggested that individual social entrepreneurs with promising business models seldom can challenge the dominant institutional arrangements on their own, and need to rely on collaborations with a range of outside stakeholders and need support from a wider institutional context to transform the energy system.

In **chapter 3** I focused on two collective strategies: 1) the creation of supportive socio-political and techno-economic networks and 2) the creation of indigenous innovation infrastructure for explaining the development of wind energy in India. This chapter highlighted that collective institutional entrepreneurship involves heterogeneous actors adapting their conflicting strategies, while at the same time facing the intended and unintended consequences of their actions. Finally, this chapter emphasized the need for deliberating on ongoing conflicts between powerful and weaker actors by being open to weaker and marginalized actors and allowing them to participate in the decision-making process.

In **chapter 4,** I developed insights regarding the differences in institutional strategies in mature and developing contexts. Building upon the examination of the historical development of wind energy in India in chapter 3, in chapter 4 I focused

on contemporary developments by comparing and contrasting the development of wind energy in Finland and India. By drawing on recent debates in the institutional entrepreneurship literature, this chapter used the concepts of political, technical and cultural work to compare institutional strategies in mature and emerging contexts. The paper emphasized that there has been resistance to the political work done to support wind energy in Finland and India due to the conflicting interests of the incumbent actors, in addition to a lack of collective action. Finland also has a stronger position than India in technical work due to the significant research and development across the value chain of wind energy technology; in terms of cultural work, the dominant focus of civil and environmental groups in India has been more on social justice and equity issues, while in Finland the emphasis has been on planning, environmental concerns, and aesthetic issues. The chapter concluded that emerging institutional contexts such as those found in India do not necessarily provide more opportunities for strategic change than mature institutional contexts, but that the challenges for collective institutional entrepreneurship in emerging institutional contexts are qualitatively different than those found in mature institutional contexts.

In **chapter 5**, I focused on showing that achieving ambitious renewable energy deployment goals in India depends on coordinating the actions of the central government and different state governments at the sub-national level. In this chapter, I accounted for significant differences in the implementation of grid-connected solar PV energy in two Indian states (Gujarat and West Bengal) by using insights from the institutional entrepreneurship literature. The paper uncovered the role of various regional actors and the collective strategies used by them to address the challenges associated with implementing grid-connected solar PV energy. This chapter particularly highlighted the role of regional government officials within regional government, regulatory agencies and regional industry associations play a critical role in steering regional sustainable energy initiatives. The chapter concluded that Gujarat was more successful in terms of implementing grid connected solar PV than West Bengal, as it was able to reduce barriers through collective institutional entrepreneurship, which eventually led to large-scale implementation.

Finally, in **chapter 6** I took a closer look at the role of temporally bounded field-configuring events in understanding the trade-offs involved in promoting solar PV innovations. I positioned this paper in the niche-protection literature, which has focused on the role of niche protection in terms of fit-and-confirm and stretch-and-transform strategies, and the manner in which different actors strategically create protective spaces for promising innovations by lobbying, negotiating and mobilizing political support. This chapter suggested that we need a better understanding of the creation, maintenance and removal of protective spaces in real time. This chapter analyzed the politics of niche protection by studying debates within two conferences as well as developments before and after these conferences, and suggested that field-configuring events are useful sites

for studying the politics of niche protection in real time. The chapter concludes by reflecting on the concept of field-configuring events, and suggests that not all events are field-configuring in nature, as it is difficult to establish – other than by studying the events' short-term impacts, such as debates in media and policy inputs – the impact of these events in terms of real policy changes.

7.3 ANSWERS TO THE RESEARCH QUESTIONS

While the different chapters address specific research questions, each based on a particular conceptual background and empirical case study, this section focuses on the overall contribution of this doctoral dissertation as well as on answering the research questions discussed in the preliminary chapter of the dissertation. I answer these questions by comparing and contrasting results across the different chapters.

Research question 1: *How do actors collectively challenge institutional arrangements in the context of energy transitions in India ?*

By considering the insights from the different empirical chapters in the dissertation, I propose a simple typology of three overarching collective strategies used by actors in attempting to shape the development of wind and solar PV energy in India. These strategies include: (1) Institutional adaptation; (2) Institutional capacity building; and (3) Institutional transformation. In short, the first collective strategy focuses on coping with a difficult and highly complex institutional setting (such as India) through tinkering and experimenting within institutional constraints to develop novel solutions within a protective space, rather than focusing on radically changing the institutional arrangements; this strategy also involves working in protective spaces outside the mainstream institutional arrangements in order to avoid such institutional constraints. The second strategy focuses on building new indigenous institutions and capabilities, in particular by drawing on transnational linkages. The third strategy is a more deliberate attempt at institutional transformation, in particular through interactions and discursive battles between heterogeneous actors (for instance, in conferences and forums). Table 7.1 presents a summary of these collective strategies and how they relate to empirical evidence in the chapters in this thesis.

Below, I discuss this typology and its empirical evidence in further detail.

7.2.1 Institutional adaptation

In **chapter 2**, I investigated the dynamics of wider upscaling of promising business models for solar energy. In terms of institutional adaptation, this chapter demonstrated how social entrepreneurs took into account the local institutional and power structures in rural India. For instance, SELCO managed to connect with existing rural financial

Table 7.1: Collective strategies for the development of wind and solar PV energy in India

Collective strategy	Description	Empirical evidence found in chapters:
Institutional adaptation	Tinkering within institutional constraints to develop workable solutions and experimenting within a protective space; for example, by conforming to institutional constraints, coping with them practically and improvising deliberate strategies for creating small and gradual changes	2, 5
Institutional capacity building	Developing indigenous institutional capacity; for example, by drawing upon cross-border linkages such as actors, knowledge networks, finance, relevant expertise and capabilities developed in different institutional contexts elsewhere; developing long-term indigenous innovation capabilities by drawing lessons from transnational linkages	2, 3, 4, 5
Institutional transformation	Deliberately challenging and changing dominant institutions through power plays and discursive struggles; for example, negotiations and contestations in concrete heterogeneous social settings; creating conditions for the involvement of all concerned stakeholders with different access to power	3, 4, 6

institutions in India, which was a complex task for providing financing to poor customers. This required small tweaks in banking rules so that the banks could provide loans to poor customers, which in turn enabled SELCO to provide them with loan guarantees. In particular, SELCO devised financing solutions for poor customers by taking their income into account, and devised an appropriate payback mechanism for them. In doing so, SELCO managed to tinker with local institutional norms and rural financing rules, designing affordable solutions for poor customers. However, enterprises such as SELCO also found it time-consuming to constantly engage with governments in this way, as it shifted their focus away from the day-to-day work of their business models.

