2019

A Comparative Analysis to Understand the Subnational Motivations for Renewable Energy Development in India

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Submitted to
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by
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for
Senior Thesis
Academic Year 2018-2019
April 29, 2019

Acknowledgements

First, I would like to thank Professor Sinha, for her ceaseless support, guidance, and mentorship throughout my senior thesis writing process. I am so grateful for her encouragement for me to return to India over winter break to conduct interviews. This thesis writing process has opened my eyes to the world of academia, and I hope to continue this research after graduation.

Second, I am incredibly grateful to my professors at CMC who have challenged me to think about environmental issues through an interdisciplinary lens. Professor Lower, who provided me support since freshman year to think about the human rights impacts of environmental degradation. In addition, the Mgrublian Center has been incredibly supportive in helping me decide to pursue a career in renewable energy policy analysis. The Center supported me through internship opportunities, which allowed me to conduct additional interviews for this thesis. Through the Center's support next year, I plan to continue this research and eventually publish the work in an academic journal.

Professor Ascher, for his guidance and mentorship during weekly Roberts Environmental Center meetings and for instilling in me an appreciation for introduce myself with both my first and last names. Professor Evans, for advising me through my time in the Environment, Economics, and Politics major and adding to my economic understanding of environmental regulations. In addition, to Professor Williams, for helping understand the environmental science lens of climate change mitigation policies.

Third, I would like to thank my friends, classmates, and sister who were always willing to listen to me about renewable energy in India. Especially those of you who studied with me in the second floor of the Athenaeum at the Roberts Environmental Center into early hours of the morning.

Fourth, to the School for International Training (SIT), for supporting me during my study abroad experience in Jaipur, which led me to become interested in renewable energy development in India.

Lastly, I want to thank my two amazing parents: for encouraging me to travel the world and study environmental policy. Their endless love and support allowed me to study abroad in Jaipur, India junior year, intern in Delhi summer 2018, and return over January 2019 to conduct additional interviews.

I would also like to thank CabbageTree solutions for helping me transcribe several of my interviews, which are attached in the appendix to this thesis.

Abstract

Providing energy security and diversifying the energy production in India align with the country's rising power ambitions and policy goals to industrialize. Renewable energy provides a useful tool for the state to meet these policy goals without producing more air pollution and additional environmental degradation. The Central Government has international ambitions of with becoming a rising responsible power; these aspirations have created new resources, incentives, and policy ideas for the subnational states in India. The purpose of this thesis is to map out the motivations, interests, and incentives of subnational elites in devising policies to promote renewable energy development in Tamil Nadu, Kerala, Gujarat, and Rajasthan. I develop an analytical framework based on four variables: 1) state-level party politics, 2) financial space/ indebtedness of state distribution companies, 3) institutional knowledge in state-level nodal renewable energy agencies, and 4) state-level linkages with the private sector to examine different modes of vertical alignment that subnational actors employ to develop renewable energy policies. I find that environmental concerns weren't the primary driver of renewable energy development; instead, environmental benefits were an unintended outcome of private sector actors and state elites coordinating with the Central Government to address the pressing needs of ensuring reliable energy for industry leaders. In particular, Kerala demonstrates that even when active environmental movements and popular support exists for renewable energy, unless there are active private sector linkages, renewable energy development will remain slow. These findings may be very helpful for central government officials in India and state-level bureaucrats trying to devise climate change mitigation policies on the subnational level. Moreover, international climate change negotiators could use these findings to engage with India more to accelerate renewable energy development to slow anthropogenic climate change.

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Introduction

On August 16, 2018, Indian Prime Minister (PM) Narendra Modi addressed a crowd outside the historic Red Fort in Old Delhi for Independence Day, heralding a new era in India's engagement with the rest of the world. PM Modi praised the country's increased ease of doing business ranking, higher stature in international organizations, and launching of Indian-made satellites into space. PM Modi asserted that "the same set of experts who had earlier dubbed India as a 'sleeping elephant' are now saying that 'sleeping elephant' has woken up and started running" (Modi 2018). During the speech, he promised universal housing, electricity, and improved infrastructure for the rural poor; these developmental priorities and outward looking policy agenda demonstrate India's rising power ambitions. PM Modi also acknowledged that "India offers a ray of hope for those who are concerned with environmental issues and global warming" (Modi 2018). The Central government has realized that there are massive foreign policy and soft power implications to the developmental status of the country, especially as an emerging world power. In particular, the Indian government has become more vocal about India's green future, announcing ambitious renewable energy targets to address domestic energy security concerns and present itself as a responsible rising leader.

India's rising power status is dependent on energy security. The Central Government recognizes that the future of the state requires the diversification of energy sources away from fossil fuel because the lack of supply and its desire to emerge as a responsible power. Renewable energy provides a powerful answer to the Central Government's concerns: Prime Minister (PM) Modi has announced an ambitious target of sourcing 175 GW of renewable energy, 100 GW of which will be from solar energy, by 2022 (Sareen and Kale 2018). However, because India is a federal system, it is necessary to analyze the state-level variation and subnational motivations in the implementation of renewable energy policies to determine the ability of the Central Government in achieving its ambitious targets. The Indian Government has realized the uneven subnational willingness to implement renewable energy targets and has allocated predicted targets met within the 175 GW target by state (see Figure 1).

This puzzle made me wonder why do regional states pursue the renewable energy policies that they do? Why is there subnational variation in the implementation of Central Government policies in India? More specifically, why is Kerala not a front-runner despite its successful environmental movement? How come Rajasthan developed its renewable energy potential so late, yet so successfully? Why did Gujarat implement a solar policy before that of the Central Government? And what factors led to subnational elites in devising the renewable energy policies in Tamil Nadu, which continues to have more installed renewable energy capacity than many European nations?

As India has become more dominant on the world stage, it has been more active in international climate change agreements. Many climate scientists and scholars argue that the ability of India to transition to clean energy technologies will dictate the global community's ability to stay within two degrees Celsius within preindustrial temperatures, a crucial threshold established during the Paris Climate Accord to prevent extreme climate change.

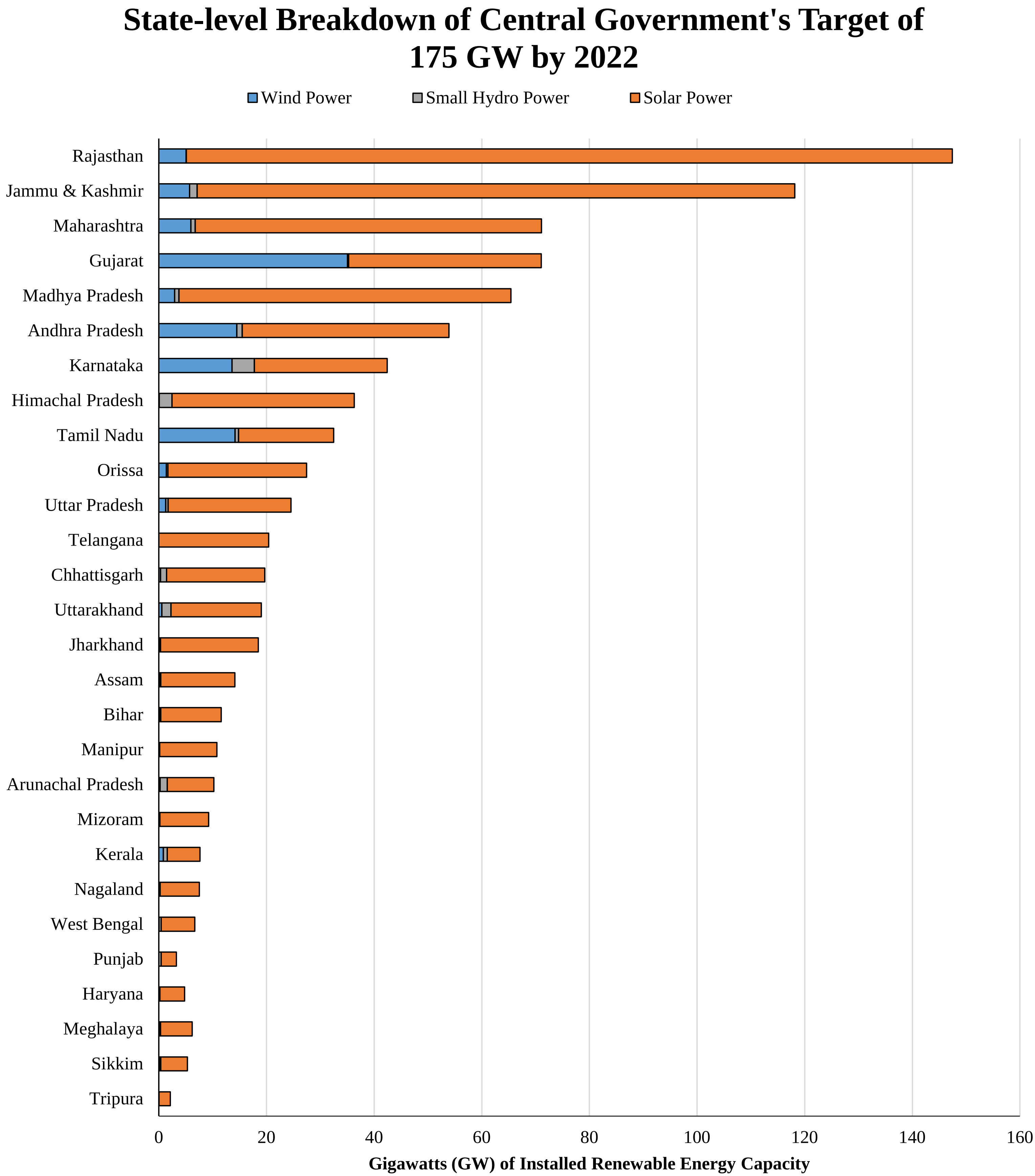

Figure 1. State-level Breakdown of Central Government's Target of 175 GW by 2022 (MNRE 2017).

In this introductory chapter, I propose an analytical framework for analyzing the motivations of subnational policymakers in devising renewable energy policies, including state-level party politics; the financial space or indebtedness of state distribution companies; institutional knowledge in state-level nodal renewable energy agencies; and state-level linkages with the private sector. I further elaborate on the origins of the analytical framework in the second chapter.

India's Rise on the International Stage

India is in the midst of an economic transformation that has increased the country's standing on the international stage. The world's largest democracy is home to over one-sixth of the world's population and now the world's third-largest economy by power purchasing parity (PPP) (IEA 2015). India is expected to overtake China as the world's most populous country by 2021, and as one of the world's fastest growing economies, electricity demand is projected to increase fourfold from 2015 levels by 2040 (IEA 2015).

Yet, despite rapid economic growth, the country faces many developmental challenges and human security concerns: India is still home to a third of the world's poor, has the world's largest population people without access to electricity, and the average GDP per capita is well below the international average. India's energy sector has grown rapidly to meet increasing demand, boosted by population growth, urbanization, and industrialization. Moreover, the World Health Organization estimates that half of the world's top 20 most air polluted cities are in India (Zhang and Crooks 2012). Hence, India faces a unique triple challenge of meeting growing per capita energy demand, cutting pollution, and expanding energy access to rural areas.

Importance of Climate Change Mitigation Strategies in Responsible Leadership

On May 9th, 2013, the level of carbon dioxide in the world's atmosphere hit 400 parts per million, a crucial indicator of humankind's effect on the environment (Gillis 2013). As the *New York Times* reported, "For the entire period of human civilization, roughly 8,000 years, the carbon dioxide level was relatively stable near [280 parts per million]. But the burning of fossil fuels has caused a 41 percent increase in the heat-trapping gas since the Industrial Revolution" (Gillis 2013). Humankind has had such a profound impact on the environment that the Worldwatch Institute deems that "there are no policies in place to prevent it from passing 450 ppm" (*Worldwatch Institute* 2014, 63). Scientists have proclaimed that we have entered a new geologic era, called the Anthropocene era, where humans are the primary driver of evolutionary change on earth (*Worldwatch Institute* 2014).

Ever since the 2009 United Nations Climate Change Conference in Copenhagen, the international community has agreed that the world should not warm over 2 degrees Celsius (2°C) from pre-industrial levels. However, the World Bank declared in 2012 that "we're on track for a 4°C warmer world [by century's end] marked by extreme heat waves, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea level rise" (World Bank 2012, 1). To put the 4°C (or 7.2°F) rise in temperatures in perspective, as of 2015, the temperature has only increased by 0.8°C; nevertheless, we are already experiencing extreme drought, excessive glacial melting, and ocean acidification.

Leading up to the Paris Climate Accord in 2015, Western media outlets characterized India as overwhelmingly polluted and unwilling to implement effective climate change mitigation policies. The *New York Times* classified India as "an intransigent outlier in global climate-change talks" (Barry & Davenport 2015). The *Financial Times* ran a story titled, "Dirty air: how India became the most polluted country on earth." Another *New York Times* article from October 2018 described the "dreaded pollution season in India," which leads to children requiring plastic masks to walk to school in the mornings, postponed sports games, and canceled international flights into Delhi (Schultz et al. 2018; Gettleman, Schultz, & Kumar 2017). United Airlines even declared that the poor air quality was severe enough to be considered a "natural disaster, and to be avoided like a hurricane or wildfire would be" (Meza 2017). These environmental and developmental concerns have massive soft power implications for India, even as a developing country.

The ability of countries to introduce climate change mitigation policies can produce large dividends on the world stage. As India emerges as a world leader, the Indian Government recognizes the importance of facilitating a clean energy transition. Since the ratification of the UN Paris Climate Accord in 2015 and the consequential creation of the treaty-based International Solar Alliance in Delhi, India has become a world leader in renewable energy development, mentoring other developing nations on policy and financial mechanisms to diffuse solar and wind energy. The Indian solar market is attracting international attention: Bloomberg New Energy Finance notes that "the Indian market is home to the largest and most competitive auctions in the world" (Bloomberg NEF 2018, 4). Promoting renewable energy development can act as a key solution to mitigating the causes of climate change, promoting economic development, and meeting increased energy demand. The Government of India has announced ambitious renewable energy targets of 175 GW of capacity by 2022; however, delivering this clean energy relies on the state governments because of the political structure of India.

The Central Government of India has orchestrated a robust series of mechanisms to support renewable energy development, including grants to develop technologies, generation-based incentives, and tax incentives (Hogg and O'Regan 2010). However, installed capacity of renewable energy varies greatly among states. As of 2017 Tamil Nadu has 10.6 GW of grid-connected installed renewable energy capacity (7.9 GW of wind and 1.7 GW of solar), the largest of any Indian state; Maharashtra is second with 7.6 GW (4.77 GW wind and 0.45 GW solar); Karnataka is third with 7.5 GW (3.8 GW wind and 1.0 GW solar); Gujarat is fourth with 6.7 GW (5.34 GW wind and 1.25 GW solar); and Rajasthan is fifth with 6.2 GW (4.28 GW wind and 1.81 GW solar).[1] Of the total 29 States of India, these five states contain over 67% of the total renewable energy installed capacity. In particular, wind energy is concentrated in just seven states: Tamil Nadu, Gujarat, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh, and Madhya Pradesh. Moreover, although climate change isn't the main policy concern, the integration of renewable energy in the state-level energy mixes to combat energy security has been impressive in states like Tamil Nadu, Karnataka, Gujarat, and Rajasthan. Certain states are more proactive in attracting renewable energy investment: a recent report by the Center for Financial Accountability found that five states—Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, and Rajasthan— attracted three-quarters of the total lending of 22,913 crore INR (3.3 billion USD) in 2017 (Vijayakumar 2018).

[1] State-level disaggregated installed capacity of grid interactive renewable power totals found in annual "Energy Statistics" reports published by the Central Statistics Office, Ministry of Statistics and Programme Implementation, Government of India. Renewable power include biomass power, waste to energy bio-power, wind power, small hydro power (less than 25 MW), and solar power.

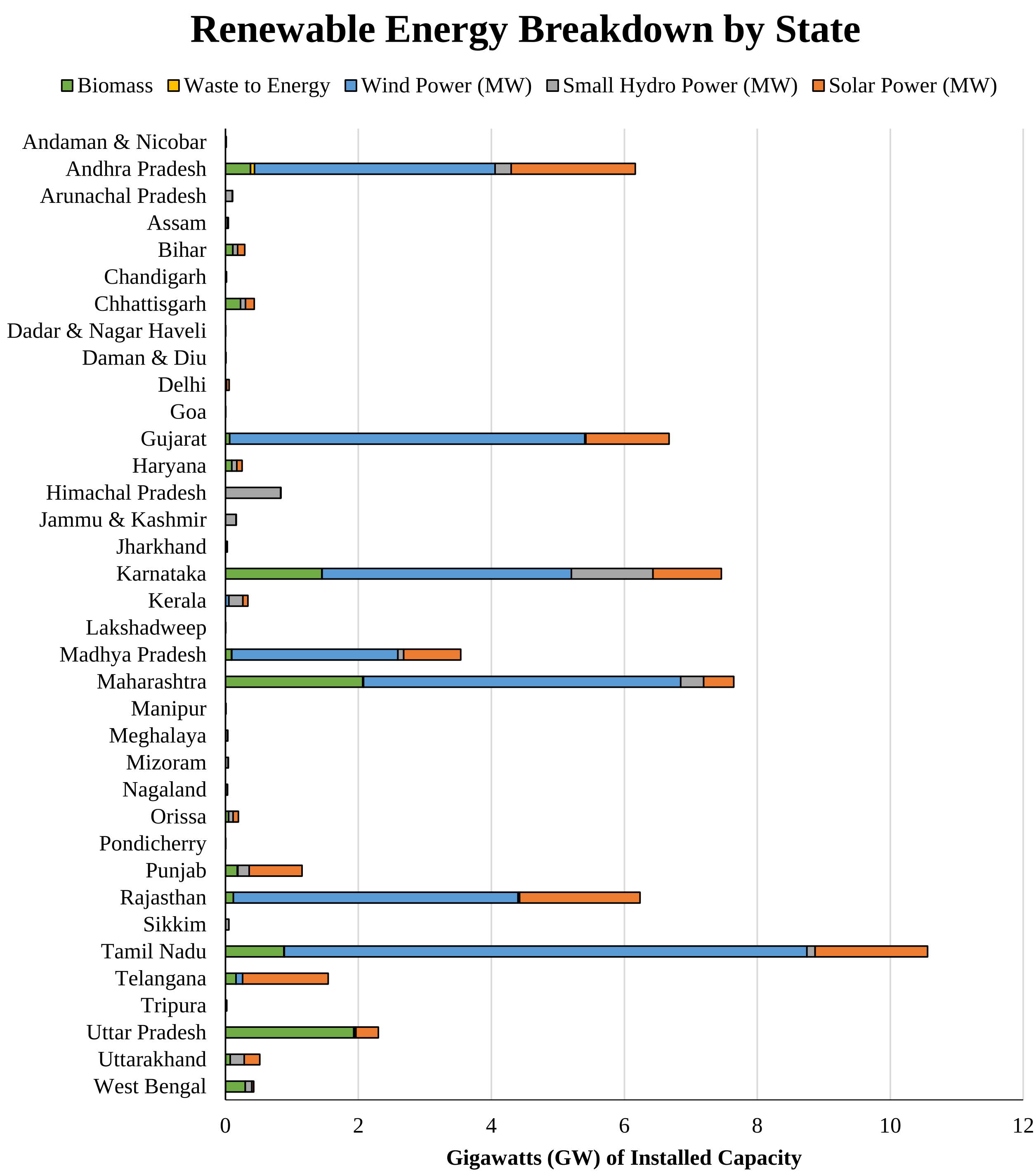

Figure 2. Breakdown of Renewable Energy Installed Capacity by State (MoSPI 2018).

Energy Governance in India

The most pressing challenge for renewable energy growth and development in India is the concept of "energy federalism." Scholars have used the term "energy federalism" to capture federal and inter-state dynamics of energy policy in the United States. Although there is scholarship on the center-state dynamics on developmental and economic policy in terms of Indian public finance and development studies, little research has been conducted on these dynamics relating to renewable energy development (Sareen and Kale 2018).

In India, electricity policy is developed by both the Central and State Governments, but only implemented by the state governments. The electricity sector in India has gone through three distinct phases: the colonial period (pre-1948), the post-independence period (1950s-1980s), and the liberalization period (1990s-2000s). The sector has progressively trended towards more oversight, but is still dominated by state governments. Nevertheless, the concerns over cross-subsidies and financial infeasibility remain to this day and significantly impact the ability of states to expand renewable energy access.

The Government of India Act 1935 had placed electricity policy on the "concurrent list," making it distinct from solely the "central" or "provincial" lists. Prior to independence, the central authorities would lay out the broad rules for the sector while the provincial governments would collect electricity taxes, grant licenses to private utilities and construct government-owned generation and distribution grids (Kale 2014, 31). During the colonial period, the Indian Electricity Act 1910 outlined the guidelines for which private firms were to be granted licenses to supply power. India's electrical power was miniscule in relation to modern-day capacity (1,713 MW or less than 2 percent of current capacity) with less than one percent of villages electrified (Kale 2014, 32).

After Indian independence, the Electricity Act of 1948 created the Central Electricity Authority and State Electricity Boards (SEBs), which acted as nodal agencies to provide accelerated electrification. As a result, between 1950s and the 1980s, the SEBs emerged as preeminent institutions with the most influence over the sector. From the early 1990s until the passage of the Electricity Act of 2003, which deregulated the electricity market, the sector shifted towards private capital (Kale 2014, 27).

Historically, subnational states in India have retained political power over the electricity sector because the allocation of electricity access and decision-making for pricing produces political power. From the 1950s until 1980s the electricity sector was entirely publicly owned, with large vertically integrated public utilities operating in each state. Having the states give more power to the central government would be against their own self-interest in maintaining authority within their own boundaries. Allocating electricity access and setting prices is a political tool that can help the governing coalition stay in power. In particular, India's electricity pricing structure is characterized by "cross-subsidies," where farmers and domestic consumers have cheap rates, while industrial consumers are charged more per kilowatt hour. However, the use of cross-subsidies yields political dividends for financially unsustainable state electricity boards. The cross subsidies and policy push for greater universal electrification troubled the SEBs financially. In 1964, the Central Government appointed a committee-- commonly known as the Venkataraman Committee-- to investigate the financial viability of the SEBs. The commission advised to charge higher rates to industrial consumers and to further electrify India's rural areas.

As international organizations have gotten involved in providing loans to Indian state electricity boards, the World Bank provided assessments for India's power sector and advocated for a greater economies of scale and privatization. A World Bank report in 1975 suggested to further centralize the electricity sector, where the CEA could be granted authority over planning and development as well as coordination among SEBs. In 1976, the government amended the Electricity Act of 1948 to increase the scope of CEA's authority (Kale 2014, 42). In the 1980s, many states in India were impacted by severe power cuts. As a response to an increasingly unstable grid and higher prices, industrialists abandoned the grid in favor of in-house captive generation, which negatively impacted the profits of SEBs.

In 1991, following the balance-of-payments crisis and subsequent deregulation of the Indian economy, the Central Government amended the Electricity Act of 1948 to attract private investment. Politicians were supportive of such reforms because of recurring power shortages. Industrial firms were also supportive because of the use of captive generation, so private sector actors could then sell their excess supplies back to the electricity grid. The Indian Ministry of Power's annual report for 1991-92 shows optimism for the new reforms: "opening up profitable investment opportunities. That offers a package of incentives which investors, both from India and overseas, will find really attractive" (quoted in Kale 2014, 44). MoP provided numerous incentives to private investors like an extension of the initial licensing period from twenty to thirty years, the subsequent renewal period from ten to twenty years. In addition, the rate of return on capital investments was increased from 2 percent to 5 percent on all investments made, and foreign equity participation was fully liberalized (Kale 2014, 45).

The liberalization of the electricity sector further accelerated the concerns over financially risky SEBs. If independent power producers (IPPs) had to sell their power to insolvent SEBs, as the 1948 required, then the financial risks could impact both the government and consumers. The Central Government decided that the state governments should dismantle their vertically integrated SEBs and privatize electricity distribution, as well as establish regulatory institutions to govern tariff policy. These two reforms would address the concerns over political interference with SEBs, which tariffs for electricity too low and subsidies too high for the SEBs to operate as financially sustainable institutions (Kale 2014, 45). The Electricity Act of 2003 further liberalized the electricity sector in India. The main aim of the reform was to scale back the influence of the state governments and open up the sector to private investment.

Approach and Methods

This thesis draws its evidence from intensive fieldwork completed during three different trips to India. First, during my study abroad program with the School for International Training (SIT) in Jaipur, Rajasthan from September- December 2017; second, during an internship in Delhi from May- July 2018, which included interviews with policymakers in Delhi and state-level civil servants in Kerala; third, during a research trip to Karnataka, Tamil Nadu, and Kerala in January 2019. During these three visits, I interviewed journalists, private sector actors, and subnational bureaucrats working on renewable energy development in the following states: Rajasthan, Uttar Pradesh, Karnataka, Tamil Nadu and Kerala. In addition, I interviewed policymakers in Delhi at prominent think tanks that assist the Central and State Governments in devising renewable energy policies. During these interviews, one official would often put me in touch with another, making the strategy a snowball sampling. Although the first couple interviews I conducted were recorded (with permission), I stopped doing so after the second visit because I realized the quality of data collected improved when respondents were not recorded. During every interview, I used a notebook to collect exhaustive notes, then after each interview I typed up everything I could remember or wrote down on a Google Document to ensure the whole meeting was documented.

For this thesis, I also analyzed State and Central Government renewable energy policy documents going back to the 1980s. I read newspaper articles, academic journal articles, reports written by international organizations, and books on the political economy of electricity in India. In addition, I collected over 20 years of state-level installed renewable energy capacity data by manually scraping the data from the Ministry of Central Statistics' annual "Energy Statistics" report in an Excel file. Although these only go back to 2006 with the creation of the Ministry of New and Renewable Energy (MNRE), I visited the websites of state-nodal renewable energy agencies to collect wind energy data from the 1990s until 2006.

Design of Study

These four states were chosen to best control for regional and economic variables. I initially chose Rajasthan because it was the state in which I studied abroad in Fall 2017. I conducted several interviews with state-level officials in the state-nodal agency, discom, and private sector actors. Because of regional differences in cultural and developmental factors between the Northern and Southern Indian states, I wanted to choose two states that were in the north and two in the south. In addition, I hoped to choose two neighboring states to control for geographic favorability— it would be challenging to compare four states with all vastly different topographies. Tamil Nadu was an immediate choice because of its success in utilizing its renewable energy resources; neighboring Kerala was interesting because it was a socially progressive state that had very little renewable energy installed capacity. I added Gujarat because of its well-known effective governmental bureaucracy and industrial legacy. The state added additional interest because of then-Chief Minister Modi's early introduction of a solar energy policy and mobilization of renewable energy investment.

In order to understand the motivations of subnational elites in devising renewable energy policies, I wanted to have a diverse set of states that did not bias my findings. Therefore, I chose four very different states: Tamil Nadu, Kerala, Gujarat, and Rajasthan. These were two sets of neighboring states in which the former was a first-mover in devising renewable energy policies, while the latter was slow to embrace renewable energy technology.

I employ a subnational comparative method defined by Snyder (2001) to identify the motivations of subnational elites in developing renewable energy policies. The subnational comparative method provides a useful tool to break the "whole nation bias" in the field of comparative politics. Snyder emphasized that "subnational comparisons provide a firm foundation for building theories that explain spatially uneven processes of political and economic transformation" (Snyder 2001, 103). Although political and economic development unfolds unevenly across states in India, few comparative studies have been conducted. Traditionally, scholars have focused on states, cities, party systems, urban slums, and sub-regions to demonstrate variation within India (Auerbach 2013; Bussell 2012; Chandra 2004; Harriss 2003; Jenkins, Kennedy & Mukhopadhyay 2014; Kale 2014; Kohli 1987; Singh 2011; Sinha 2005; Varshney 2002; Wilkinson 2004; Yadav & Palshikar 2003). I apply the subnational comparative method to renewable energy development.

Economic development theories have traditionally relied on a unitary and top-down notion of the state. Disaggregating the states and their activities by itself is not enough by itself. Based on a theory of nested games to analyze the strategic choices by subnational rulers, provides insights in how competition and cooperation *internal* to the nation-state can affect the developmental prospect of the country. Subnational institutional capacities differ depending on the state. Although regional politics shape the political choices made by subnational rulers, rewards imposed by the vertical center creates an intergovernmental constraint on the choices made by regional elites (Sinha 2003, 49). In respect to renewable energy policy, disaggregating the state-level policies can provides fruitful insights on renewable energy transitions, demonstrating the successes of certain states and the failures of others. Despite India being framed as unwilling or unable to commit to climate change mitigation policies, by disaggregating the state we see that certain states are even more successful than certain developed countries when it comes to installing renewable energy capacity. Moreover, this analytical framework creates a theory of renewable energy development to understand the policy motivations of the political elites in Indian states.

Brief Overview

This thesis is divided into eight chapters. The next (second) chapter is a literature review and develops an analytical framework for understanding the motivations of subnational elites in implementing renewable energy policies. Based on the literature, I identify four categories that are crucial for understanding the motivations of subnational policymakers in devising renewable energy policies: *state-level party politics; financial space or indebtedness of state distribution companies, institutional knowledge in state-nodal renewable energy agencies; and state-level linkages with the private sector.* The third chapter chronicles the history of wind and solar energy policy on the Central Government level. Moreover, the Central Government is necessary to analyze in order to understand the introduction of policy, but it does not say much about renewable energy development in India by itself. The most important thing is to look at state-level motivations: In the next four chapters, I disaggregate the Indian state and chronicle the renewable energy policies in four states (Tamil Nadu, Kerala, Gujarat, and Rajasthan) and apply the theoretical framework to understand the motivations of subnational policymakers in devising such policies.

Tamil Nadu, Karnataka, and Kerala are all above the Indian Average in terms of literacy and blow the Indian average for infant mortality data, while and Rajasthan are both below average in both categories. Kerala is a small and densely populated state in the south with high human development indicators and abundant hydro power, but doesn't have much wind or solar energy installed capacity. Tamil Nadu has the largest economy of any state in India and provides its largest percentage of electricity from renewable sources; however, the motivating factor was due to electricity shortages and expensive coal in the 1980s. Gujarat is a hub of economic development and "good governance" and the state pioneered innovative solar energy policies under then Chief Minister Modi's leadership. Rajasthan has India's largest solar and wind energy potential and has achieved impressive capacity installation in recent years, but still has a low electrification rate and continues to build coal-fired power plants.

Table 1. Overview of Economic and Energy Indicators in Four States (sources: Roy 2013; GoI Census 2011; MoSPI 2018)

	Tamil Nadu	**Kerala**	**Gujarat**	**Rajasthan**
Population (Census 2011)	72.14 million	33.39 million	60.43 million	68.62 million
Gross State Domestic Product (GSDP Per-capita INR) RBI Statistical Review Handbook 2010-11	59,345	62,339	60,499	29,787
Per-Capita Energy Consumption (kWh)	1,131.58	525.25	1,615.24	736.2
Statewide Energy	Hydro: 2.2	Hydro: 1.88	Hydro: 0.77	Hydro: 1.09

Installed Capacity (percentage of total installed capacity) (2017)	GW (10.21%) Thermal: 8.71 GW (40.44%) Renewable: 10.63 GW (49.35%) **Total: 21.54 GW**	GW (73.72%) Thermal: 0.33 GW (12.94%) Nuclear: 0 GW (0.00 %) Renewable: 0.34 GW (13.33%) **Total: 2.55 GW**	GW (2.78%) Thermal: 20.25 GW (73.10%) Renewable: 6.67 GW (24.08%) **Total: 27.7 GW**	(6.68%) Thermal: 8.99 GW (55.09%) Renewable: 6.24 GW (38.24%) **Total: 16.32 GW**
Renewable Energy Potential (Utilization rate: total capacity divided by potential) (2017)	Wind: **14,152MW** (55.55%) Solar: **17,670 MW** (9.57%) Small Hydro: **660 MW** (18.64%) Total RE: **34,152 MW** (30.93%)	Wind: **837 MW** (6.15%) Solar: **6,110 MW** (1.21%) Small Hydro: **704 MW** (30.26%) Total RE: **8,732 MW** (3.88%)	Wind: **35,071 MW** (15.23 %) Solar: **35,770 MW** (3.49 %) Small Hydro: **202 MW** (8.22 %) Total RE: **72.726 MW** (9.17 %)	Wind: **5,050 MW** (84.79 %) Solar: **142,310 MW** (1.27 %) Small Hydro: **57 MW** (41.84 %) Total RE: **148,518 MW** (4.20 %)
Percentage of Electrified Households (Census 2011)	93.4%	94.4%	90.4%	67.0%

2

Literature Review and Theoretical Framework

Introduction

My main research question is: what are the motivations of subnational bureaucrats in India in devising policies to promote renewable energy diffusion. This chapter includes an exhaustive literature review on the policy motivations of governments to implement renewable energy policies, governance literature on India's interaction between the Central and State Governments, and public goods provisions. This chapter builds the theoretical framework of this thesis and concludes by identifying four variables to assess the motivations between the Indian Central Government and state-governments in devising renewable energy policies. The theoretical assumptions of this paper have several roots. First, the paper assumes the rationality of actors based on rational choice institutionalism (see Zarhani 2019; Shepsle 1989) and game model behavior between different levels of government (Tsebelis 1990). In terms of the rational choice approaches in political science, there is an assumption that human activity is goal oriented and actors try to maximize their goal achievement. Moreover, rational choice institutionalism emphasizes that institutions shape the behaviors of rational actors (Zarhani 2019). Weyland (2002, 60) notes that the rules of governing behavior are based on products of utility-maximizing individual actions by actors motivated by strategic interaction.