Another example of institutional adaptation can be found in chapter 5, where I discussed the collective strategies of the head of the State Energy Department along with other actors in the state with respect to tinkering within institutional constraints. I showed that the principal energy secretary, D.J. Pandian, coordinated the actions of different actors in the state for mobilizing political support for solar PV, brokering information between state-level political elites and creating legitimacy for solar PV in Gujarat. Despite the constraints associated with financing solar PV in India and

the reluctance of financial institutions in financing projects, he was instrumental in reducing the negative perception of financial risk among financial institutions and banks, convincing them to fund solar projects in the state and to trust the project developers. He was also instrumental in reducing ongoing bureaucratic constraints for solar PV project developers, facilitating access to land, mobilizing financing for their projects by setting up linkages with international financial institutions such as ADB and World Bank and resolving project developers' problems through several meetings, while implementing their projects. Similarly, the Solar Association of Gujarat collectively mobilized project developers and investors in the state and helped them to resolve ongoing policy and regulatory issues, obtaining clearances from government agencies and facilitating project implementation. The association was also instrumental in facilitating linkages between the banking and financial institutions and project developers, in spite of the financial risks and uncertainties associated with financing solar PV projects; without these linkages, projects would not have been financed in Gujarat.

In sum, the first strategy in the typology is about the role of institutional adaptation, which involves the tinkering of and within institutional constraints. The strategy is about the ways in which actors practically cope and tinker with dominant institutional constraints to meet specific goals without the ambitions of purposefully challenging institutional arrangements. Actors try to develop workable solutions whilst being aware of the limits of their influence in steering change; they manage to adapt to and co-evolve with partially reconfigured institutional arrangements, or in spaces away from dominant institutional arrangements, rather than radically transforming them. This resonates with original niche-based approaches in the transitions literature, which argued for the importance of partial and temporal protection against mainstream regime-selection pressures (Kemp et al., 1998).

7.3.2 Institutional capacity building

In terms of institutional capacity building (that is, drawing upon transnational linkages and gradually developing indigenous innovation capabilities),in **chapter 2** I highlighted that promising business-model experiments have been supported by drawing on relevant foreign expertise, cooperation with international institutes and access to technological know-how and equipment through transnational linkages. For instance, I provided evidence of social enterprises importing components of solar PV energy systems such as microchips from the US, batteries from China and LED lights from Japan. More importantly, these imports were accompanied by a new institutional capacity in the form of partnerships with international organizations such as the United Nations, World Bank, UNFCC and GTZ for obtaining access to finance and distribution channels for their products. This empowered these PV social enterprises in terms of indigenizing their operations and localizing their solutions to meet the needs of poor customers.

Regarding institutional capacity building, in **chapters 3 and 4** I discussed that in the 1980s and 1990s, Indian wind energy firms were dependent on Danish and German governments and firms for access to technologies and relevant know-how to gain indigenous capabilities for developing an Indian wind energy sector. A key strategy of the Indian government in this time period was to encourage joint ventures and financial and technical collaborations with foreign firms and international organizations (such as DANIDA – the Danish International Development Agency) for developing demonstration programs and preparing an Indian wind atlas. These two chapters also showed the increasing role of international networks in these processes – such as the Global Wind Energy Council (GWEC), EU India Wind Energy Network (EIWIN), International Renewable Energy Agency (IRENA) and World Wind Energy Association (WWEA) – in creating advocacy for wind energy in India, by translating learning experiences in the form of best practice guidelines from other countries. This institutional capacity buildings enabled the Indian wind energy firm Suzlon to gain substantial output capability, develop indigenous innovation capabilities and become the first Indian firm to achieve global competitiveness, all in a short period of time. However, over the years other Indian wind turbine manufacturers have continued to be much more dependent on foreign manufacturers for knowledge and complex, high-value wind turbine components, and have struggled to develop capabilities for indigenous research and development for low wind speed conditions in India.

In **chapter 5**, I emphasized that the Gujarat government mobilized transnational linkages to obtain access to low-cost finance for solar PV projects in the state. These linkages were mobilized by the principal secretary of the Energy department, and included linkages for accessing external knowledge, expertise and financial resources through international organizations such as IFC (International Finance Corporation) and ADB (Asian Development Bank). On the other hand, such linkages were limited in West Bengal, which limited the deployment of grid-connected solar PV energy. The fact that Gujarat mobilized support from transnational linkages and was successful, along with West Bengal's limited mobilization, suggests that such linkages are crucial for the successful deployment of innovations in specific region and are an essential institutional strategy.

Theoretically, the second strategy in the typology relates to existing debates on the development of global niches (Geels & Raven, 2006; Smith & Raven, 2012) and to recent debates on the role of transnational linkages and the manner in which the development of niches are dependent on wider global and international technology, markets and resources networks (Berkhout et al., 2010; Raven et al., 2012; Wieczorek et al., 2015). These transnational linkages are crucial because they complement technological know-how, finance, expert knowledge and relevant capabilities for the development of sustainable technologies in developing countries (Binz et al., 2014; Gosens et al., 2014; Hansen & Ockwell, 2014).

7.3.3 Institutional transformation

In **chapters 3 and 4**, I emphasized that meetings and forums provided avenues for institutional transformation through collective learning and acted as arenas for power plays and discursive struggles involved in the development of wind energy. For example, in these chapters I showed that different wind energy associations in India and the Global Wind Energy Council worked collectively to disseminate information among heterogeneous actors in different wind industry forums (such as WE2020), with the purpose of creating legitimacy for wind energy among policy makers and attempting to transform critical policy and regulatory bottlenecks. Wind energy firms and associations have used public hearings organized by regulatory agencies and ministries and engaged in discursive struggles for introducing supportive policies and regulations and resisting the efforts of the incumbent utilities. I also showed that while industry forums have been successful to some extent in stimulating collective learning and resolving ongoing policy concerns of industry actors in wind energy in India, forums that seek to resolve land issues and project developments in remote areas in forests, villages and agricultural lands have been problematic. Wind energy developers have often not paid adequate attention to consultation processes with the local population and village-level bodies before initiating projects, which has often resulted in local institutional conflicts such as land grabbing, false, unmet promises of local development by wind energy firms and negative environmental impacts resulting from wind energy projects. I also showed that despite their advocacy efforts, civil society groups and advocacy organizations in India have found difficulties in terms of transforming wind energy policies and regulations. Civil society groups that are invited for commenting and deliberating in public forums have faced the challenged of moving beyond mere consultation and participation in public forums organized by government and regulatory agencies to having an actual impact on the decision-making process. Therefore, I have shown that institutional transformation strategies have had mixed success – and have also failed – in terms of drawing out different views and controversies and engaging with weaker actors.

Finally, in **chapter 6** I focused on the role of two particular events (two solar PV conferences discussing issues on the National Solar Mission: SOLARCON India and Future of Solar Energy in India) that were deliberately organized to try to transform the institutional context for solar PV in India. The chapter found two crucial institutional issues discussed at these events. The first issue was related to the protection and development of an indigenous manufacturing ecosystem in India to improve international competitiveness. I discussed the debates on the necessity of the domestic content requirement and anti-dumping duties for supporting Indian solar PV manufacturers; skeptics questioned if such institutional arrangements were useful in helping them capture learning dynamics, gain relevant capabilities and become globally competitive. The second issue was related to new and innovative ways of financing solar PV while being cautious about not repeating the previous mistakes of using capital-

intensive subsidy models that were previously popular. Instead, advocates promoted the stimulation of solar PV by using generation-based mechanisms that are useful in the long run. The chapter highlighted the importance of narratives as political devices for institutional transformation at these events, and the fact that such events were, to some extent, influential in transforming institutions in terms of raising critical issues in popular media debates and developing a set of policy recommendations. However, the chapter also pondered the difficulty in actually establishing causal links between these events and concrete institutional changes.

Theoretically, the third strategy in the typology relates to existing debates on the negotiations and coalition building between actors in conferences and forums for the development of shared cognitive rules (Geels & Schot, 2007), and linkages between niches and regimes and the concrete work carried out by hybrid actors in developing such linkages (Elzen et al., 2012; Diaz et al., 2013; Kivimaa, 2014). The third strategy also relates to debates on the politics of sustainability transitions and concrete discursive arguments mobilized by heterogeneous actors for securing their interests and shaping sustainability transitions (Raven et al., 2015 b).

In sum, the three strategies identified here are: (1) institutional adaptation; (2) institutional capacity building; and (3) institutional transformation. These strategies represent the ways in which Indian actors collectively engaged in institutional dynamics in the fields of wind energy and solar PV energy. However, the research also suggested that the three collective strategies found mixed success. I conclude that actors in a complex institutional setting (such as in India) have become used to institutional adaptation and tinkering, which has resulted in reduced efforts to develop stronger institutional arrangements in the longer run. While India has benefited from learning from transnational linkages, this has also led to overreliance on help from international sources, without the need for indigenous research and development in the long term. Similarly, while discursive strategies in forums and conferences have been useful in collective learning, they have also had unintended impacts in terms of excluding weaker actors and marginalizing their interests. Therefore, I conclude that while these strategies are successful in some instances, they also have unintended consequences and failures, which deserve further policy. I will return to this matter in section 7.6. Now I turn to the second research question of the dissertation.

Research question 2: *What lessons can be drawn for the sustainability transitions literature based on derived insights from the collective institutional entrepreneurship literature?*

First, my research contributes to the sustainability transitions literature by developing a typology of collective institutional strategies. I illustrate the usefulness of this typology by drawing on specific empirical examples from the different chapters in the dissertation. By developing this typology, the dissertation contributes to recent debates on the micro-

foundations of sustainability transitions, which relate to a closer focus on the role of actors and their strategies in shaping transitions in socio-technical systems (Farla et al., 2012; Raven et al., 2015), as well as to increasing the attention given to institutional approaches in sustainability transitions (Brown et al., 2013; Funfschilling, 2014; Funfschilling & Truffer, 2014). The typology developed resonates and is complementary to existing and current debates in the sustainability transitions literature, but provides a more systematic overview of collective institutional strategies.

Second, my research offers deeper insights into niche-regime interaction, which has repeatedly been coined as an important element in the sustainability transitions literature (Smith et al., 2010; Geels, 2011; Diaz et al., 2013), along with the transformation of stable institutional arrangements associated with these interactions (Geels, 2004; Funfschilling & Truffer, 2014). While the earlier transitions literature based on the MLP model provided a good analytical lens for the analysis of long-term socio-technical change, the MLP model was also criticized for suggesting a simplistic account of socio-technical change, without placing much focus on the role of agency in steering socio-technical change (Genus & Coles, 2008; Markard et al., 2012; Farla et al., 2012). Here, I have taken a more balanced perspective by not emphasizing a simple dichotomy between niches and regimes. In particular, I discussed that there is much more heterogeneity in terms of opposing coalitions of actors within niches. Furthermore the actors within promising niches have contested power relationships between them, often resulting in conflicts. This demands a fresh look at existing conceptual approaches which look at contested relationship between niches and regime.