Second, the framework is based on governance theory, where a diversity of actors (Central Government, subnational governments, private sector, civil society) interact in diverse and complex ways. Moreover, the agency of rational actors at different levels of the game is crucial in drafting and implementing economic policy.

This paper examines the role of the state as multi-layered institutions with complex and dynamic interaction between the layers in order to analyze the determinants of policy choices of regional leaders. The paper employs the subnational comparative method (Snyder 2001) and regional institutional analysis method (Sinha 2005; Mitra 2006; Zarhani 2019) to depict the interrelations of renewable energy governance and development in India.

Motivations for Developing Renewable Energy Policies

Despite a vast amount of research on the normative perspective of the importance of a clean energy transition, there is a lack of research regarding the policy motivations of governments in encouraging renewable energy development (Marques, Fuinhas, & Manso 2010). In addition, the few studies that exist focus on the United States and Europe. Moreover, the majority of research on factors of promoting renewable energy is applied to wind energy, so there is a need to analyze the motivations of other types of renewable energy, especially in developing countries (Bird et al. 2005; Menz and Vachon 2006). Based on a literature review of research relating to the motivations of governments in devising progressive renewable energy policies, three main categories of explanations arise: first, political factors; second, socioeconomic factors; and third, country specific factors.

Political Factors

A diverse array of political science literature argues that institutions frame the manner in which political actors operate, both directly and indirectly, which impacts policy outcomes (Day 2002; Shepsle 1989; Hall and Taylor 1996; North 1990; Steinmo and Tolbert 1998; Weingast 1989). Environmental policy theorists hypothesize that the capacity of political organizations, the ideological views of political actors, and inter-party competition impact the likelihood of environmental policy adoption (Bennear 2007; Mazur and Welch 1999; Ringquist 1994; Ringquist and Clark 2002; Sapat 2004).

Several studies, including Menz and Vachon (2006) and Carley (2009) find that political motivations are the most relevant aspect to promoting renewable energy. The existing literature highlights that public policy is relevant to explain renewable energy development (Van Rooijen and van Wees 2006; Wang 2006; Wustenhagen and Bilharz 2006; Gan et al. 2007; Johnstone et al. 2010). Public policy relating to renewable energy includes Research and Development (R&D), incentive programs, investment incentives (grants or low-interest loans), incentive tariffs, including feed-in-tariffs, and compulsory renewable energy targets, including tradable certificates. Gan et al. (2007) provide a summary of the objectives, advantages, and disadvantages to these policies. Moreover, the effectiveness of such policies focus primarily on European countries. Van Rooijen and van Wees (2006), Want (2006), and Wüstenhagen and Bilharz (2006) focus on the Netherlands, Sweden, and Germany respectively. Because most of these policies were adopted in the late 1990s and early 2000s, data is not widely available and causal claims are difficult to make. Johnstone et al. (2010) find that the effect of public policies depend on the type of renewable source. Johnstone et al (2010) also concludes that of the policy instruments researched, obligations like production quotas are significant at the 1% level of significance. The remaining incentives are statistically not significant (Marques, Fuinhas, and Manso 2010).

Energy security is a major factor in governments promoting renewable energy development (Marques et al. 2010). The general literature, and Gan et al. (2007) more specifically, suggests that substituting the currently energy imports with self-sufficient energy sources is a major driver for renewable energy development. However, Chien and Hu (2007) found that renewable energy development did not have an import substitution effect, where foreign imports of oil are placed with domestically-produced renewable energy.

One negative externality relating to the generation of fossil-fuel based power is greenhouse gas emissions (GHGs), which include carbon dioxide, chlorofluorocarbons, methane, nitric acid, and ozone. The release of GHGs leads to the greenhouse effect and anthropogenic global warming. As a result, the average temperature is expected to rise over 6 degrees Celsius by 2100 (World Bank 2012). The most relevant factor relating to anthropogenically induced climate change is carbon dioxide: most of the literature (Sadorsky 2009; Van Ruijven and van Vuuen 2009) suggest that the largest motivating factor of renewable energy development are the environmental concerns associated with conventional energy production.

An alternative argument for renewable energy diffusion is based on political mobilization from environmental degradation. In China, a change in social pressure and elite priority from increasing public concern over air pollution led to ambitious renewable energy policy. In 2012, less than one percent of the 500 largest Chinese cities met the World Health Organization's air quality standards (Zhang and Crooks 2012). The air quality has also sparked a public health crisis, with 1.6 million deaths attributed to pollution alone (Rohde and Muller 2015). Chinese citizens have mobilized by voicing their concerns in letters to the government and large-scale protests, which are rare in the Chinese context (Tong and Lei 2014).

Conversely, although 13 of the 20 most polluted cities around the world are located in India, protests against air pollution are rare (Chauhan 2015). In India, environmental regulations and standards are perceived as barriers to economic growth and job creation (Isoaho, Goritz, and Schulz 2017, 239). For instance, the population of Vapi, Gujarat protested against higher environmental standards despite the city containing some of the world's worst air (Barry and Bagari 2014). Scholars attribute this apathy to the highly-polluting pharmaceutical and chemical industries; however, the example of Vapi represents a larger lack of interest in environmental legislation in India. Health issues from environmental degradation are not a central concern for the majority of society, or most likely, less important than economic needs (Isoaho, Goritz & Schulz 2017). Nevertheless, a key policy goal of the Indian government is providing affordable and reliable access to electricity to all (Ghosh and Ganesan 2015).

Socioeconomic factors

Socioeconomic factors identified in Marques et al. (2010) include prices of fossil fuels, carbon dioxide emissions, contribution of fossil fuels to electricity generation, energy consumption, and income. Because the prices of traditional energy sources do not include the environmental costs, renewable energy has historically been more expensive than the fossil-fuel based alternatives. Prices have historically failed to reflect the negative externalities of carbon dioxide and other air pollution, making renewable energy seemingly too expensive in the short term. Research by Bird et al. (2005) and Van Ruijven and van Vuuen (2009) find that prices of conventional energy such as natural gas, oil, coal and nuclear power motivate governments to promote renewable energy development. In context of India, there is an additional challenge of implementing renewable energy because of the need for affordable energy. Chang et al. (2009) find that countries with high economic growth deal better with high energy prices related to diffusion of renewable energy because of the higher willingness to pay from consumers.

In addition, socioeconomic factors impact the likelihood of renewable energy development. Consistent with other environmental policy analyses (Ringquist 1994; Sapat 2004;

Carley 2009), the literature predicts that states with greater wealth will have a higher percentage of renewable energy because of the ability to invest more heavily in renewable energy development. States with larger growth rates will tend to also have growing state demand for electricity, which can be satisfied by increased use of renewable energy.

In terms of deregulation, there is little consensus regarding the environmental and renewable energy effects of electricity deregulation (Palmer 1997). Although some argue that deregulation will encourage consumer choice and lead to greater differentiation and RE-based development (Delmas et al. 2007), others contend that deregulation will encourage more centralized fossil fuel generation due to traditional economies of scale.

Singh finds that a cohesive subnational identity among Malayali in Kerala generated progressive social policies like improved education and health outcomes, which created high levels of human development (Singh 2011). According to Singh (2011), the subjective sense of "we-ness" is a key determinant of public goods provision and social development. Despite Kerala being less developed than Tamil Nadu before independence, due to social mobilization based on the Malayali identity, Kerala developed very uniquely in the Indian context. Nevertheless, Human Development Indicators cannot alone explain a state's motivation to encourage renewable energy investment in a state. Singh's research motivated me to identify the "institutional knowledge category," which I hope accounts for the institutional differences between states in achieving certain policy outcomes.

Geographic specific factors

Individual state-level or country-specific factors such as culture, wealth, or production potential of renewables has been used as a possible explanatory variable for implementing progressive renewable energy policies (Vachon and Menz, 2006). Renewable energy potential and land availability are two very significant explaining variables. This underscores the importance of governments conducting feasibility studies and provides them to the public to encourage developers to develop favorable areas.

Although Menz and Vachon (2006) and Langniss and Wiser (2003) find that windy land areas is a motivating factor of renewable energy policy introduction, Carley (2009) finds that the amount of windy land area in a state is negatively associated with renewable energy installed capacity. Using data from states in the United States, Carley (2009) determines that states with the highest windy land area (Nebraska, North Dakota, South Dakota, Kansas, Oklahoma, and Wyoming) had not adopted mandatory renewable energy portfolio standards (RPS) policies nor had high rates of RE development. In addition, the least windy states had an average renewable energy generation of 1.72 million MWh, the mid-level windy states had 2.29 million MWh, and the most windy states had 0.70 million MWh, so mid-level windy land areas are most aggressively pursuing RE development. Understandably, states with the smallest amount of windy land are lagging behind the mid-level states, but are developing at a faster rate than those with the greatest windy land. States with the greatest windy land are reluctant to deploy RE at a faster rate. Carley (2009) hypothesizes that this is because policymakers assume that development will occur without mandates or costly incentives. In addition, these states have low population growth rates and rely heavily on base-load coal as the primary source of energy, which creates less of a need for renewable energy deployment as a means of meeting growth in demand. Therefore, states with greater renewable energy potential do not necessarily have a higher likelihood of transitioning to clean energy.

Neo-institutional rational choice model of governance

According to Mitra (2006), India has uniquely durable, adaptable, and innovative institutions. This elasticity and durability are the result of strategic thinking of India's elites. The structure of government, based on constitutional and institutional arrangements for elites, creates the "room to maneuver" (Mitra 1991; quoted in Zarhani 2019), and explains the sustainability of India's democracy. The room to maneuver allows political elites to negotiate and bargain and sustain orderly rule, assuming these elites aim to improve the level of welfare. Based on the neo-institutional model of governance, Mitra (2006, 2008) proposes three parameters of governance: security, welfare, and trust; He argues that the strategic engagement of policy elites is contingent on improving the level of welfare and accommodating identity, which decreases the likelihood of rebellion or rioting, and enhance orderly rule and governance in a society.

Public Goods Literature

Political externalities play a powerful role in shaping how governments carry out efforts to deliver public goods. In developing countries, citizens look to their governments to provide basic goods and services like roads, education, clean water, and electricity. Such goods enable economic development, so demand is widespread, even when governments are not able to supply them. The decision of governments to decide how to provide basic necessities is fundamentally shaped by political externalities (Min 2015). Every choice in the implementation of public goods schemes has large benefits and costs that manifest themselves in the political area.

As politicians seek to remain in office, public goods schemes are compelling mechanisms to coalesce political support. Better schools, improved electricity and additional roads provides universal acclaim; however, there are numerous scoping and ordering decisions that support their implementation. Every decision generates political benefits and costs that are not seen by technical and economic factors that dominate project plans and policymaking discourses. In electoral settings, these political externalities map tightly onto the reelection incentives for politicians. Min finds that democracies provide electricity to 10 percent more of their citizens than non-democratic states. He calculates that a consistent history of democratic rule in an average-size developing country in the post-World War II era would lead to an additional 3.5 million more residents with electricity access (Min 2015, 163).

Min's findings show that among the world's poor, competitive elections have a large impact in motivating governments to target the poor with valuable public goods like electricity access. Hence, political externalities associated with energy access vary dramatically across regime types and political settings: electoral pressures induce democracies to prioritize the delivery of electricity because of political externalities. In India specifically, the subnational levels dictate much of the developmental agendas, so to understand the provision of electricity and integration of renewable energy development, it is important to look at the subnational level. In addition, Min finds that the source of energy does not seem to make a difference in creating political externalities; Although Min does not directly research the implementation of renewable energy programs, his research concludes that "all efforts to deliver public goods, whether these be electricity generated from dirty coal-burning plants or green energy from renewable sources, are accompanied by political externalities" (Min 2015, 169). The public goods literature has not fully incorporated the different political tradeoffs specific to certain forms of energy. One might suppose that the negative externalities of coal-fired power plants would lead to more environmental protests, especially from the surrounding areas. Therefore, it is important to develop a framework that bridges the subnational political externalities of energy production and the motivations of elites in promoting a clean energy transition.

Polycentric Hierarchy Theory

Scholars overwhelmingly characterize developmental approaches by analyzing the national government. The existing traditions of inquiry can be classified into three main categories: neoclassical view, statist view (or developmental state), and public-choice view (or neoliberal). All dominant theories in economics and political science study variations in developmental success through a nation-centric framework. However, regional variations within dirigiste nation-states challenge the underlying assumptions in statist and neoliberal approaches. Despite the existence of a central framework, regional differences within a state suggest that regional political elites can circumvent or mitigate the effects of nationally-created policies. Moreover, statists focus disproportionately on market failures: the high performing states within in India and other countries are not anti-market, as previously assumed, but are market-enhancing.

These doubts expose a significant limitation in the existing research on the political economy of development. Neoliberals and statist both have seen the state as a unified actor, which succeeds or fails coherently. Only few scholars have addressed the multilevel character of states; this is especially true for India.

Sinha introduces the polycentric hierarchy model as an approach to disaggregate the interactions between various nodes at different levels as a substitute for the top-down unitary state. Sinha (2005) criticizes the conventional theory of India’s “Hindu rate” of growth before economic liberalization. Instead, Sinha (2005) finds there were different patterns of interactions between the Center and States before liberalization, which contributed to varying inflows of private investments to States, indicating a divergence in developmental trajectories.

The polycentric hierarchy model focuses on both the national and subnational levels as a result. Subnational states in India are not entirely autonomous, so they cannot be considered like nation-states; however, they respond to and evolve strategies towards the Central Government in diverse ways. The model postulates that policy framework of growth "may not be centrally guided but is a joint product of central rules, provincial strategic choice, and subnational institutional variation" (Sinha 2005, 27). The Central Government is not a single actor that imposes the rules of the game; instead, there are several interactions between the central state, state-level bureaucrats, and private market. These complex, diverse, and dynamic interactions cannot be analyzed using the conventional institutionalist or neo-statist theories.

Sinha develops a theory on polyarchy to address gaps in the literature on disaggregating the state and its institutions (Sinha 2015, 33). Actors within a state bargain with other actors to reap the benefits of centrally determined economic and political rewards. Interaction *among* these varying state institutions are key to understanding policy outputs and state action. Much of this interaction is strategic and shaped by rules of the game, preference of the actors, and territorial distribution of political incentives. Scholars have recognized the interdependence of regional orders and national policy; however, few have developed explicit political theories of the interaction (Schmitter 1997; Whiting 2001).

Sinha develops a theory that allows to understand how different state actors decide on policy goals. In this framework, states are not hierarchies with a unitary decision maker; instead, they are *polyarchies* marked by multileveled actors and institutions (Sinha 2015, 33). Polyarchy is especially suited to understand the territorial character and internal heterogeneity in large states. In a polyarchy, policy is approved by the higher-level state agency in coordination with the lower-level state organizations. Decisions are joint; however, the higher level agency has veto power to either accept or reject the project or policy. Therefore, polyarchies are a combination of horizontal (within subnational units) and vertical (across levels of governments) interactions. When relaxing the unitary state assumption in this way, one can generate new and fruitful observations about economic policy.

Sinha reconceptualizes the state and complements a new way of analyzing interaction within the state. She uses a theory of two-level or nested games to understand the dynamic between central and local rulers in economic policy. The two-level game theory is prominent in understanding the interaction between the interaction between domestic and international politics (Putnam 1988; Evans, Jacobson, and Putnam 1993). Scholars have used the two-level framework to understand international economic policies (Milner 1997); The notion of nested games in comparative politics provides a similar idea (Tsebelis 1990; Scharpf 1997). Nevertheless, the application in comparative political economy has been less prominent.

The two theories emphasize interconnected games: political actors act in two different arenas simultaneously. While actors face different pressures and constraints from different domains, the goals, choices, and actions of these actors are shaped by the interconnected nature of these different arenas. Tsebelis, concerned with suboptimal behavior, argues that "what appears suboptimal form the perspective of any one game is in fact optimal when the whole network of games is considered" (1990, 7). Putnam similarly finds that "At the national level, domestic groups pursue their interests by pressuring the government to adopt favorable policies and politicians seek power by constructing coalitions among those groups" (Evans, Jacobson, and Putnam 1993, 437). Sinha extends this theory to yield a framework of multilevel games, deemed “comparative political economy.”

Regional Elite Strategy Analysis

In order to disaggregate the state, this paper assumes that not only national elites and institutions matter, but also that regional elites and institutions contribute to the policymaking process. These regional elites, operating as intermediaries between the society on the regional level and the Central Government, are the catalysts of social and economic change. Their strategic choices in the nested two-level games contribute to the creation and implementation of economic policies in India.

The model is based on vertical interactions: the Central government can reward the State by financial incentives or political favors in the framework of coalition politics. The Central government can punish the State by reducing the incentives or invoking article 365 as emergency powers of the President. Regional leaders have the choice of either cooperating with the center on policy implementation or rejecting the policies; however, leaders can also pick and choose the policies that are most favorable to them and reject the others (Zarhani 2019).

Disaggregating Climate Change Mitigation Policy

Scholarship on the subnational motivations of implementing climate change mitigation strategies are emerging, albeit slowly. Acknowledging the constraints imposed by domestic political environments can help in understanding the difficulties in achieving a global consensus in mitigating climate change. Much of the literature that has examined subnational linkages relating to climate change mitigation efforts have a normative lens and frame the research regarding the importance of extending the United Nations Framework Convention on Climate Change (UNFCCC) framework to the subnational level (Jordan et a., 2015; Hsu et al., 2019). Although such studies are useful for international policymakers, climate change policies can be very broad, encompassing a wide array of different policy agendas; in addition, climate change mitigation policies can be difficult to quantify their effectiveness. Renewable energy policy is one type of climate change mitigation policy that is easier to quantify using renewable energy installed capacity for each state. Moreover, no research so far has applied the polycentric hierarchy framework to subnational renewable energy development in India and no research has explored the subnational motivations of implementing renewable energy policies.

Applying the Polycentric Hierarchy Framework to Renewable Energy Development

Although Central government policies are helpful in shaping the broader renewable energy landscape, state-level policies are even more important in understanding the policy drafting and implementation process. This is relevant to increasing research on subnational comparisons and "multi-level governance" in the implementation of climate change mitigation efforts in particular (Snyder 2001; Chaudhary et al. 2015; Hsu et al. 2017; Atteridge 2012; Jordan et al. 2015; Hsu et al. 2015). Although the literature has some understanding of the shaping of Central Government renewable energy policies in India, there is not a similar understanding of the variety of motivations on the state-level (Chaudhary et al. 2015).

The renewable energy sector has depended, to a large extent, on state-level policies. With states having the ability to devise and implement their own policies such as the exact feed-in tariff for wind power projects, wheeling charges for renewable energy projects, state-level policies influence the relative investment attractiveness for developers. It is important to note that despite the centrality of states in implementing policies, state-level capacity is often constrained along the lines of knowledge-creation, sourcing dimension, and access to finance (Chaudhary et al. 2015). The motivations of state-level bureaucrats and their agency, capacity, and willingness to promote renewable energy in context of their wider state-level priorities remain relatively unexplored. Therefore, in the next four chapters, I chronicle the historical renewable energy development in four states in India: Tamil Nadu, Kerala, Gujarat, and Rajasthan. I hope to understand the interplay between state-level policies and central government policies, to identify where there is synergistic alignment (harmonized to ensure deployment-friendly policy regimes), autonomous alignment (where no vertical linkage is present), and one-dimensional alignment (where linkage is one-sided) (Chaudhary et al., 2015; Hsu et al., 2017).

Developing a Bridging Analytical Framework

The purpose of this thesis is to map out the motivations, interests, and incentives of subnational elites in devising policies to promote renewable energy development. Bridging the literature between the subnational development, provision of public goods, and environmental literature, I create a bridging analytical framework. This model combines the polycentric hierarchy model presented by Sinha, Min's theory on public goods provisions, and the environmental literature to posit that growth in renewable energy is not entirely centrally guided; instead, renewable energy development in India is a joint product of central rules, provincial strategic choice, and subnational institutional variation. I develop an analytical framework for examining different modes of vertical alignment that subnational actors employ to develop renewable energy policies.

Analytical Framework

The state-level analyses are conducted using a unique framework that synthesizes various ideas across a diverse set of literatures to understand the policy motivations of state-level actors in devising renewable energy policies. My analytical framework includes four factors: In the empirical chapters where I discuss state-level motivations, I elaborate on how these factors work to affect motivations of regional elites:

1) **State-level Party Politics**
2) **Financial Space/ Indebtedness of State Distribution Companies**
3) **Institutional Knowledge in State-level Nodal Renewable Energy Agencies**
4) **State-level Linkages with the Private Sector**

State-level Party Politics

First, state-level party politics explain the political will of subnational elites in devising policies and the cohesion of governing coalition explains the willingness of engage with the Central Government's policies. Isoaho, Goritz, and Schulz argue that a governing coalition's willingness and ability to implement successful renewable energy policies is a function of rulers being most interested in remaining in power. Only when this interest is seriously threatened by a specific policy problem that governing coalitions will be willing to address and solve the issue. In terms of renewable energy policy, if a governing coalition faces pressure from powerful groups in society that are negatively impacted by the current energy regime or profits from promotion of renewable energy. Relevant societal pressures could also be less relevant to renewable energy specific needs, like providing universal electricity access. However, when these policy goals can be addressed using renewable energy because of geographical advantages or technological advances, then the governing coalition is likely to promote these policies. Moreover, the political survival of the governing coalition will depend on powerful groups interested in keeping a fossil-fuel dominated status quo (Tsebelis 2002; Moe 2010). Governing coalitions are only willing to actively promote renewable energy policies when the social pressures demanding the departure from the status quo are more threatening than those demanding its preservation.

Second, the distribution of power within and outside the governing coalition shapes its ability to develop and implement policy effectively (Khan 2011). Weak and fragmented governing coalitions are more likely to allow policy or rent capture to hold together factions within the governing coalition. In addition, weak governing coalitions are often forced to co-opt other social organizations in society as a survival strategy (Migdal 1988). Once a decision-maker in a governing coalition has decided to implement a certain policy, the policy implementation process will be easier the less fragmented the coalition is and the less external opposition it faces. Therefore, although distributions of power can strengthen a government's policy implementation capacity, others can act as a barrier. In India, if the state and central governing parties are aligned, there could be stronger vertical linkages in the policy development process.

Financial Space/ Indebtedness of State Distribution Companies

Second, the financial space a state distribution company (discom) indicates the state's ability to manage consumer demands. Discoms in India often cross-subsidize electricity, so commercial consumers pay more than domestic consumers and farmers because of political demand. This is a useful category in understanding the subnational elites' decision-making process to manage political demands of providing subsidies while avoiding deteriorating quality and declining finances. This factor incorporates the ability of the state government to cross-subsidize, which depends on the proportion of industrial users and extend of open access or captive power use, that might limit cross-subsidies.

The financial sustainability of the State Distribution Companies (discoms) in India impacts the investor friendliness of the State. Financially insolvent discoms often need to delay payments to independent power producers (IPPs), which negatively impacts investor confidence in a State.

Institutional Knowledge in State-level Nodal Renewable Energy Agencies

Third, every state in India has a corresponding state-level nodal renewable energy agency to implement the fiscal incentives and policy frameworks of the Central Government's renewable energy agency. The willingness and institutional knowledge of bureaucrats in these state-level nodal renewable energy agencies greatly impacts the implementation of Central Government schemes and explains the vertical linkages between the State and Central Governments.

State-level Linkages with Private Sector

Fourth, when considering that nearly all of India's renewable energy is installed and managed by private companies, it is important to analyze the state-level government's interaction with the private sector. This variable incorporates both the willingness of private companies in the state to utilize captive power and the interaction renewable energy developers have with the subnational policymakers. In several cases, industrial or commercial organizations will use captive power to ensure reliable energy access. Moreover, since the deregulation of the electricity sector with the Electricity Act of 2003, private companies play a larger role in generating electricity, especially renewable energy, than they had previously.

These four factors provide a way to map the motivations of subnational elites in devising renewable energy policies on the state level in India. The framework therefore explains the willingness of state-level bureaucrats to cooperate with the Central Government on policy and financial incentives to accelerate renewable energy development. These factors explain whether the vertical linkages with the Central Government are synergistic or disruptive.

Conclusion

This chapter analyzes the existing literature on the motivations for devising renewable energy policies. The chapter concludes with an analytical framework to analyze the motivations of subnational elites in coordinating with the Central Government to devise renewable energy policies. A key theme of the paper is that renewable energy development in Indian states is not solely determined by factors relating to the electricity sector nor by factors involving environmental movements. Instead, subnational elites are motivated by incentives created by the Central Government to promote economic investment. In the next chapter, I focus on the Central Government's policy goals and financial programs introduced to understand the environment that helped enable subnational diffusion of renewable energy.

3

Central Government

Introduction

The Central Government creates fiscal incentives and a policy framework for the State Governments in India. When analyzing the motivations of subnational bureaucrats in devising renewable energy policies, it is important to understand the renewable energy programs introduced by the Central Government. The Government of India has created significant policy, regulatory, and financial incentives to encourage renewable energy development starting in the 1980s. At the international level, India is emerging as a key actor in climate negotiations. The Central Government has promoted progressive policies and created institutions, but this has not been implemented uniformly on the state level. Moreover, following liberalization in the 1990s, the Central Government's policies were significantly impacted by industrial influence through lobbying groups advocating for renewable energy development.

In response, a number of dedicated institutions were created to facilitate renewable energy development. On the policy side, the Ministry of New and Renewable Energy (MNRE) has played a key role in catalyzing renewable energy development, including resource mapping, R&D investment and promotional projects.[2] On the financing side, the India Renewable Energy Development Agency (IREDA) provides financial support to renewable energy projects.[3] Agencies were also created to promote renewable energy on the state level: Although there are

[2] The precursor institutions to the Ministry of New and Renewable Energy (MNRE) were the Commission for Additional Sources of Energy (CASE), established in 1981; the Department of Non-Conventional Energy Sources (DNES), formed in 1982; and the Ministry of Non-Conventional Energy Sources (MNES) in 1992. The MNES was renamed to MNRE in 2006.

[3] IREDA is under administrative control of the MNRE and was established as a non-banking financial institution in 1987 to promote, develop, and extend financing assistance for new and renewable sources o energy.

concerns over the varying institutional capacities of each state nodal agency, a number of agencies have been created, which is a crucial first step for future reforms (Sargsyan et al. 2011). I analyze the fiscal incentives and policy frameworks developed by these institutions to understand the willingness of subnational elites in implementing such programs. The Central Government has distinct goals of leading the country on the international stage; however, the Central Government also creates new resources, incentives, and policy ideas for the states. Therefore, it is crucial to analyze the renewable energy policy goals of the Central Government, even if states have autonomy over the implementation of these programs.

In this chapter, I chronicle the Central Government's domestic policies and regulatory frameworks relating to solar and wind energy development in addition to engagement internationally regarding renewable energy. I characterize the motivations of the Central Government in devising renewable energy policies as primarily that of energy security and industrial development rather than by environmental concerns

Central Government's Policy Goals Relating to Energy

India's impressive economic growth over 7% annually began with a series of far-reaching reforms the country enacted in the 1990s to liberalize its economy. During this process, India changed from a predominately inward-looking country, seeking self-reliance and marked by socialist policies and regulation, to a country with greater international participation and market orientation. The Government reduced trade barriers, invited foreign investment, and deregulated a number of sectors. These financial and fiscal reforms encouraged competition and private-sector participation, especially with IT, pharmaceuticals, and automobile manufacturing

(Aghion, Burgess, Redding, & Zilibotti 2008; Goldar & Kumari 2007; Das et al. 2012; Chaudhary et al. 2014).

The government of India recognizes that electricity access improves welfare and economic opportunities in the country and plans to expand access to the 300 million people currently without access to electricity (*Economist* 2017). The population remains overwhelmingly rural (67% live in rural areas) and poor (roughly 73 million people live on less than 1.9 dollars a day); however, increased urbanization and economic growth has led to a massive increase in welfare and quality of life for the majority of Indians, but sustaining this will require a dramatic increase in energy use (*Reuters* 2007). The government of India recognizes that electricity access improves welfare and economic opportunities in the country and plans to expand access to the 300 million people currently without access to electricity (*Economist* 2017). This dramatic increase in energy demand creates significant challenges for policymakers in India: electricity demand in India is expected to quadruple by 2040 and over 70% of the country's generating capacity is from coal-fired power plants (IEA 2011). The three main policy goals of the Central Government have been 1) improving energy security, 2) expanding energy access, 3) enhancing the financial sustainability of state-level distribution companies (discoms), and 4) promoting industrial development.

Improving Energy Security

Energy security is necessary for India to achieve its rising power status. The Central Government has attempted to promote domestic production to reduce price fluctuations and ensure reliable supply for industrial development. One powerful tool in promoting energy security is diversifying the energy generation make-up and promoting renewable energy development. India is already the world's fourth largest energy consumer, and energy demand is expected to rise more in India than any other country in the world by 2030 (Simmons, Coyle, & Chapman 2014; IEA 2015). First and foremost, the Central Government's energy policy has been focused on securing domestic energy sources for economic development.

National policies have been implemented to improve the functioning of the power sector, including open access to transmission and distribution networks, regulation of tariff, and programs to improve rural electrification. The government established the Power Grid Corporation of India (POWERGRID) to operate five centrally-controlled regional electricity grids, while states and private companies operate transmission and distribution segments.

India's energy sector is managed by several different Government Ministries, which include the Ministry of Power; Ministry of Coal; Ministry of Petroleum and Natural Gas; Ministry of New and Renewable Energy; Ministry of Environments and Forests; Department of Atomic Energy; and the Planning Commission (Simmons, Coyle & Chapman 2014).

The process of liberalization in the 1990s and through the 2000s has led to more energy diversity as additional private sector actors have diversified energy supply investments. One such example is increased investment in liquified natural gas (LNG), which began with an import arrangement with Qatar in 2004. Indian firms such as Petronet have established trading relationships with both foreign and domestic partners to ensure a stable supply chain. India currently has six nuclear power plants with a combined generating capacity of 4.4 GW. As part of the Government's energy growth strategy, it has indicated plans to increase the share of nuclear power from four percent in 2011 to twenty-five percent over the long term (Simmons, Coyle & Chapman 2014).

Expanding Energy Access

India's energy distribution demonstrates larger inequalities in the economy. Large urban centers produce the majority of economic growth and are almost universally connected to the electricity grid, while rural areas have little or no energy access. Though India is projected to have one of the world's largest middle class, the rural poor have been largely bypassed in terms of access to public goods like electricity.

The government launched the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme to increase rural household access by expanding electricity infrastructure to rural areas and providing free electricity connections to households below the poverty line (BPL) in 2005 (Rawat 2013). PM Modi renamed the program the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) program in 2015 with the aim of strengthening sub-transmission and distribution infrastructure including metering in rural areas In addition, capital subsidies target BPL households in un-electrified villages and rural communities. More recently, PM Modi has announced the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) scheme in 2017 to provide energy access to all by last mile connectivity to remaining un-electrified households in both rural and urban areas (Government of India National Portal, accessed 2019). The aim of the Saubhagya scheme is to achieve 24x7 power for all by 2019 by providing electricity connections to each household across the country. This program provides subsidies for equipment such as transformers, wires, and meters and is implemented by the Ministry of Power (Palani 2018).

Engagement with State Distribution Companies

The Central Government has identified that the financial sustainability of the state-level distribution companies have negatively impacted electricity supply, so it has created programs to improve the viability of the State Electricity Boards (SEBs). Because electricity use is on the concurrent list, the implementation of any sort of energy-related goal is contingent upon the state governments and State Electricity Boards.

Given continued concerns over power shortages, high tariffs from cross-subsidies, and poor operational performance of state electricity boards (SEBs), the Central Government began to institute reforms in the early 1990s (Singh 2006). In 1991, the Central government amended the Indian Electricity Act of 1910 and the Electricity (Supply) Act of 1948 to attract private investment in power generation (Singh 2006). These attracted foreign and domestic capital and led to many long-term power purchase agreements; however the financial sustainability of the SEBs threatens the long-term viability of such agreements. These measures were strengthened in 1995 in the Mega Power Policy, where energy generation plants above 1000 MW capacity would receive additional incentives in the form of a 10-year tax holiday, exemption of customs duty for imports and reduced hassles for clearances (Singh 2006).

Reforms for the SEBs were first introduced by international organizations, but were not implemented uniformly among the Indian states. In terms of international influence, the World Bank was instrumental in the power sector reforms in India. After success in restructuring electricity supply in Latin American countries, the World Bank as a multilateral financial institution promoted policy reforms through conditions attached to loan disbursements, and assisted the east Indian state of Orissa (Rajan 2000). The so-called “Orissa Model” was based on the functional unbundling and corporatization of the SEB into two generation, one transmission and three distribution companies, where the two distribution companies were subsequently privatized. The Orissa Electricity Regulatory Commission (OERC) was created under the Orissa Electricity Reforms Act of 1995. Following the success in reforms, the states of Haryana and

Andhra Pradesh initiated a reform process, but did not privatize the distribution companies. The primary responsibilities the SERCs include the licensing for undertaking business in its state and setting of tariffs for electricity. Because of electricity being a subject in the concurrent in the Indian constitution, both the Central and State governments have the power to make policies. While transmission and generation has participation from both the Central and the state governments, distribution fall exclusively in the purview of the respective state government.

The Central Government began providing policy support for states to reform their electricity commissions. In 1998, the Electricity Regulatory Commissions Act created the Central Electricity Regulatory Commission (CERC) and state-level regulatory commission. The main functions for CERC are regulating tariffs of generating companies, owned or controlled by the Government of India, and also tariffs for the inter-state transmission of electricity. These reforms have created additional transparency to the tariff-making process. Reforms have also led to additional scrutiny from public hearings and rationalization from increased transparency of distribution tariff changes; in addition, reforms have slowed increases in cross-subsidies (Singh 2006).