For instance, I showed in the wind energy case in India that there were significant tensions between one set of actors (wind energy associations, medium- and small-scale industries, wind turbine manufacturers) supporting the re-introduction of AD (accelerated depreciation tax) benefits, as it was the essential driver of wind energy development in India, while another set of actors (Indian government, Ministry of New and Renewable Energy, Ministry of Finance, independent wind power producers, civil society organizations) considered the re-introduction of AD benefits as harmful for the long-term development of wind energy in the country. Another example of the tensions between several actors during the National Solar Mission concerned the introduction of domestic content requirements and anti-dumping duties. One group of actors (domestic solar PV manufacturers, solar industry associations, government agency MNRE) supported the introduction of domestic content requirement (DCR) and anti-dumping duties, while other actors (PV project developers, civil society organizations, WTO, US government) were not in favor of these measures. The latter were of the opinion that short-term measures might not result in the development of long-term indigenous capabilities for domestic manufacturing, and that they might even result in restrictive trade practices and rent-seeking activities. To summarize, in both cases conflicts emerged between heterogeneous actors, and the nature of the conflicts was far

more complex than incumbent-challenger dynamics with proponents and opponents of change, as emphasized in the transitions literature. Hence, niche-regime interactions are especially complex and require new conceptual approaches that focus on the collective struggles between heterogeneous actors, rather than just focusing on struggles between promising niches and the socio-technical regime.

7.4 REFLECTION ON THE METHODOLOGICAL APPROACH

A first limitation of the dissertation is that it does not explicitly focus on carrying out a comparative cross-case analysis between wind and solar PV energy in India. Such an analysis could have resulted in different insights regarding institutional strategies for steering the different technologies in a similar institutional context. The second limitation relates to the collection of data from semi-structured interviews. Although this dissertation mobilizes extensive empirical data consisting of expert semi-structured interviews, participant observations and primary as well as secondary data, a number of limitations still exist. The first major limitation relates to the difficulties of data collection through semi-structured interviews in a geographically large and complex country like India.

An obvious limitation follows from the interviews conducted during two field trips in India, in 2012 and 2013, since obtaining access to all potential interviewees in India was logistically as well as administratively challenging. The interviewees were located in different cities in a large country, which made the process of meeting the relevant experts in wind and solar PV energy quite challenging. Another challenge related to submitting repeated interview requests to experts and waiting several days for an appointment. Furthermore, while it was possible to interview a few experts from firms, it was still a challenge to contact a representative number of experts from wind and solar PV firms and interview them, given the practical difficulties of obtaining access to them amid their busy schedules. Despite these constraints, it was still possible to conduct fifty interviews, collect a range of archival data sources, gather insights from observations in conferences and public forums and to triangulate between these different date sources.

A second limitation relates to the generalizability of the results, as the research was mostly based on one institutional context; that is, that of the energy sector in India. Despite the fact that I have built my research on conceptual and empirical insights from several other studies that have documented similar insights in different contexts, it is still difficult to suggest the extent to which the findings are generalizable and the extent to which they hold relevance for studying other sectors or similar case studies (wind and solar PV) in different institutional contexts.

7.5 IMPLICATIONS FOR POLICY AND PRACTICE

In the beginning of this chapter, I developed a typology of collective institutional strategies: (1) institutional adaptation, focusing on coping with a difficult and highly

complex institutional setting through tinkering with institutional constraints and experimenting within such constraints, rather than focusing on radically changing the institutional arrangements; (2) institutional capacity building, focusing on developing indigenous capabilities; and (3) institutional transformation that is a deliberate attempt at institutional transformation, particularly through interactions and discursive battles between heterogeneous actors (in conferences and forums, for example). The typology, which is based on insights from different empirical chapters, is useful for policy makers and practitioners to look at different ways of collectively maneuvering complex transition processes with other actors. The three strategies discussed in this paper complement and require adequate coordination between one another, and successful outcomes might not be achieved by only focusing on one strategy alone. While this research was not explicitly concerned with the question of which contextual conditions can explain success and failure, I here propose an explorative, simplified representation of such conditions and the ongoing dilemmas for stimulating transitions through the strategies identified in the dissertation (as shown in table 7.2)

Based on the typology and the explorative, simplified representation of such conditions, along with the ongoing dilemmas summarized in the table above, I discuss three essential lessons for policy makers and practitioners. The first essential lesson for policy makers is that they need to focus on creating conditions that support institutional adaptation in the short term and institutional transformation in the long term. In order to support this, policy makers can stimulate protected spaces where heterogeneous actors can experiment with alternative solutions away from the scrutiny of the wider public, media controversy and vested interests against the novel institutional solution. These protected spaces can include specialized working groups, experimental and collective platforms and specialized forums where powerful actors can work in collaboration with weaker actors to temporarily develop novel solutions, later implementing them in the real world by being open to failures. For instance, such arrangements can include developing groups in which a few government representatives, entrepreneurs, financial institutions and poor users are able to modify existing financial and energy regulations in order to facilitate energy access. There are opportunities for using institutional adaptation to develop energy solutions for the vast heterogeneity of users not served by the current energy system; this can be done by creating specialized groups in which actors can experiment and tinker with such protective settings, and then bring solutions to the real world. These groups could be provided with specialized incentives and legitimacy for mobilizing the desired change, along with ample opportunities for learning from ongoing failures.

The second important lesson is that policy makers need to be receptive towards global networks of innovation, and therefore frame national policies and regulations for supporting promising innovations by taking them into account. Policy makers need to be sensitive about encouraging transnational linkages for stimulating localized learning