Due to the poor capacity realization by IPPs, additional reforms were initiated for distribution companies. In 2001, reforms were discussed during the Meeting of the Chief Ministers on Power, which led to the Accelerated Power Development & Reform Programme (APDRP) to promote distribution reforms and provide transitional finance for SEBs undertaking reforms. The main objectives were to achieve 100% metering, conduct energy audits, replacement of distribution transformers, and the use of IT solutions to ensure accountability.

In 2002, the Ministry of Finance and the Reserve Bank of India (RBI) created a program for one-time settlement of SEB debts. The scheme allowed for a waiving of 60% the surcharge and interest on delayed payments, and securitizes the remaining surcharge and interest and the full principal amount through tax-free bonds to be issued through RBI by respective state governments. Nevertheless, this was a short-term fix to prevent a large crisis; larger long-term reforms to promote the sustainability of the India power sector were passed in 2003.

UDAY Scheme

The Central Government has been active in providing financial support the state-level distribution companies. In 2015, the Central Government initiated the Ujwal Discom Assurance Yojana (UDAY) scheme to improve the financial health and operational efficiency of the state-level power distribution companies (discoms). Under the scheme, states can convert their debt into state government bonds, but must fulfil certain conditions. One such requirement is to reduce the average aggregate technical and commercial (AT&C) losses to 15% by 2018-19. Of the 24 participating states that have reported data on AT&C losses, only seven have losses under 15%-- Himachal Pradesh, Andhra Pradesh, Goa, Gujarat, Kerala, Telangana, and Tamil Nadu (Kwatra 2018). UDAY also requires discoms to maintain commercial sustainability and bring down the gap between average cost of supply (ACS) and average revenue realized (ARR) to zero; however, this gap has widened in certain states, including Jharkhand, Punjab, Goa, Manipur, and Jammu and Kashmir. Operational inefficiencies still persist like lack of effective billing procedures, poor measurement of power consumption, and ineffective monitoring of power theft. Moreover, only four states have performed well on financial and operational parameters relating to the scheme: Gujarat, Karnataka, Himachal Pradesh, and Telangana (Kwatra 2018).

In summary, the energy policy goals of the Central Government are best characterized as the struggle between Central directives involving fiscal support and policy recommendations and the state governments in their unevenness of to implement reforms Providing energy security and diversifying the energy production in India align with the country's rising power ambitions and policy goals to industrialize. Renewable energy provides a useful tool for the state to meet these policy goals without producing more air pollution and additional environmental degradation. Next, I will chronicle the policy and regulation regarding renewable energy development that the Central Government has developed to support the state governments.

History of Policy and Regulation Regarding Renewable Energy Development in India

The Central Government of India has orchestrated a robust series of mechanisms to support renewable energy development, including grants to develop technologies, generation-based incentives, and tax incentives (Hogg and O'Regan 2010). The Government's wind program began in the early 1980s, and the solar energy program began in 2008 (Isoaho, Goritz & Schulz 2017). These incentives are important in studying subnational motivations because they are selectively adapted by the subnational actors depending on the willingness of the state-level actors.

India's renewable energy development growth is highly unusual: growth for more than two decades has come almost entirely from private sector investment and there is no dedicated renewable energy legislation to compile all governmental policies. Provisions in the Electricity Act of 2003 and other national policies for power generation have supported various fiscal and regulatory incentives (IRENA-GWEC 2011, 90).

IRENA-GWEC (2011) identifies four phases in wind energy development: Phase 1 is characterized by technology demonstration and research and development (1981-1990); Phase 2 is economic liberalization and institutionalization (1991-2000); Phase 3 is Passing of the Electricity Act, provision of tariffs by the states (2000-2008); Phase 4 is new incentives and reinforcement of tariff scheme (2009-present). Chaudhary et al. (2015) organizes wind development into four phases: Phase 1 (1985-1990) as early exploration; Phase 2 (1990-1999) as an emerging sector; Phase 3 (2000-2008) as rapid expansion; and Phase 4 (2009-present) as reflection and evolution. In terms of the solar energy sector, Chaudhary et al. (2015) identifies three phases: the first (pre-2005) was on maintaining a presence; Phase 2 (2005-2008) on gathering steam; Phase 3 (2009-present) as "take off."

Central Government's Involvement in Wind Energy Policy

Energy security was a major driver for developing new and renewable energy after the two oil crises of the 1970s. With a sudden increase in the price of oil, Indian policymakers realized the adverse economic and security impacts. This concern led to the establishment of the Commission for Additional Sources of Energy (CASE) under the Department of Science and Technology in 1981 (IRENA-GWEC 2011, 82). Wind energy contributes most to India's renewable energy installed capacity, with 32 GW as of 2017 (MoSPI 2018). Here, I examine the trajectory of wind energy policy and regulatory development and touch on the patterns of technology development.

Phase 1: Research and Development, Demonstration Projects (1981-1990)

Wind energy policy dates back to the early 1980s when the Government of India created the Department of Non-Conventional Energy Sources (DNES) within the Ministry of Energy following in the aftermath of the global fuel crisis in the 1970s. The crisis sparked increased prices in oil and energy shortages in India. CASE formulated programs to develop new and renewable energy in India, accelerating coordination to intensify research and development in the wind energy sector. In 1982, DNES within the Ministry of Energy started to promote renewable energy development. DNES commissioned the Indian Institute for Tropical Meteorology to publish a first assessment of wind resources in the country (Mani and Mooley, 1983; cited in IRENA-GWEC 2011, 83). DNES continued a multi-pronged approach, creating ties with countries with developed wind power industry and developing local demand. Policy efforts focused on creating an ecosystem to engage heavy industries to deploy wind power (Chaudhary et al. 2015).

In 1985, the Central Government initiated the Wind Resource Assessment Programme to conduct wind mapping, covering 25 states with over 600 stations. This was necessary to further diffuse wind energy capacity data for private investors because of the high upfront costs associated with such a study: the 1985 assessment required eighty three masts of 20-25 meter height, 172 masts of 5 meter height, and sophisticated wind data recording instruments. The Wind Energy Resource Survey for India included five volumes published in 1990, 1992, 1994, 1996, and 1998 (Jagadeesh 2000).

The Danish International Development Agency (DANIDA) and financial instruments through the creation of the Indian Renewable Energy Development Agency (IREDA) enabled technology transfer. IREDA was created by funds from the World Bank and Asian Development

Bank and funded the first commercial project in 1989, signaling the beginning of a domestic wind power sector heavily influenced by international markets.

Series of demonstration projects in resource-rich states to show the economic feasibility of wind energy in India. In 1984, DNES partnered with the Gujarat Energy Development Agency (GEDA) and JK Synthetics Limited to install a 40 kW grid-connected Dutch wind turbine (IRENA-GWEC 2011, 83). The project was connected to the grid and privately owned, but implemented in partnership with the state nodal renewable energy agency GEDA.

Phase 2: Economic Liberalization and Institutionalism (1991-2000)

The second phase was primarily characterized by increasing engagement with Indian industry. In 1991, under the broad economic reforms implemented by the government to encourage private sector investment, foreign capital flowed into the Indian wind sector. Under the economic reforms, joint ventures with multinational corporations were permitted, which facilitated new trade policy and reduction in custom duties for wind parts. Import duties were reduced for Independent Power Producers (IPPs) and secured rates of returns were offered to foreign investors through cost-based tariffs. The DNES continued to engage stakeholders and proceeded to negotiate with the Ministry of Finance to extend a federal tax break of 100% accelerated depreciation (AD) for investments in renewable energy assets. The AD tax break was instrumental for the growth of the sector for many years after (Rajsekhar, Van Hulle, & Jansen 1999).

In 1992, the Department of Non-Conventional Energy Sources was made into a separate Ministry of Non-Conventional Energy Sources (MNES) (IRENA-GWEC 2011). This change in institutional structure led to more detailed policy guidelines for the promotion of renewable energy development. MNES created a target of 500 MW of wind energy through private sector participation during the 8th Five-Year Plan (1992-97). MNES introduced the grid power policy of 1993-1994, which set the stage for four important policy instruments to facilitate development: feed-in tariffs, banking of energy, wheeling of power, and third-party sale of power (to end-users rather than utilities or transmission companies). In addition, the Government of India enacted high tax rates for turbine imports and low tax rates for component imports. These policies encouraged private-sector participation and established a base for manufacturing wind-power systems, which align with larger macro-economic objectives of liberalization and privatization by the Indian government.

Several licensing agreements and joint ventures followed with Danish and German wind generation companies (Vestas, Micon, Enercon, Nordex, DeWind, and Sudwind GmbH) entered the Indian market, a response to strong projected demand growth (IRENA-GWEC 2011; Chaudhary et al. 2015).

In terms of energy demand, due to high commercial tariffs and uncertainty in power supplies, industries began to explore market options to increase energy certainty. Wind power offered a captive-generation option, which became increasingly attractive with extended tax breaks; the model of “captive generation,” where private companies produce their own energy, persists as a strong model as the sector developed (Chaudhary et al. 2015).

One adverse effect of the capital-subsidy-based demand driving policy from policies such as AD and tax breaks were that there was little incentive to enhance the productivity of installed capacity. Given the incentives were geared towards capacity installation rather than performance, manufacturers provided little choice as to the technology, which slowed the rate of installed capacity addition.

Phase 3: Passing the Electricity Act, provision of Tariffs by the states (2000-2008)

This period is best characterized with the liberalization of the electricity sector and rise of renewable energy policy in relevance on the Central Government level. Institutionally, the MNES was renamed the Ministry of New and Renewable Energy (MNRE) in 2006, which signified a push by the Central Government in encouraging the deployment of renewable energy (MNRE 2018, 10). Prior to the Electricity Act of 2003 (EA 2003), there was no legal framework in India for the promotion of renewable energy. EA 2003 created an institutional framework and division of responsibilities that exist until today; it supported the need for “preferential tariffs” to promote investment in renewable energy.

The Electricity Act (EA) 2003 aimed to foster competition, private investment, and power for all. By de-licensing generation and allowing open access, the Central government provided the foundation for states to enact more progressive renewable energy policies. The act explicitly recognized the role of renewable energy projects to provide utility scale power to the grids. In addition, EA 2003 provided a framework for preferential feed-in tariffs and quotas as well as introduced important reforms like allowing captive generation, establishing provisions for power trading, and granting phased open access to both transmission and distribution. These reforms had a significant impact on attracting private investment into the power sector (Sargsyan et al. 2011). Most notably, the Electricity Act of 2003 was the first time State Electricity Regulatory Commissions (SERCs) were mandated to develop renewable energy in their states (MoP, 2003). The main support measures of the EA 2003 include the fixation of minimum quotas for sourcing renewable energy, known as renewable purchase obligations (RPOs) for all distribution companies under the jurisdiction of the SERCs and the determination of preferential feed-in tariffs (FITs). These two policies constitute the backbone of renewable energy policy and have created a predictable market demand for renewable energy (Schmid 2012, 319). Nevertheless, it was contingent upon the newly created regulatory machinery within each state to promote renewable energy within the states' power sectors: The Central Government advises SERCs on the suggested RPO, but SERCs decide them for their own state. In addition, non-compliance in meeting RPOs is not penalized: a 2017 analysis by Greenpeace, a prominent NGO, reports that only six states have complied with their RPO targets (Engelmeier 2013; Mishra 2018).

The subsequent National Tariff Policy 2005 further articulated the government's goal of providing "power to all" by 2012 and increase per capita consumption to 1,000 kWh by 2012. The EA 2003 and National Tariff Policy 2005 together established a strong framework to implement supply-side incentives with preferential feed-in tariffs and demand-side RPOs (Sargsyan et al. 2011).

During this period, wind turbine manufacturing firms became more active in the regulatory process, both as firms and through manufacturers' associations. In addition, after India's ratification of the Kyoto Protocol in 2002 and the subsequent National Clean Development Mechanism (CDM), industrial Indian business lobbies noted the opportunities "green business" could contribute to local markets (Shukla et al. 2004). This was the first formal link between energy security, industrial policy, and climate change concerns (Chaudhary et al. 2015).

With more favorable policies in place after the power sector reforms, foreign firms that produce wind energy systems like GE, Enercon, and Wincon saw a growing market and introduced more advanced wind technologies (Chaudhary et al. 2015). These wind power firms additionally took advantage of lower labor and utility costs in India and localized their supply chains by manufacturing many of their components within the country. Domestic Indian firms also increased their global presence outside of India: Suzlon completed a series of acquisitions and licensing agreements and developed manufacturing and research capabilities for all key supply components of wind turbine systems. The company's share of revenue from international sales grew roughly 80% by 2007, making up 10.5% of the global market and 55% of the domestic market (Lewis 2007; 2011; cited in Chaudhary et al. 2015). These trends demonstrate the acceleration of the Indian wind power industry, growing at the fastest rate in the world between 2003 and 2008 with a mean annual growth rate of roughly 35% (Chaudhary et al. 2015). This period resulted in a gradual move away from the purely captive generation model to one selling power to the state utility under feed-in tariffs: By 2007, nearly two-thirds of annual installations were under the fixed feed-in tariff program (Chaudhary et al. 2015).

Moreover, the policy implementation and innovation primarily came from the state-level. Certain states like Tamil Nadu, Karnataka, Rajasthan, and Maharashtra, with high-quality wind resources, responded positively by strengthening infrastructure, providing cheap wheeling and banking incentives, and extending attractive preferential tariffs to wind developers (Chaudhary et al. 2015). Another example of state-level policy innovation during this period was Maharashtra's "Green Energy Fund," financed by a "Polluter-pays" tax on heavy industry, which was set up by means of coordination between local regulators, the state department of energy, and the state renewable energy nodal agency, and helped provide funds to strengthen the grid infrastructure for wind projects (Chaudhary et al. 2015).

Table 2. Timeline of Renewable Energy Policy Developments from Central Government (adopted from Sargsyan et al. 2011, 23):

1992	Creation of the Ministry of Non-Conventional Energy Sources (MNES)
1994	MNRE Policy and Tariff Guidelines for States

1995	Accelerated Depreciation Introduced for Wind
2003	Electricity Act of 2003
2004	State Electricity Regulatory Commission start setting up Feed in Tariff for Renewable Energy
2005	National Tariff Policy (Renewable Purchase Obligations), Integrated Energy Policy sets Renewable Energy Targets
2008	National Action Plan on Climate Change
2009	Generation Based Incentives for Wind

Phase 4: New incentives and reinforcement of tariff scheme (2009-2012)

The fourth phase is best characterized by wind energy policy's growth in prominence in national policy making, including the 11th National Five Year Plan (Chaudhary et al. 2015). In terms of the promotion of renewable energy, India's National Action Plan on Climate Change (NAPCC) has created eight priority national missions to address climate change mitigation and adaptation across the country. The NAPCC is important because it signifies an increased willingness by India's Central Government to engage with multinational organizations in acknowledging the importance of clean energy, but still emphasizes the importance of economic growth in its developmental approach (Government of India 2008).

In 2009, the Ministry of New and Renewable Energy (MNRE) introduced a scheme for Generation Based Incentives (GBI) to broaden the investor base, improve the efficiency of existing projects, and facilitate large independent power producers and foreign direct investors to the wind power sector (MNRE 2009). Under the scheme, the GBI provided wind producers 0.50 INR per unit of electricity fed into the grid for a period no less than 4 years and no more than 10 years with a cap of 62 lakhs per MW. This scheme could not be used in addition to the MNRE Accelerated Depreciation Tax benefit. GBI was an attempt to increase the efficiency of wind energy projects instead of simply increasing installed capacity. This incentive, when combined with a higher tariff in a number of states, led to a large capacity addition between 2009 and 2012.

Between 2010 and 2012, more than 5,000 MW of new capacity was installed, where more than two thirds of projects used the accelerated depreciation benefits rather than the GBI, which led to only 2,000 MW of projects (IRENA-GWEC 2012). In 2013, the MNRE reintroduced the GBI with the same policy goals, but extended the cap to 100 lakhs INR per MW and allowed developers to also take advantage of the Accelerated Depreciation tax benefit. In addition, the MNRE created a target of 15,000 MW of wind generating capacity from the extension of this policy.

A new tax code introduced in 2011 discontinued the depreciation benefits for turbines out of concern that the tax credit led to installation of projects with poor performance (Chaudhary et al. 2015). In addition, GBI was only implemented from 2009 until 2012, in part due to a concern over the financial feasibility of the program. However, the decision on GBI was reversed after lobbying by industry lobbies (Ramesh, 2013).

Although the main policy motivation for wind energy development was for energy security, the government has increasingly included it in the national climate change narrative. The 12th National Five Year Plan recognizes the benefits of wind power from both a climate change mitigation and industrialization perspective, acknowledging the importance of introducing an integrated wind policy through a National Wind Mission, similar to the National Solar Mission (Planning Commission 2013). By 2009, roughly 59% of the total installed capacity was attributed to support from the CDM, demonstrating the importance of multinational cooperation in India’s renewable energy development (Chaudhary et al. 2015).