Table 7.2: Conditions for facilitating and steering sustainability transitions

Collective strategy	Contextual conditions	Ongoing dilemmas and failures	Means of facilitating contextual conditions
Institutional adaptation	Tinkering with institutional constraints for workable solutions and focusing on attaining achievable goals	Institutional adaptation can result in reduced focus on radical institutional transformation and create incentives for rent seeking	Crafting careful strategies through muddling which deploy institutional adaptation strategies in the short term with institutional transformation strategies in the long term
Institutional capacity building	Development of indigenous innovation capabilities by drawing lessons from transnational linkages	Too much focus on transnational linkages can result in reduced focus on indigenous learning; risks of international trade conflicts; continuous political support for innovations might not result in national competitiveness due to unintended impacts occurring from the global nature of technological developments	Carefully balancing the need for developing institutional capacity in the short term by drawing upon transnational linkages and developing indigenous capabilities in the long term
Institutional transformation	Transforming institutions through negotiations in concrete social settings	Risks of weaker actors being excluded from the deliberation process; too much deliberation can result in more conflicts between heterogeneous actors with different interests; risks of redundant learning and discussion without concrete action; deliberation may slow down the decision-making process, create uncertainty and reduce commitment towards collective goals	Deliberative decision-making process needs to balance the interests of all concerned actors but also enable quick decision-making without being captured by vested and powerful interests; managing inputs from non-experts and experts to enable transitions depending upon learning from ongoing failures

by carefully reducing restrictions on foreign investment such as low-cost finance from international financial institutions, setting suitable tax duties on import of equipment, facilitating technology transfer and cross-border R&D linkages, licensing arrangements and facilitating knowledge-sharing mechanisms. For instance, they can further facilitate such transnational linkages by developing specialized programs to enhance long-term indigenous capabilities (for example, by obtaining access to low-cost international finance, facilitating trade shows for knowledge linkages, conducting personnel exchange programs involving Indian and non-Indian experts, creating collaborative agreements for informal learning, facilitating specialized subsidies and generous tax mechanisms, etc.). Since building domestic indigenous capabilities is a complex and lengthy process, policy interventions for creating them must focus on drawing limited help from transnational linkages in the short term; meanwhile, the long-term focus should be on the development of indigenous capabilities through specialized interventions. Relying on obtaining relevant know-how and expertise from transnational linkages might be beneficial in the short term, but these linkages can also have long-term adverse impacts by gradually reducing the chances for the development of indigenous capabilities. Acknowledging the fact that overreliance on transnational linkages can lead to reliance on few foreign agents, the government can focus on exploring alternative means of developing informal foreign linkages from diverse sources, as well as on providing gradual support for the development of local indigenous capabilities. Therefore, the key issue in this matter is to stimulate the development of indigenous capabilities through a combination of learning from transnational linkages and encouraging indigenous experimentation through trial-and-error learning.

The third essential lesson is that policy interventions need to consider diversity of opinions from all concerned actors. This is essential during the drafting, designing and implementation stage need to consider the viewpoints and opinions of heterogeneous actors, giving emphasis to weaker actors such as ordinary citizens, civil society groups, advocacy groups and users. Policy makers have to ensure that no voices are left unheard in the process, and even make sure that vested interests do not sabotage transitions towards sustainability by adopting a system of checks and balances to reduce rent seeking. Policy makers have to create legitimacy for their decisions in a manner that does not exclude weaker groups and/or support the power and influence of groups with vested interests. Moreover, this is also important due to the fact that creating changes in energy systems has political consequences in terms of creating 'winners and losers', and requires accommodating the interests of heterogeneous actors in the short term while gradually reducing the legitimacy of actors with vested interests in the long term. However, policy makers must also realize that too much focus on facilitating participatory measures might result in a more complex and even slower decision-making process, resulting in the limited achievement of specific policy and regulatory objectives.

The critical issue in this matter is not to reduce the impact of powerful experts on the decision-making process, but to develop approaches through which powerful actors can obtain meaningful inputs from non-experts and weaker actors on important policy concerns, implementing a course of action by understanding the relevant tradeoffs. Furthermore, policy makers need to gradually adapt their strategies by balancing multiple tradeoffs, learning from mistakes made during previous interventions and developing new strategies by deliberating with other actors. Even after considering these issues, a transformation towards sustainability can be still challenging due to unpredictable constraints, which are unknown at the present moment and might only be visible in the near future.

7.6 AVENUES FOR FUTURE RESEARCH

As I reach the end of this dissertation, I would like to address a number of potential avenues for future research. Although I believe this dissertation has important implications for studying energy-system transformation in India, it is still not without limitations.

First, it can be useful to test the typology of institutional strategies developed in the concluding chapter of the dissertation and to investigate technologies other than wind and solar PV technologies and even look at institutional settings other than India. It might be interesting to see whether insights from the dissertation have relevance for understanding sustainable energy transitions in mature institutional contexts. Furthermore, the typology in the study needs further work and refinement, as at the moment it is explorative in and based on insights from different empirical chapters.

Future research also needs to focus on developing specific conditions under which these strategies are successful or less successful, along with identifying strategies that are successful in the long term for stimulating sustainability transitions. Such a conceptualization of successful strategies will be useful in providing novel theoretical and practical insights on enabling sustainability transitions. Future research can even focus on utilizing insights from the dissertation to study sustainability transitions in different sectors (such as health, water, agriculture and mobility), investigating the extent to which findings are relevant. This would enable a cross-case comparison looking at important differences between successful and less successful institutional strategies for socio-technical transformation in different sectors.

Second, there is a need for more research on the unanticipated effects of institutional transformation and the manner in which attempts at transforming institutional arrangements can end up marginalizing weaker actors. These issues are emphasized in chapters 3 and 4, where it is shown that weaker actors – such as civil society groups, citizens and villagers – have often been marginalized in public policy and regulatory debates. Since solutions to sustainability and social problems are complex due to deep-rooted institutional arrangements, they can end up serving the interests of powerful

actors without involving weaker and less-powerful actors, who are often marginalized. Furthermore, efforts to involve weaker actors may not be completely participatory, and may end up worsening their situation. Failure to involve weaker actors reinforces the existing institutional order and inequalities, and even creates more negative impacts (Khan et al., 2007). Building on these debates, there is a need for critically examining power issues in institutional change processes by examining the manner in which the institutional actions of powerful actors marginalize weaker actors, thus reinforcing unequal power relations. Therefore, future research needs to place a stronger focus on unheard voices and opponents of institutional innovation, acknowledging the role of inequalities in the transformation of institutional structures (Hirsch & Lounsbury, 2015; Munir, 2015; Hudson et al., 2015).

Finally, there is a need for mainstreaming and advocating the potential of sustainability transition studies for scholars working on similar themes using insights from institutional theory (e.g., Ferraro et al., 2015; Greenwood et al., 2015; Hoffman & Jennings, 2015). There have been recent debates in institutional theory for better understanding complex social problems (such as climate change, sustainability, poverty alleviation and inequality) through redesigning the existing institutional arrangements that create these problems in the first place (Wittneben, Okereke, Banerjee & Levy, 2012; Ansari, Wijen & Gray, 2013; Dorado & Ventresca, 2013). Concepts and insights from sustainability transition studies can be useful for better understanding the institutional change processes and for redesigning institutional arrangements for sustainability transformation. Therefore, there is considerable potential for cross-learning between different academic communities working on issues related to ongoing sustainability challenges.

Chapter 8

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Chapter 9

Appendix

Table 9.1: Chronology of important developments in emergence of wind energy in India

	Key developments in Indian wind energy sector
Before 1985	Initiation of Department of Non-Conventional Energy source (DNES) in 1982; wind energy handbook published in 1983; Commission for Additional Sources of Energy (CASE) started Department of Science & Technology in March 1981; National wind resource assessment started in 1983; first wind energy data book published in 1983; CASE transformed into Department of Non-Conventional Energy Sources (DNES)
1985	Wind resource assessment programme; first grid connected wind turbine in Veraval Gujarat; thrust to wind power in the 7th National Five Year Plan
1986	First demonstration projects in Gujarat with collaboration between Natural Energy Processing Company (NEPC) and Danish International Development Agency (DANIDA); first wind farm with ten 55kW wind electricity generators (WEGs); installation of five wind farms; development of 550 kw wind farm by RRB Consultants & Engineers Private Ltd India (RRB); non-objection certificates to wind energy projects in Tamil Nadu
1987	Co-operation between Indian and Danish government for demonstration projects; Indian Renewable Energy Development Agency (IREDA) established for financing of renewable energy projects; Danish grant for supply of wind turbines, erection, commissioning and monitoring of wind farm projects in Gujarat and Tamil Nadu; NEPC Micon as first joint wind turbine venture in India; presence of Vestas RRB in India; first research paper demonstrating technical feasibility of grid connected wind turbine projects in India
1988	Establishment of demonstration projects in Tamil Nadu and Gujarat by DANIDA
1989	First set of fiscal incentives and policy schemes for wind power; financing of wind power projects by IREDA
1990	Policies by Government of India to promote private investment in wind power (100 %tax depreciation, wheeling, banking, third party sale, tax holidays, relaxation in custom and excise duty); first 10 MW mega-scale demo wind farm at Lamba, Jamnagar
1991	Electricity Laws (Amendment) Act of 1991 encouraging private sector participation in the Indian wind energy sector; policy measures to stimulate private sector investments in wind energy; joint ventures and technical collaborations permitted with foreign entities; joint ventures between Indian and European wind energy companies; GOI abolished the clearance requirements of the Central Energy Authority (CEA) for any renewable energy projects from 1991; study by DANIDA on grid conditions in Gujarat for wind energy

1992	DNES upgraded to Ministry of Non-conventional Energy Sources (MNES); first systematic attempt to assess the potential for harnessing wind energy for electricity generation; wind energy sector was liberalised for private participation; target of 500 MW for wind energy through private sector participation set by MNES
1993	MNES guidelines to Indian states regarding fiscal incentives; procurement guidelines by respective state electricity boards for wind power; tax rule setting wind turbines exempt from excise duty and sales tax to reduce manufacturing cost; revised guidelines by MNES on accelerated depreciation, banking and wheeling and third party sales,guidelines for procurement of power from wind energy; new trade policy in 1993 which played an important role by reducing import duty for critical components such as rotor blades and electronics of controllers to zero
1994	Introduction of wind energy estates by MNES and IREDA; Enercon India Ltd. formed in joint venture between Enercon GmbH and Mehra Group of India
1995	National guidelines for clearance of wind power projects; introduction of 100% acceleration depreciation of the project cost; first set of guidelines by MNRE on turbine approval and certification; 100 % accelerated depreciation allowed for wind energy
1996	Wind energy potential upgraded to 20000 MW by MNES; lowering of tax incentives for wind power producers and introduction of Minimum alternative Tax ; establishment of Indian Wind Power Association (IWPA)
1997	Introduction of minimum alternative tax; Turbine approval and certification guidelines for independent third party testing and quality assurance evaluation; prohibition of second hand imported turbines; establishment of Indian Wind Turbine Manufacturer's Association (IWTMA)
1998	CWET established by MNES with the co-operation of Danish Government; Electricity Regulatory Commissions Act; change of exercise duty system set no exercise duty on first parts of wind turbines and rotor blades; responsibility of feed in tariff transferred from state electricity boards to State Electricity Regulatory Commissions as a result of the Electricity Regulatory Act
1999	Wind energy potential upgraded to 45000 MW; the Ministry of Textile's technology upgrading fund scheme for owners of textile mills to avail themselves of capital subsidies by setting up captive power plants or selling to third parties
2000	Turbine approval provisional scheme (TAPS) issue turbine certification based on the Indian wind and grid conditions
2001	Energy conservation Act; duty exemption certification for wind turbines; introduction of first1 MW wind turbine machine in India by Suzlon