To summarize, although early wind energy development was driven by energy security concerns, firm-level actions and policy imperatives by the Central Government have significantly shaped the sector. However, policy implementation has been uneven between the states.

Central Government's Involvement in Solar Energy Policy

The evolution of solar energy policies is distinct from that of wind energy in India. Despite both being renewable sources, solar energy development has accelerated faster than wind energy development; however, there is more than three times more wind energy installed capacity than solar installed capacity (Energy Statistics, 2018). Moreover, the Central Government's solar energy policy goals were primarily focused on energy access in early years, and have more recently incorporated diplomatic ambitions under the leadership of PM Modi. In this section, I chronicle the Central Government's solar policies, highlighting policy learning and motivations that motivated policy creation.

Phase 1: (until 2005): Introduction

Before 2005, the solar energy sector was almost exclusively focused on academic research & development (R&D) and small-scale demonstrations. Installations focused on pilot and small-decentralized projects. The DNES (later the MNES) funded several pilot projects to explore solar-power applications, mostly focused on decentralized, rural installations. The primary policy interest motivating the development of solar was to demonstrate that a localized, indigenous energy source could help India solve its energy deficit and decrease oil import bills (Gupta and Ramachandran 2003). Because of high input costs, the central government funded most projects because states did not find value in investing in such projects. However, due to the lack of a domestic industry created in the solar sector and lack of demand, the solar industry remained stagnant.

Phase 2: (2005-2008): Gathering steam

Once the international solar market boomed in the mid-2000s, policy makers in India began to consider the energy-security and energy-access benefits of solar energy. The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) program (described earlier in this chapter) was the first solar development program, but exclusively focused on improving energy access in rural areas.

One important development was when Indian firms such as Moser Baer and Tata BP solar established large manufacturing plants to produce solar panels for growing global demand. Although initially established for export, the companies benefited from international knowledge linkages through joint ventures and began to sell to domestic consumers as demand increased within India.

The Central Government introduced the semiconductor policy of 2007, which provided incentives and capital subsidies for solar manufacturers, who could reduce their capital costs for plants by 25%. At this point, little emphasis was put on R&D, so technology was dependent on products developed in developed markets. The economic crisis of 2007-2008 significantly slowed the Indian market, with Indian manufacturers over-burdened by uncovered investments (Mishra 2009).

Phase 3 (2009- 2019): International Ambitions

The Government of India launched the Jawaharlal Nehru National Solar Mission (JNNSM) in 2009 to promote solar energy development with a goal of 22,000 MW by 2022. The JNNSM, one of the eight missions established by the NAPCC, is a major effort to promote ecologically sustainable energy for India's energy security challenges. It was also motivated by a global effort to develop climate change mitigation policies: the JNNSM was devised by the Prime Minister's Council on Climate Change, established in 2007 with government, industry, and civil society representatives. The development of solar energy in India is integral to its perception of itself as a global leader: India's NAPCC recognizes the importance of the United Nations Framework Convention on Climate Change (UNFCCC) and emphasizes that "our approach must be compatible with our role as a responsible and enlightened member of the international community, ready to make our contribution to the solution of a global challenge" (Government of India 2008).

There were several reasons for the mission-based policy approach by the Indian government. By the late 2000s, India was increasingly under pressure at international forums to take meaningful steps towards climate change mitigation. At the same time, within Indian policy circles, there was a growing interest in the solar sector because of its potential to address industrial development and employment generation concerns. A mission-based policy approach allowed for the incorporation of more diverse policy concerns and interest to address a chronic energy shortage and import dependence of energy in India. The announcement by then PM Singh strategically positioned the policy initiative at the intersection of climate change mitigation, energy security, and industrialization: "[Solar power] has the potential of transforming India's energy prospects, and contributing also to national as well as global efforts to combat climate change” [and] “As a result, the movement for decentralized and dispersed industrialization will acquire an added momentum, a momentum which has not been seen before” (quoted in Chaudhary et al. 2015). In addition, with the falling price of solar power, JNNSM filled a strategic gap in the government’s policy needs.

The JNNSM was housed under within the Ministry of Power (MoP) for implementation rather than the Ministry of Environment and Forests (MoEF), which demonstrates the government’s commitment to energy security rather than climate change policy. In terms of stakeholders consulted, the mission structure facilitated actors such as NGOs, the World Bank, solar manufacturers including Moser Baer and Tata BP Solar were involved in the policymaking process. The increased consultation of actors resulted in an increased integration of climate change mitigation objectives within the solar mission (Chaudhary et al. 2015).

One major policy change that the JNNSM enacted was the reverse-auction-based feed-in tariffs. This policy instrument makes project developers bid for the minimum feed-in tariff at which they are willing to develop a solar project, which then minimizes the amount policy makers need to spend to support a solar project. The strategy reduces costs for developing and creates a bidding environment that theoretically reduces corruption and improves competition (Chaudhary et al. 2015). A second policy change was the creation of a special solar RPO, created within the RPO targets outlined in the National Tariff Policy. This created a niche market for solar installations, and also allows states to go further with setting goals. However, this policy instrument faces similar criticism as the general RPO targets: the lack of penalties makes states less likely to implement them (Chaudhary et al. 2015).

In 2015, the United Nations Climate Change Conference (COP 21 or Paris Climate Conference) led to the Central Government to further develop progressive policy in incentivizing solar energy development. India pledged to reduce its emissions intensity of GDP by 33% to 35% by 2030 from 2005 levels. Previously, India declared a voluntary goal of reducing such a figure by 20% to 25% over 2005 levels, by 2020. Prime Minister Modi has announced an ambitious target of sourcing 175 GW of renewable energy, 100 GW of which will be from solar energy, by 2022. By the end of 2017, India had installed 16GW in installed solar capacity. When considering that the global solar capacity in 2010 was 40 GW, India's targets seem especially ambitious (Sareen and Kale 2018, 271). In addition, India committed to sourcing 40% of its electricity generation from non-fossil fuels by 2030, which requires more than 500 GW in renewable energy installation (Kumar 2019). Moreover, India's renewable energy targets are more ambitious than those of the United States and China. The Centre for Science and Environment in New Delhi shows that by 2030, India will have between 250 and 300 GW of solar and wind energy capacity.[4]

During COP 21, India also announced the International Solar Alliance (ISA), a joint effort between India and France, as an intergovernmental treaty-based organization signed by 70 nations, with the purpose of promoting solar energy generation in "solar resource rich countries located between the Tropic of Cancer and the Tropic of Capricorn" (Vickery 2016). The organization hopes to galvanize over $1 trillion of investments by 2030 to produce at least 1,000 GW of solar energy in the developing world (Purushothaman 2018). On October 2nd 2018, Indian Prime Minister (PM) Narendra Modi proclaimed that "In the future, when people talk of organisations for the welfare of mankind established in the 21st century, ISA will be at the top of the list. This is a great forum to work towards ensuring climate justice. ISA could replace OPEC as the key global energy supplier in the future" (*Economic Times* 2018). The establishment of

[4] By contrast, the United States, under the Clean Power Plan, was projected to reach 275 GW of solar and wind capacity by 2030. China pledged 300 GW solar and wind power by 2030 (Clemencon 2016, 17).

ISA demonstrates India's desire to rise as a "morally responsible leader" and promote its soft power on the international stage. The establishment of the ISA has already bolstered India's soft power. In September 2018, PM Modi and French President Macron received the "Champions of the Earth" award, the UN's highest environmental recognition, for pioneering the ISA with "bold environmental leadership on the global stage" (UN Environment 2018). However, considering the energy access concerns facing India's developmental approach, India is struggling to align of domestic policy goals of improving industrial development with its leading of climate change mitigation efforts.

In terms of improved energy access: over 99% of people who have gained access to electricity in India since 2000 have done so as a result of grid-extension measures, which have been the primary focus of government programs and coal has fueled roughly 75% of these new electricity connections, and roughly 20% from renewable sources (IEA 2017, 44). In addition, a draft national renewable energy mini-grid policy was published in 2016 with the aim of developing 500 MW worth of micro-grids and mini-grids. However, the policy has not been finalized, and the policy process has been left to the states to devise, which has led to investor concern over the certainty of the market. These governmental actions demonstrate the priorities of the Central Government and undermine the argument that their solar policies were implemented for environmental reasons or concerns over climate change mitigation: Industrialization and energy security were the main driver for renewable energy policy. The Government of India has used the framing of climate change mitigation for instrumental value in bolstering its position on the world stage and its developmental needs.

Moreover, the success of the Central Government's solar policies is dependent on successful state-level policies for implementation. Certain states such as Gujarat have been more aggressive in supporting solar power development by providing higher plant feed-in tariffs. Other state-level policies include bank guarantees, lower wheeling charges, which are mostly aimed at encouraging deployment of solar energy. This policy structure often favors local state-level developers who constitute a powerful lobby within their respective states, unlike the Indian manufacturers who find more traction within the central government policy making process (Chaudhary 2015).

Policy Instruments Introduced by the Central Government

In terms of policy instruments to promote renewable energy, there are market-based instruments like feed-in tariffs (FITs) and Policy and fiscal incentives, and command and control instruments like Renewable Purchase Obligations (RPOs). FITs are often used by governments beginning a clean energy transition, where the government sets minimum prices at which renewable energy must be purchased from generating companies or private producers through contracts like power purchase agreements. This includes transmission or distribution utilities or trading licensees. The central government also provides generation-based incentives (GBIs) for wind and solar power. Policy and fiscal incentives include incentives to attract private sector investment, including 80% accelerated depreciation for tax calculations; tax holiday for renewable energy generation, and other financial incentives and capital subsidies for projects with high capital costs. RPOs require each distribution licensee to include renewable energy as a certain percentage in its resource portfolio. Percentages are dictated by the MNRE and timetables vary across States. To introduce more flexibility, the MNRE introduced a tradable Renewable Energy Certificate (REC) mechanism (Schmid 2012). These policy instruments have created a conducive environment at the national level and provide states flexibility in increasing renewable energy development in each state.

The various policy and regulatory initiatives have had mixed impacts. In terms of wind sector development, the efforts in the mid-1990s of accelerated depreciation, preferential tariffs, and resource mapping initiatives have had significant impact on installed capacity. According to a World Bank report, of India's numerous policy and financial incentives, generation based incentives, RPOs, and National Action Plan on Climate Change have had less of a significant impact (Sargsyan et al. 2011, 23).

In 2009, the feed-in tariff and RPO were launched to address the gaps in two of the most important policy support instruments. A key issue has been the lack of uniformity in feed-in tariffs across states. In 2009, the CERC feed-in tariff regulation published a uniform feed-in tariff determination methodology for each renewable energy technology based on market benchmarks of capital and operating costs.

Table 3. Roles of the State and Central Government Agencies in Policy Development, Regulation, and Promotion of Renewable Energy (Reproduced from Sargsyan et al. 2011, 25).

Level	Central government (Ministry of Power/ Ministry of Finance)	MNRE	CERC
Central	• Develops national electricity tariff policies, which also cover renewable energy • Provides fiscal incentives for promoting renewable energy	• Develops national renewable energy laws • Sets technical standards for renewable energy • Conducts resource assessments for renewable energy; supports R&D in renewable energy technologies • Promotes effective use of information technology for renewable energy, manages database • Reviews renewable energy	• Sets guidelines for feed-in tariff design for different renewable energy technologies • Regulates the regional electricity corporation mechanism • Regulates interstate open access, and third-party sales

		programs to understand their effectiveness and efficiency	
State	**State government**	**State nodal agency**	**SERCs**
	• Develops state-level renewable energy policy • Provides fiscal incentives for promoting renewable energy sources	• Conducts resource assessments for various renewable energy sources • Allocates renewable energy projects and progress monitors • Provides facilitation services to project developers—IREDA personal escort project developers to various government departments with the objective of facilitating and streamlining clearances • Facilitates clearances and land acquisition • Creates awareness and educates the masses about adoption of renewable energy • Maintains database on renewable energy sources	• Develops feed-in tariff methodologies for different renewable energy technologies • Determines RPOs and enforcement mechanism • Sets regulations on interstate wheeling, open access, and third-party sales

Conclusion

The Central Government has international ambitions of with becoming a rising responsible power; these aspirations have created new resources, incentives, and policy ideas for the subnational states in India. This chapter finds that the policy goals of the Central Government are primarily improved energy security, expanded energy access, and enhanced financial feasibility of the State Electricity Boards. The Central Government has devised impressive renewable energy policy instruments; however, the implementation of such programs is contingent upon the willingness of state-level bureaucrats in devising renewable energy policies. In the next four chapters, I chronicle the history of state-level policymaking on renewable energy, identify linkages with the Central Government in coordinating programs, and apply the analytical framework developed in Chapter 2 to determine the subnational motivations for facilitating a clean energy transition.

4

Tamil Nadu

Introduction

By disaggregating the state, we see Tamil Nadu as a global success story in terms of attracting renewable energy investment. In 2018, the State had 7,861 MW of wind energy: more installed wind power than Sweden or Denmark (McKenna 2018). The State does not have a dedicated wind policy, but has created attractive incentives to developers to promote wind power, which include progressive wheeling and banking charges.[5] Tamil Nadu was a unique first mover in the Indian wind energy market; by 1999, the State already had 72 percent of India's installed wind capacity with 718.9 MW of wind power capacity (cited in Table 3 of Jagadeesh 2000). As of 2017, Tamil Nadu accounts for 32 percent of total installed renewable energy capacity in the country and contributes to 14.9 percent of the total electricity generated in the State (77218 MU) in 2011-12 (Five Year Plan Tamil Nadu, 405).

The state had synergistic links with the Central Government in coordinating renewable energy development. Effective government planning led to investor confidence, which allowed renewable energy to grow and become over 35% of the state's installed capacity by 2017 (Nesamalar 2017). However, in terms of motivations of regional elites in devising policies on renewable energy, Tamil Nadu provides a powerful example of how state-level government-industry linkages led to a large installed wind energy capacity. Tamil Nadu has used renewable energy as an industrial and diversification policy: Environmental concerns weren't the primary

[5] Wheeling and banking charges encourage private sector renewable energy development by properly compensating energy generators for producing energy. A 2% wheeling charge then implies that 3% of the energy generated by the windmill farm would be deducted as the commission so the developer can sell it as captive power to a third party: the 98% balance is made available to the consumer. Banking allows a private developer to store its energy generated for consumption at a later time if the consumer does not need it.

driver of renewable energy development; instead, environmental benefits from renewable energy were an unintended outcome of private sector actors and state elites coordinating with the Central Government to address the pressing needs of ensuring reliable energy for industry leaders.

In this chapter, I first provide a brief summary of economic development in Tamil Nadu; second, I chronicle the history of renewable energy development; third, I apply the analytical framework developed in Chapter 2 to analyze the motivations of regional elites in devising renewable energy policies.

History of Economic Development in Tamil Nadu

Tamil Nadu leads many other Indian states in economic development. Tamil Nadu has a highly developed industrial sector, strong economic growth, and has one of its highest Human Development Indicators (Ramakrishnan 2018, 255). Tamil Nadu contributes nearly 8.4% to India's GDP, making it the second largest contributor, only after Maharashtra (Power for All Tamil Nadu, 3). The State is also the most urbanized state of India, with 48.4% of the population living in urban areas. Tamil Nadu is India's eleventh largest state in terms of landmass and the seventh most populous state, and has the highest number of business enterprises and stands second in total employment in the country (Nesamalar et al. 2017). Tamil Nadu was formed in 1950 from an area of Southern India known as the Madras Presidency under British rule. Even at the time of India's independence, Tamil Nadu had a well-defined "subnational" identity based on its distinct culture. This identity has played a significant part in the development of the state (Singh 2016).

The Tamil Nadu Electricity Board (TNEB) was formed in 1957 under the Electricity Supply Act, 1948 as a successor to the Electricity Department of the Government of Madras (TNEB 2007). Tamil Nadu has achieved complete village electrification (Power for All Tamil Nadu, i), the state produces a net surplus of power, and provides free electricity of 100 units bi-monthly to all domestic customers (Power for All Tamil Nadu, i). The state has made significant progress in expanding electricity access and availability while leading the country in renewable energy capacity.

Tamil Nadu has a vast amount of renewable energy potential and few reserves of fossil-fuels, which made a transition to renewable energy economically viable. Tamil Nadu benefits from having 14,152 MW of state-wide wind energy potential, India's third largest (only after Gujarat and Andhra Pradesh) (see figure 4). Located in southern India, Tamil Nadu houses the Western Ghat mountain range, including the Aralvaimozhi, Kambam, Palakkad, and Shencottah passes, which provide a tunneling effect to create vast potential for wind energy. Roughly 80% of the total wind energy is generated during monsoon from the months of June to September, which creates several challenges in terms of grid-stability (Nesamalar et al. 2017).

Tamil Nadu has few oil, gas, or coal resources, so most of the coal used in the state must be imported from other states in India or from global markets. The lack of fossil-fuel resources in the state led to the diversification of the energy mix after the oil crisis of the 1970s. In terms of a main motivating factor in diversifying the energy generation base, there were major shortages and constraints in acquisition of fossil fuels through the 1980s. More recently, coal production in India has fallen, which requires more imported coal; however, the price of imported coal has increased by 1.5 over the last couple years, threatening the operational viability of thermal power plants (Solar Energy Policy 2012, 2-3).