2002	100 % accelerated depreciation benefit reduced to 80 %; reduction in excise duties for wind turbine components; establishment of Indian Wind Energy Association (InWEA)
2003	Indian electricity Act (sections 3, section 4, section 61(h), 86 (1)(e) mentioned in the Act relevant for renewable energy)
2004	First wind order tariff issued by Maharashtra state electricity regulatory commission based on cost plus methodology; RPO obligation passed by Maharashtra State Electricity Regulatory Commission
2005	National Electricity policy (Clause 5.12 stipulating conditions for development of renewable energy resources as per section 3 of Electricity Act 2003); renewable purchase obligations and preferential tariffs for purchase of electricity generated from wind power projects; first 2 MW class turbine by Suzlon
2006	National tariff policy; Integrated Energy Policy; Rural electrification policy; opportunities for project developers to earn additional revenue on wind energy projects through CER (certified emission reduction) credits in CDM mechanism
2007	Working Group on New and Renewable Energy in the 11th plan specifying 10500 MW of renewable energy
2008	National Action Plan on Climate Change specifying 15 % renewable energy by 2020; working group on policies on renewable introduced by Forum of Regulators; introduction of generation based incentive; CERC (Central Electricity Regulatory Commission) paper on promotion of electricity from renewable energy sources; open access regulations; introduction of Indian Energy Exchange and Power Exchange India Limited
2009	Introduction of generation based incentives for wind power; CERC (Central Electricity Regulatory Commission) tariff regulations for wind power CERC (Terms and conditions for tariff determination from RE sources) regulations; creation of task force constituted by CERC for integration of renewable energy resources into grid; report by Forum of Regulators on renewable purchase obligations
2010	Report on low carbon strategies for inclusive growth in India by Planning Commission targeting 30000 MW of wind power by 2020; CERC order for determination of levelled generation tariff; CERC guidelines on renewable energy certificate mechanism (REC) ; IEGC (Integrated energy grid codes) codes for wind energy providing must run status for wind farms; introduction of forecasting of wind power; Indian wind atlas published by CWET; power market regulations for promoting competitive electricity markets

2011	Renewable Regulatory Funds mechanism for wind energy; introduction of national clean energy fund; report by MNRE on strategic plan for new and renewable energy sector; trading of renewable energy certificates on Indian Energy Exchange and Power Exchange of India; announcement of national clean energy fund for renewable energy technologies
2012	12th Five year plan announcing renewable energy capacity addition; withdrawal of accelerated depreciation benefit; guidelines for mandatory forecasting of wind farms; guidelines for installation of prototype wind turbines to facilitate indigenization; introduction of zone based tariff method for wind energy in Maharashtra; scheduling of wind power introduced in the IEGC (Integrated Energy Grid Code); introduction of new land allocation policy for wind energy on foot print basis; relaxation in criteria with respect to minimum wind density of 200 Watts per square meter at 50 m hub height
2013	Re-introduction of generation based incentive by MNRE and IREDA; new guidelines in Electricity Grid Code (IEGC)'s for forecasting and scheduling of wind energy; establishment of the Wind Independent Power Producers Association (WIPPA)
2014	Introduction of National Wind Energy Mission with efforts of MNRE

Samenvatting (Summary in Dutch)

Het doel van deze dissertatie is het verkennen van de rollen van verschillende actoren en hun collectieve strategieën in het realiseren van fundamentele verandering in gevestigde energiesystemen gebaseerd op fossiele brandstoffen in India. De energiesystemen in India zijn grotendeels gebaseerd op kolen, grootschalige waterkracht centrales, olie en aardgas en deze energiesystemen worden vandaag de dag geconfronteerd met grote uitdagingen op het gebied van klimaatverandering, energiezekerheid, energiearmoede en dit alles in een context waar gestreefd word naar snelle economische groei. Om deze energie uitdagingen het hoofd te bieden en om wind- en zonne-energie te 'mainstreamen', is de Indiase overheid gestart met de Jawahar Lal Nehru National Solar Mission en de National Wind Energy Mission. Hoewel dit veelbelovende initiatieven zijn, zijn er nog steeds belangrijke uitdagingen in het mainstreamen van wind- en zonne-energie omdat er een veelvoud van belangen en doelen aan ten grondslag liggen. De uitdagingen zijn ook complex meerdere en verschillende stakeholders betrokken zijn binnen de bestuurlijke lagen van de centrale overheid en overheden van de verschillende staten binnen de federale context van India. De 'capabilities' om beleid en regulatie op een betekenisvolle manier te implementeren zijn beperkt. Om hiervoor een oplossing te vinden en om verder te komen is het noodzakelijk dat verscheidene stakeholders – die onderling verschillen in termen belangen, onderliggende motivatie, aanspraak op macht en toegang tot hulpbronnen – op collectieve wijze actie ondernemen. Deze dissertatie richt zich op het begrijpen van deze uitdagingen en op de verschillende strategieën van actoren om op collectieve wijze de institutionele configuratie binnen de context van het energiesysteem in India te veranderen. Dit proefschrift onderzoekt de volgende centrale onderzoeksvraag: Hoe betwisten actoren op collectieve wijze de institutionele configuraties binnen de context van energietransities in India?

Dit proefschrift bouwt voort op de 'sustianbility transitions' literatuur en op de 'collective institutional entrepreneurship' literatuur. Theoretisch gezien is het proefschrift gepositioneerd als volgt: hoewel de huidige 'sustainability transitions' literatuur gericht is op bevragen van energietransities door het bieden van verschillende conceptuele perspectieven, zijn er empirisch gezien relatief weinig inzicht in de rol van collectieve actor strategieën in het betwisten van dominante institutionele configuraties.

Het introductie hoofdstuk van dit proefschrift presenteert een overzicht van de theoretische positionering van het onderzoek binnen de 'sustainability transitions' en 'collective institutional entrepreneurship' literaturen, van de onderzoeksmethoden en van de verschillende artikelen die als hoofdstukken dienen. Hoofdtukken twee tot en met zes richten zich op het beantwoorden van de centrale onderzoeksvraag door te kijken door verscheidene theoretische lenzen naar de ontwikkeling van wind- en zonne-energie in India en door te empirische studies te doen waarbij de analyse-eenheden ('units of analysis') onderling van elkaar verschillen. Methodologisch gezien mobiliseert het proefschrift een 'qualitative case study approach' door gebruik te maken van materiaal

verzameld tijdens veldwerk in India: archiefdata, semigestructureerd interviews en het observeren van participanten in forums en conferenties.

Hoofdstuk 2 richt zich op 'social enterprises' die off-grid zonne-energie oplossingen bieden voor gemarginaliseerde groepen mensen in India die geen of weinig toegang hebben tot energie. Hoofdstuk 2 is gericht op sociale ondernemingen (social enterprises), die off-grid zonne-energie oplossingen bieden aan gemarginaliseerde groepen mensen zonder toegang tot energie. Er wordt een brede classificatie gegeven van verschillende opschaling-dimensies van veelbelovende business model experimenten het benadruk het belang van institutionele innovatie voor transities naar een duurzame samenleving.