In addition to geographic favorability, Tamil Nadu benefitted from prioritizing the development of infrastructure, which led to an easier diffusion of renewable energy. A grid network created by Tamil Nadu Electricity Board (TNEB) was extensive and was close enough to high-wind potential sites, that integration into the grid was easy to coordinate. The wind sites were very close to towns and connected with highways for accessibility to provide labor and provide accommodations for personnel to develop the projects (Jagadeesh 2000). The international port of Chennai was also useful in ensuring a stable supply chain of wind turbine parts by importing heavy machinery components (Jagadeesh 2000). This led to many wind turbine manufacturers moving to Tamil Nadu. However, as the second chapter demonstrated, geographical favorability cannot alone explain renewable energy development. As figures 3 and 4 show, Tamil Nadu became a leader in wind energy installed capacity despite not having the country's largest geographic potential. The remaining part of the chapter chronicles the policy initiatives that the regional elite devised to promote renewable energy production in the State.

Table 4. Overview of Economic and Energy Indicators in Tamil Nadu (sources: Roy 2013; GoI Census 2011; MoSPI 2018).

Land Area	130,058 sq. km
Population (Census 2011)	72.14 million
Human Development Index (HDI)	0.57
Gross State Domestic Product (GSDP Per-capita INR) RBI Statistical Review Handbook 2010-11	59,345
Net State Domestic Product (NSDP) (Billion Rupees) RBI Statistical Review Handbook 20111-12	3,822.29
Per-Capita Energy Consumption (kWh)	1,131.58
Statewide Energy Installed Capacity	Hydro: 2.2 GW (10.21%)

(percentage of total installed capacity) (2017)	Thermal: 8.71 GW (40.44%) Renewable: 10.63 GW (49.35%) **Total: 21.54 GW**
Renewable Energy Potential (Utilization rate: total capacity divided by potential) (2017)	Wind: **14,152MW** (55.55%) Solar: **17,670 MW** (9.57%) Small Hydro: **660 MW** (18.64%) Total RE: **34,152 MW** (30.93%)
Percentage of Electrified Households (Census 2011)	93.4%
Motor Vehicles per 1000 people (Ministry of Road Transport 2011)	217
Credit Rating of State Electricity Board (Ministry of Power)	B

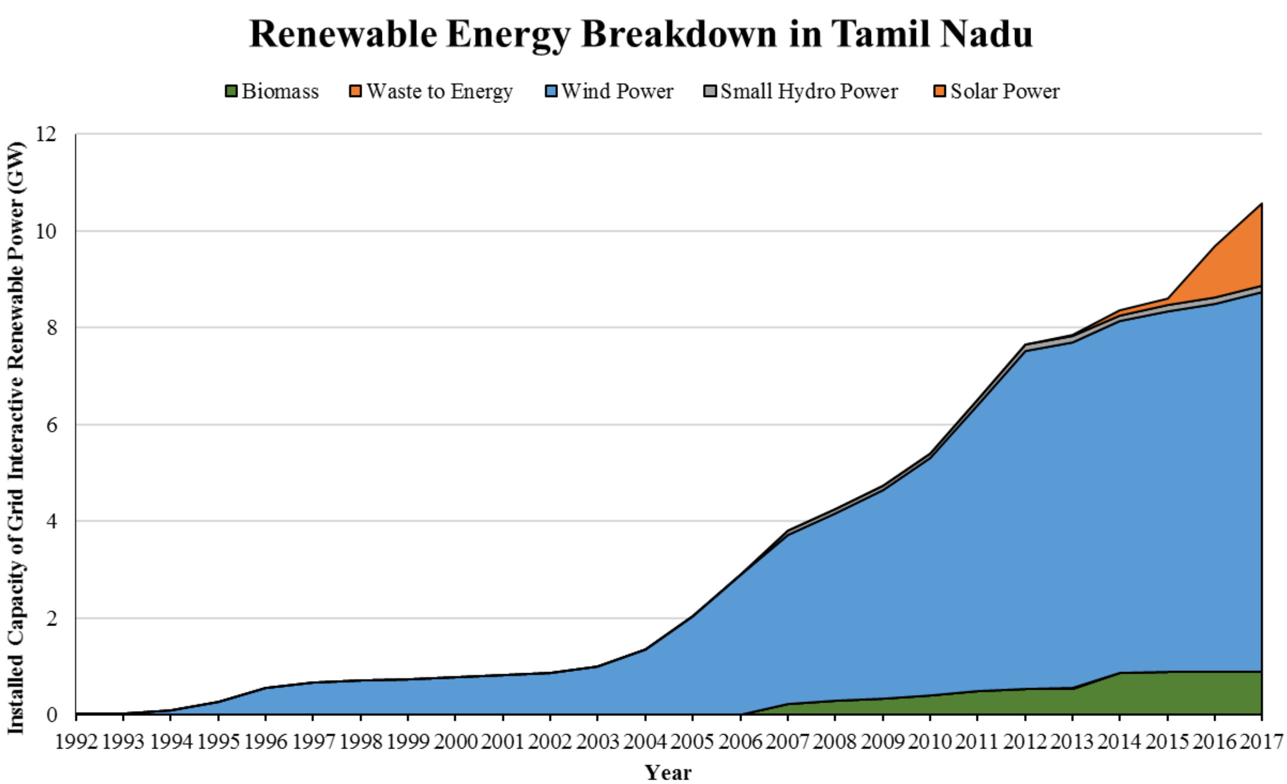

Figure 3. Renewable Energy Growth by Year in Tamil Nadu (MoSPI 2007-2018).

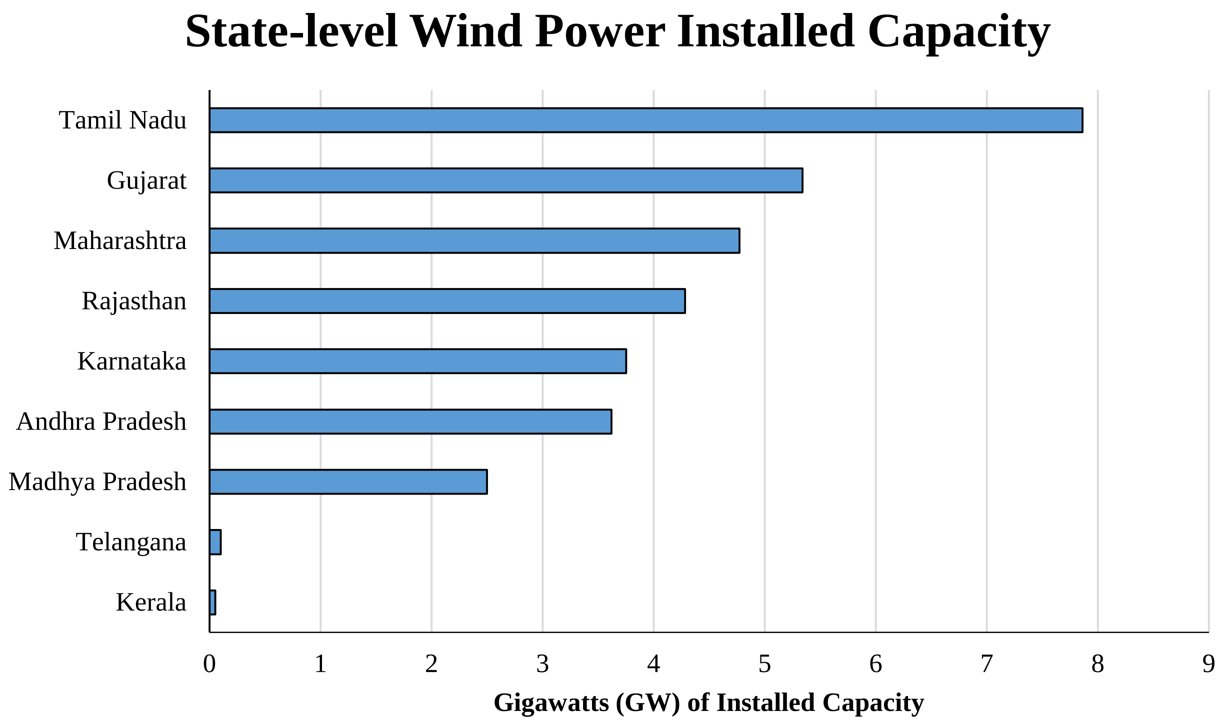

Figure 4. State-level Wind Power Installed Capacity (MoSPI 2018).

History of Renewable Energy Development in Tamil Nadu

Tamil Nadu has India's largest amount of total wind installed capacity with 7,861 MW as of March 31, 2017 (See figure 3, MoSPI 2018). The State does not have a dedicated wind policy, but it has created attractive incentives to developers to promote wind power. As of 2016, the expected increase in installed capacity for FY 17 was expected to be 2,509 MW from thermal sources, 165 MW from co-generation sources, and 5,100 MW from renewable sources, which demonstrates the state's effective policies promoting renewable energy (Power for All Tamil Nadu, 1).

Wind Energy Development

Tamil Nadu has been a leader in producing renewable energy since 1985, when a demonstration project for grid-connected wind farms was introduced by the former Department of Non-Conventional Energy Sources (NCES). In 1988, the Danish International Development Agency (DANIDA) helped implement a 10 MW demonstration project at two additional sites in Tamil Nadu. Based on early successful demonstration projects, the Tamil Nadu Electricity Board (TNEB) identified potential sites and developed the initial infrastructure for setting up wind turbines to attract private investment (IRENA-GWEC 2011, 88).

In the 1980s, the central government began to promote wind-based energy generation. Feasibility studies found that there was significant wind potential in Tamil Nadu. TNEB began setting up wind farms in Muppandal in the mid-1980s on a demonstration basis, which later expanded to 19 MW of wind installed capacity by 1993-1994. The state encouraged the private sector to set up captive wind generation projects by providing several incentives. TNEB devised a policy where provide sector companies that set up projects in high potential wind areas, power could be “wheeled” through TNEB’s grid to their industrial unit. Excess power generated could then be sold to TNEB for a fixed rate. This “wheeling” policy attracted significant private sector investment. (Ramakrishnan 2018, 264). However, some high paying industrial demand moved out of TNEB, which further threatened its financial sustainability

TNEB undertook several proactive efforts to establish the techno-economic feasibility of wind energy production, which included attractive state-level policies of wheeling, banking, and options for third-party sales. These policies lead to the addition of 19.4 MW of wind energy installed capacity between 1986 and 1993 (IRENA-GWEC 2011, 88). In the early 1990s, soft loans from the Indian Renewable Energy Development Agency Ltd. (IREDA) and federal fiscal and financial incentives further supported the growth of wind power (see Appendix F for data on Tamil Nadu's wind growth in comparison to other states).

For the sake of wind energy diffusion across India, the Centre for Wind Energy Technology (C-WET), a national institution governed by the MNRE, was located in Tamil Nadu. C-WET provides wind feasibility assessments and certification support to wind companies in India. The R&D unit within C-WET was established in 1999 with the support of DANIDA to provide research to innovate wind turbine components and create the National Wind Resource Assessment Program to provide state-level data on wind energy potential (IRENA-GWEC 2011, 89).

The Government of Tamil Nadu also provides fiscal incentives for wind energy development, including to buy surplus energy at a stipulated price (Dasgupta & Sankhyayan 2017). The most innovative aspect of the state's policies were the guarantee to transmit the power generated by the windfarm to a factory site of the industrial undertaking concerned/ unit nominated irrespective of the distance from the wind farm. Never before had such policies been implemented in India: the policy allowed for private sector actors to take advantage of the reliability and cost-effectiveness of renewable energy when compared to thermal power. A 2% wheeling charge then implies that 2% of the energy generated by the windmill farm would be deducted as the commission and the balance 98% only made available to the party at a place where power is required (Sinha and Ramana 1995, 59).

Solar Energy Development

In 2012, Tamil Nadu introduced a Solar Energy Policy, which set a target of generating 3,000 MW of solar energy by 2015. The target was planned to be achieved through 1,500 MW of utility-scale projects, 350 MW of rooftops, and 1,150 MW of REC (Solar Energy Policy 2012). The preamble notes that conventional energy sources like coal, oil, and natural gas are limited in quantity and energy demand is leading to fossil-fuel based power plants that produce greenhouse gas emissions, which have “an adverse impact on global warming and climate change” (Solar Energy Policy 2012, 1). Achieving energy security for the state, reducing carbon emissions, making Tamil Nadu a solar hub, and encouraging domestic manufacturing are all major objectives stated in the policy. The state created a Solar Purchase Obligation (SPO) mandatory at 6% (3% until December 2013 and 6% January 2014 onwards), which is administered by Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO). The policy references the State’s high solar insolation (5.6-6.0 kWh/sq. m) with roughly 300 clear sunny days every year, and the State hopes to “enhance energy security, making Tamil Nadu the global reference in the solar energy sector” (Solar Energy Policy 2012, 1). In terms of policy goals, this shows that Tamil Nadu’s primary focus is energy security, but this helps fulfill global ambitions. In terms of Government of India programs referenced, the policy acknowledges the Jawaharlal Nehru National Solar Mission (JNNSM) under the National Action Plan for Climate Change (NAPCC), which provides tariff subsidies to increase scale and drive down costs to grid parity and achieving 22,000 MW by 2022.

In 2019, Tamil Nadu released an updated Solar Energy Policy, which sets a target of 9,000 MW of solar energy by 2023. Most significantly, 40% is earmarked for consumers, mostly for rooftops, rather than captive use for industry. The policy references the Intergovernmental Panel for Climate Change (IPCC) and the India’s Nationally-Determined Contributions after the Paris Climate Accord in a hope to create international consensus to limit warming to 1.5 degrees Celsius. The policy also notes the Indian Government’s commitments to reduce emission intensity of GDP by 33-25% by 2030 from 2005 levels and install 40% of electric power capacity by 2030 along with forest and tree cover to add 2.5-3 GtCO2e of carbon sinks by 2030 (TEDA 2019). The new policy's focus on internationally-established norms shows India's increasing interest, even on the state level, in becoming a rising power.

Next, I will use the four factors I identified to map out the motivations of the political elites in devising policy to create a clean energy transition in Tamil Nadu:

Applying the Analytical Framework to Tamil Nadu

In applying the analytical framework developed in Chapter 2, we see that the institutional knowledge of actors in the state-nodal renewable energy agency and linkages with private sector actors facilitated renewable energy development in Tamil Nadu.

State-level Party Politics

After independence, the Indian National Congress (INC) governed the Madras State and held power until 1967. Starting in 1967, the Dravida Munnetra Kazhagam (Dravidian Progress Federation or DMK), led by C.N. Annadurai, came to power in Tamil Nadu. Based off the ideology of the Dravidian movement, a Tamil-speaking native population in South India, which sought to achieve equal status for all castes and classes as well as gender equality. DMK appealed to a broad base of constituents: the "common man, the middleman, the ordinary Dravidian" (Barnett 1976, 100). In terms of industrial development, the hegemony of cultural subnationalism with an emphasis on individual-centric, discursive, and cultural mobilization led to a subnational state distinct from the Central Government. The culture-centric politics based on linguistic (tamil) and spatial (south) differences. The movement created a distinct sub-national identity, defined by anti-Brahmanist, anti-North Indian, anti-Hindi, and anti-religious, which helped contribute to Tamil Nadu’s distinct developmental trajectory (Ramakrishnan 2018).

In 1997, another Dravidian party, the All India Anna Dravida Munnetra Kazhagam (AIADMK), which had broken off from DMK, came to power. Both the DMK and AIADMK parties began distributing private goods like gas stoves, television sets, and bicycles, which gave rise to a trend of unsustainable subsidies. The two-party populist electoral contest that ensued between the DMK and AIADMK led to additional electricity subsidies.

In Tamil Nadu, there has been stable policy continuity and the governing coalition has been willing to implement policies to integrate wind energy into the existing installed capacity. Hence, the political will to implement renewable energy policies did not change depending on the party in power; this can be explained by the engagement of the public sector in investing in captive wind energy. The policy support required from the state-level bureaucracy was minimal because of the Despite active electoral politics and frequent party turnover in the governing coalition between the DMK and AIADMK, Tamil Nadu has significant policy continuity in regards to energy policy. This policy continuity is best

Financial Space/ Indebtedness of State Distribution Companies

The State Electricity Board in Tamil Nadu has struggled to maintain financial sustainability in an attempt to respond to political demands for subsidized electricity. Tamil Nadu’s distribution company received a score of B (below average) or C+ (low) for its poor operational and financial performance capacity during 2015-17 according to the Annual Integrated Rating of State Distribution Utilities (Ramakrishnan 2018, 255). After a movement of well-organized farmers demanded highly subsidized electricity, Tamil Nadu has over subsidized electricity for farmers through financially unsustainable cross-subsidies; this has negatively impacted the indebtedness and reduced the investor friendliness of the state.