Hoofdstuk 3 is gericht op de historische ontwikkeling van windenergie in India. Dit hoofdstuk bouwt voort op de inzichten van hoofdstuk 1 en kijkt naar de rol van institutionele innovatie. Het benadrukt het belang van collectief institutioneel ondernemerschap (collective institutional entrepreneurship) waarbij meerdere actoren hun strategieën tot institutionalisering van innovatie aanpassen in een situatie van onderling conflict. Dit hoofdstuk benadrukt de noodzaak om verder in te gaan op deze conflicten tussen machtige en mindere machtige actoren door open te staan voor de input van gemarginaliseerde actoren en hen de mogelijkheid te bieden om te participeren in het besluitvormingsproces.

Hoofdstuk 4 vergelijkt windenergie in India (een opkomende institutionele context) met Finland (een ontwikkelde institutionele context). Dut hoofdstuk bouwt voort op de inzichten van hoofdstuk 3 (dat institutioneel ondernemerschap in opkomende en ontwikkelde contexten vergelijkt). Dit hoofdstuk stelt dat opkomende institutionele contexten zoals India niet noodzakelijkerwijs meer kansen bieden voor strategische verandering in vergelijking met ontwikkelde institutionele contexten. Het concludeert dat uitdagingen kwalitatief van elkaar verschillen.

Hoofdstuk 5 vergelijkt verschillen in implementatie van grid-connected zonne-energie in twee Indiase staten (Gujarat en West-Bengal) door de inzichten van de institutional entrepreneurship literatuur toe te passen in regionale context. Het beschrijft de redenen van succesvolle implementatie in Gujarat en de minder succesvolle implementatie in West-Bengal door uiteen te zetten wat de rollen waren drie cruciale actoren: bureaucraten van de regionale overheid, regionale regulatoren, regionale industrie associaties.

Hoofdstuk zes analyseert twee belangrijke punten van debat op het gebied van zonne-energie in de National Solar Mission in India met betrekking tot het stimuleren van 'capabilities' binnen India en het efficiënte gebruik van publieke financiering mechanismen door het volgen van de verhalen die verteld worden door verschillende actoren in conferenties en forums. Dit hoofdstuk brengt de rol van forums naar voren om te begrijpen hoe actoren elkaar onderling beconcurreren in de discursieve strijd om alternatieve interpretaties van vanzelfsprekende institutionele configuraties.

Tenslotte biedt hoofdstuk zeven een conclusie en samenvatting van de belangrijkste bevindingen. In hoofdstuk zeven wordt de centrale onderzoeksvragen beantwoord en wordt duidelijk gemaakt hoe dit proefschrift een theoretische bijdrage levert aan de 'sustainability transitions' literatuur. De inzichten van de verschillende empirische hoofdstukken leiden tot een simpele typologie van drie overkoepelende collectieve strategieën die de actoren gebruiken in hun pogingen tot het veranderen van de institutionele structuren van de gevestigde energiesystemen. Deze collectieve strategieën zijn: (1) institutionele adaptatie gericht op het experimenteren binnen en buiten institutionele beperkingen in beschermde ruimtes; (2) het bouwen van institutionele capaciteit gericht op het ontwikkelen van 'indigenous capabilities' door middel van transnationale verbindingen; en (3) institutionele transformatie door te richten op bewuste pogingen om de institutionele configuratie te veranderen middels discursieve strijd tussen heterogene actoren in forums. Door het ontwikkelen van deze typologie draagt dit proefschrift bij aan recente debatten over de micro-fundamenten van transities naar duurzaamheid, hetgeen gerelateerd is aan het in meer aandacht voor hoe actoren en hun strategieën vormend zijn voor socio-technische systemen. Tot slot wijst dit proefschrift op manieren waarop transities naar duurzaamheid gestuurd kunnen worden. De typologie inzichten leiden ook tot implicaties voor beleid en praktijk en wijzen op mogelijkheden voor interessant vervolgonderzoek.

Curriculum vitae and biography

Suyash Jolly was born on November 6 th 1985 in Dehradun, India. After graduating from Vellore Institute of Technology in Mechanical Engineering in 2008, he enrolled in the Innovation Science master's program at the Department of Industrial Engineering and Innovation Sciences at Eindhoven University of Technology. In 2010, he graduated from the Department of Innovation Sciences with great appreciation. He started his doctoral research in the NWO WOTRO project: Experimenting for sustainability transitions in India and Thailand under Professor Rob Raven and Geert Verbong in 2011. His doctoral research focuses on role of collective institutional entrepreneurship in development of solar PV and wind energy in India.

Suyash is also a member of various associations such as Sustainability Transitions Research Network (STRN), European Group of Organization Studies (EGOS) and Academy of Management (AOM) and also completed PhD certificate in Netherlands Graduate Research School of Science, Technology, and Modern Culture (WTMC). His research interests are in role of institutional strategies for transformation of socio-technical systems, social and sustainable business models, business models for sustainability, science and technology studies, frugal innovation in emerging economies and innovation policy. In future he is interested in studying role of field configuring events and hybrid forums for sustainability transitions and contributing to new research agendas in sustainability transitions research. He will also soon start working as a postdoctoral researcher on development of smart grids in India. During his doctoral research he has published his research and presented his work in well renowned international journals and prominent conferences. An overview is presented below.

RESEARCH OUTPUT

Jolly, S., Raven, R.P.J.M., 2016. Field configuring events in sustainability transitions: The case of solar energy in India. Technological Forecasting and Social Change, 103, 324-333

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Jolly, S., Raven, R.P.J.M., Verbong, G.P.J., 2012. Upscaling of wind energy niches in Tamil Nadu and Andhra Pradesh and the role for collective institutional entrepreneurship. Abstract presented at *Proceedings of the STRN Conference: Sustainable Transitions: Navigating Theories and Challenging Realities, August 29-31 2012, Copenhagen, Denmark.*

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Eindhoven University of Technology
School of Innovation Sciences