The Tamil Nadu Electricity Board (TNEB) was formed as a government-owned statutory monopoly responsible for generation, transmission, and distribution of electricity. The main objective of TNEB was to expand electricity access, ensuring equitable access for all. At this point, TNEB had a uniform pricing policy for all consumers, even though it was more costly to service rural areas, but electricity for irrigation pumps was charged at rates lower than costs to promote agricultural productivity and rural incomes. Nevertheless, TNEB operated efficiently and earned a net positive income without needing subsidies from the state government (Ramakrishnan 2018).

In the 1960s, Tamil Nadu became one of the first few states to experience the green revolution. Higher productivity in agriculture required higher capital investments, intensive use of fertilizers and constant water supply. Although many farmers benefited from technological progress, those with lower water tables required additional electricity for irrigation purposes (Ramakrishnan 2018). Rising inequality, as a result of rising inequality, gave rise to a strong peasant movement around state-welfare programs, including the subsidization of electricity. In 1963, a delegation of farmers from a subdivision of Coimbatore district approached the Electricity Minister and Chairman of TNEB and demanded that subsidized electricity be allowed for additional domestic lighting uses. In 1967, the DMK government imposed severe penalties on illegal use of subsidized electricity for water pumping; the peasant movement quickly got the penalties revoked. In 1970, when Annadurai’s successor, Karunanidhi, hiked the electricity tariff by 2 paise/kWh and introduced a crop-based agriculture tax, a district-wide agitation organized into a hunger strike, massive rallies, and non-cooperation. Violence ensued when policy attended to repress the movement and the tariff was eventually lowered and tax revoked (Ramakrishnan 2018). By 1973, the movement organized across the state and formed the Thamizhaga Vivasayigal Sangam (Tamilian Agriculturalists Association or TVS). TVS refused to pay for electricity dues and became increasingly militant as negotiations with the government failed.

In 1977, the AIADMK took control over the parliament and M.G. Ramachandran (MGR) promised to embrace “paternalistic” populism and promised subsidies for the poor and protection for a repressive elite class. In 1978, the TVS reaffirmed its stance of not wanting to pay electricity tariffs or land taxes; when the government declined to provide such subsidies, statewide agitations and violence ensued. As a result, the MGR government allowed smaller farmers to pay a lower rate than larger farmers and later brokered a deal to meet certain demands for the 1980 elections. In 1984, after MGR’s third reelection, the government introduced programs of free lighting for huts in villages and tribal colonies, which was subsidized by larger industrial and commercial tariffs.

The state government also offered many concessions to power-intensive industries. The TNEB’s generating capacity in hydro plants expanded dramatically to promote industrial development. However, from 1972-3, the power sector began experiencing many electricity shortages: the days of work lost due to electricity shortages over the five years from 1972-1976-7 were 832 days for the industries and 410 days for large commercial consumers (Ramakrishnan 2018). With increased power shortages, consumers resorted to high-cost diesel-based captive generation, which accelerated the flight of big industries from TNEB.

During MGR’s rule (1980-1987), the financial performance of TNEB began to deteriorate significantly. After discontinuing the costly metering of agricultural electricity demand, theft and rent-seeking became pervasive (Ramakrishnan 2018). Farmers were provided with free power because of their political organization and domestic tariff rates remained constant; however, tariffs for industrial and commercial consumers nearly doubled in an effort to cross-subsidize the agricultural and domestic consumers.

As of 2000, TNEB sold 18.66% of its energy to domestic consumers, 8.97% to commercial consumers, 36.64% to industrial, and 29.52% to agricultural consumers (TNEB 2001). Moreover, the Tamil Nadu Government provided a subsidy to TNEB starting in April 1, 2004 for free electricity to agricultural consumers, amounting to Rs. 196 Crores (1.96 billion INR); the Government also reduced the electricity tariff rates for domestic consumers, for a total subsidy of Rs. 954 Crores (9.43 billion INR) for 2005-06 (TNEB 2006).

The Central Electricity Act of 2003 required all State Electricity Boards to be unbundled into generation, transmission, and distribution entities. As a result, some states immediately unbundled their state electricity boards; however, in Tamil Nadu, the Tamil Nadu Generation and Distribution Corporation was founded in 2010 following the state-level unbundling of the Tamil Nadu Electricity Board. Tamil Nadu was one of the last states to enact such reforms, which shows the autonomous and bottom-up policymaking process employed by the State in relation to the Central Government. TNEB was reorganized into TNEB Limited, Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) and Tamil Nadu Transmission Corporation Limited (TANTRANSCO). TANGEDCO provides retail supply of power to end users and maintains the wire business for supply of power. TANGEDCO is a recipient of the Central Government's UDAY scheme and was given a rating of "B" by the Ministry of Power (Ministry of Power, 2018). However, there are concerns if TANGEDCO will meet the efficiency improvement requirements by metering agricultural consumption. According to the Ministry of Power, TANGEDCO is dependent on tariff subsidies from the Government of Tamil Nadu, which has increased substantially and has exposed TANGEDCO to increasingly exposed credit risk.

The Tamil Nadu Electricity Regulatory Commission (TNERC) was created as a result of reforms encouraged by the Central Government. The main objective of the TNERC is to rationalize the electricity tariff and promote transparent policies regarding subsidies (TNERC 2019). A second objective of TNERC is to implement the Central Electricity Regulation Commission's Renewable Energy Certificates (REC). In terms of the CERC's notification on REC in 2009, TNERC established a renewable energy purchase specification of 8.95% for 2011-12. Although constituted in 1999, TNERC did not have a Chairman until 2002. The members and staff of the TNERC have mostly been ex-TNEB employees, which has worried reformers (Ramakrishnan 2018). Despite having a poor performing state electricity board because of political demands, Tamil Nadu has been successful in implementing renewable energy because of a well-functioning state-nodal renewable energy agency.

Institutional Knowledge in State-level Nodal Renewable Energy Agencies

State-level agencies like TNEB and TEDA promoted active steps and policies, which accelerated to integrate renewable energy into the existing energy apparatus (Jagadeesh 2000). The state nodal agency, Tamil Nadu Energy Development Agency (TEDA), was established in 1984 as an independent agency established by the Government of Tamil Nadu to help diffuse non-conventional forms of energy (TEDA 2019).

Benecke (2011) applies a renewable energy stakeholder network analysis for who governs and how governance takes place. In Tamil Nadu, interactions between public and private sector actors have created a network of trusting relations (Benecke 2011). These state-market relations “crucially determine the effectiveness of renewable energy service delivery” (Benecke 2011, 38).

TEDA has benefitted from synergistic knowledge sharing with the Central Government. In 1984, the Central Government’s MNES initiated its wind power program to conduct wind resource assessments, demonstration projects, and industry utility partnerships to help diffuse wind energy across states in India (MNES 2003). The program identified 201 potential sites and mapped out a 45,000 MW Gross potential with 13,000 MW of Technical potential across the country (MNES 2003). By 2003, MNES installed 1702 MW of wind installed capacity, of which 63 MW were demonstration projects at 29 locations and 1639 MW were commissioned by private sector companies (MNES 2003). This capacity made it the fifth largest installed capacity in the world (MNES 2003). Of the units fed to the grid, 80% were from captive production and 20% were sold to third parties. Moreover, MNES policies encourage domestic wind manufacturing, but only 500 MW of wind potential is actually produced domestically, the rest is imported (MNES 2003). Much of the technical analysis was provided by the Centre for Wind Energy Technology (C-WET), which is headquartered in Tamil Nadu’s capital Chennai (MNES 2003). As a result, the State’s first wind turbine was set up in Kayathar, Tamil Nadu. This initiative was the result of a partnership initiated by the Central Government to provide technical knowhow to Tamil Nadu. The synergistic links between the State and Central Governments allowed Tamil Nadu to become a pioneer in wind energy production (MNES 2003).

The success of TEDA and TNEB’s incentives for wind production in Tamil Nadu motivated the Central Government in formulating guidelines on the implementation of windfarm development projects to diffuse policy recommendations to the other states. These guidelines were then implemented by Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, and Gujarat (Sinha and Ramana 1995, 59). In 1995, after the success of Tamil Nadu in promoting wind energy development, the Central Government's MNES formulated guidelines to encourage other states to accelerate wind power production. MNES guidelines on policy included 2% wheeling charges, banking up to one year, third party sales at remunerative prices, buyback facility at a minimum price of Rs 2.25 per kWh for base year 1994-1995 and a 5% annual escalation in tariff. These recommendations were the result of Tamil Nadu's effective governmental bureaucracy to facilitate renewable energy development and influenced the Central Government in formulating guidelines on the implementation of windfarm development projects with private sector participation (Ramana & Kozloff 1995, 59).

Moreover, as the Central Government was focusing on the larger economic liberalization of India's economy, Tamil Nadu's proactive engagement with the private sector allowed the Central Government to further its policy objectives of economic liberalization through renewable energy policy guidelines for the states. The MNES initiated several fiscal incentives as a result in 1995 to further private sector renewable energy development across India. These policies include: concessional import duties on wind turbine parts, 80% accelerated depreciation tax benefit, loans through the IREDA, Income Tax holiday, and acknowledged that 9 states had introduced policies, some with sales tax incentives (MNES 2003).

Linkages with the Private Sector

The largest motivating factor in the clean energy transition in Tamil Nadu was the effective linkages between the policy elites and private industry. The state faced a large gap between demand and supply of power in the 1980s. TNEB took the first step to install the first wind farms in sites such as Muppandal, Kayathar, and Kethanur; this action created confidence in the State Government's support of commercializing the nascent industry among private wind farm developers, which encouraged future investment (Jagadeesh 2000).

TNEB implemented wheeling and banking policies implemented policies to encourage industry to set up at a site with high wind potential and the power could be wheelied through TNEB's grid to their industrial demand. Excess power could be sold to TNEB. Hence, this decision to integrate more renewable energy into the grid was not based on environmental principles. The fact that it was a carbon-free technology was helpful, but not the motivating factor for TNEB to open up wind energy development (Ramakrishnan 2018, 264).

TNEB established an effective system for proactively engaging with private developers to extend the grid connection to wind farms and creating new sub-stations; TNEB also extended consultancy services for processing the applications for issuance of No Objection Certificate (NOC), Chief Electrical Inspectorate to the Government (CEIG), registering the wind parks and compensating developers adequately, which had previously been difficult because of the lack of metering technology. Moreover, the TNEB officials had significant domain knowledge in the area, demonstrating professional qualifications and expertise not found in many other states (Jagadeesh 2000).

Because the majority of demand came from industries like leather-tanning, textiles, cement, and automotive components, these industries were the earliest to take advantage of captive power. In particular, the textile industry played an important part: To this day, the Tamil Nadu Spinning Mills Association (TASMA) owns over 3,000 MW of wind farms, over 40% of the state's total capacity (Sushma 2018). In 1999, the State's establishment of the Ministry of Textile's Technology Upgradation Fund Scheme (TUFS) significantly accelerated investment in the sub-sectors of textile and jute industry.[6] The Government of India operated a Technology Upgrade Fund Scheme for Textile and Jute Industries from 1999 until 2012 to modernize the production facilities in the textile industry (IRENA-GWEC 2011, 88). The Government gave a 5% interest subsidy, which were reimbursed to the units every quarter.

The owners of textile units could take advantage of the capital subsidy by either setting up a captive power plant or sell it on to third-party buyers. Under the scheme, textile industry providers could set up wind farms, and the Tamil Nadu Industrial Corporation Limited (state-owned company) financed efforts to purchase and create wind turbines for local energy production. By 2002, Tamil Nadu's installed wind energy capacity was 895 MW, which made up 53% of India's installed wind capacity (IRENA-GWEC 2011, 88).

The textile market and cement industry profited immensely from the tax concessions such as the 100% depreciation and 5 year tax holiday by setting up wind farms. In addition, these industries, which rely on heavy power, benefitted from more reliable captive power; this was especially important because wind energy is most productive during the summer monsoon months, when power cuts were most common because of mismanaged supply (Jagadeesh 2000). Therefore, integrating wind energy capacity into the grid improved TNEB's power supply position.

Conclusion

Tamil Nadu was successful in promoting renewable energy investment because of synergistic links with the Central Government, strong institutional capacity in TEDA, and the state's effective private sector linkages. The state promoted renewable energy for primarily energy security concerns and provided fiscal incentives to promote renewable energy

[6] The scheme was extended in 2004 and again in 2007 to 2010. It was slightly modified but continued until 2012.

development. More recently, Tamil Nadu has begun to use the rhetoric of climate change mitigation strategies, but environmental concerns seems to be an unintended consequence of a liberalized energy market where wind energy was more profitable for industrial captive use than thermal power.

Table 5. Timeline of Renewable Energy Policy Developments in Tamil Nadu (reproduced from Ramakrishnan 2018, 257).

1927	Electricity Department Established
1930	Rural electrification began
1957	Formation of TNEB
1963	Peasant movement in Coimbatore geban
1973	Thamizhaga Vivisayigal Sangam formalized
1984	Free power provided to small farmers
1988	Discontinuation of Metering of Agricultural consumption
1998	TNERC constituted
2003	Central Government’s Electricity Act
2010	TNEB unbundled; created TANGEDCO and TANTRANSCO
2015	TN agrees to UDAY scheme

5

Kerala

Introduction

In Kerala, an active environmental movement did not facilitate the diffusion of renewable energy installation in the state. Instead, the poor linkages between the political elites and private businesses lead to slow renewable energy generation. Kerala has uniquely high human development indicators and an active environmental movement (Sen 1995). The Silent Valley hydroelectric dam protest in the 1970s organized by the Kerala Sastra Sahitya Parishad (KSSP) was India's first large environmental movement. However, this environmental movement did not lead to high solar and wind utilization rates within the state; Kerala's prioritization of the demands of activist organizations over private sector developers has slowed renewable energy development in the state. In 2017, Kerala ranked 15th in installed renewable energy capacity; however, this lack of renewable energy cannot be explained by the state's small geographic size. Kerala's utilization rate of renewable energy potential is roughly half that of the Indian national average (3.88% versus 6.38%), which is surprising given its progressive developmental successes (MNRE 2017; MoSPI 2018).[7] In particular, Kerala's utilization rate of wind power potential is especially low (see Figure 5 in Chapter 5).

Ever since the successful protest of a proposed hydroelectric dam in Silent Valley, Kerala has experienced an energy deficiency. The subsequent importation of electricity from the Central grid's electricity is predominantly generated from fossil fuels. A journalist in Kerala explained to me the state's energy concerns: "power has always been a major issue because Kerala is a small state and an environmentally-concerned state" (Author's Interview with Journalist in Kerala

[7] Utilization rate is calculated as a percentage of the total installed renewable energy capacity divided by the renewable energy potential.

2018). However, lack of land cannot alone explain the energy deficiency: poor policy management by the state-level nodal renewable energy agency and few linkages between the government and the private sector have led to slow renewable energy development in the state. In terms of motivations of regional elites in devising policies on renewable energy, Kerala is a powerful example of the importance of state-level government-industry linkages in diffusing renewable energy capacity. Despite active environmental movements and coordination between the state and the Central Government, renewable energy development has been slow.

If Kerala had such an active environmentalist and activist base in its policymaking process, then why does the state use so little of its wind and solar potential? Also, if energy security was such a concern, why did the state still import the majority of its electricity from neighboring states, especially given its high composition of fossil-fuel generated electricity? In this chapter, I first provide a brief summary of economic development in Kerala; second, I chronicle the history of renewable energy development; third, I apply the analytical framework developed in Chapter 2 to analyze the motivations of regional elites in devising renewable energy policies.

History of Economic Development in Kerala

Kerala provides a very unique developmental model within the Indian subcontinent. Rather than being driven by a neoliberal market, Kerala's economy has regulated market forces and has been controlled by a popularly elected Communist government. Although Kerala has been governed by the world's first elected Communist government, party leaders in Kerala never seized factories, Marx's "means of production," nor banned private property; instead, the leaders implemented progressive policies to increase welfare across the state (Jaffe and Doshi 2017). As a result, Kerala has India's highest Human Development Index (HDI), which is 0.71 according to the Human Development Report of 2015 (See Figure 5). The population of Kerala has a 93.91% literacy rate, 77-year life expectancy, and a sex ratio of 1,084 women per 1000 men, the highest in India (GoI and GoK 2016, 6). Scholars such as Amartya Sen and Jean Dreze have been interested in Kerala's ability to eliminate basic deprivations and achieve impressively high human development indicators despite having a low income level per capita when compared to international standards (Ramachandran 1997). Kerala has achieved these outcomes by expanding basic education, health care, and equitable land distribution (Sen 1995). As a result of progressive women's education policies, population growth is only 4.91%, making the birthrate below that of China, which demonstrates the effectiveness of bottom-up policymaking (Sen 1995, 221). The low birth rate also puts fewer constraints on the state's resources (Census 2011).

CHART 2

Ranking of Indian states in the world according to 2015 Human Development Report

INDIAN STATES			COMPARABLE COUNTRIES	
States	Constructed HDI score	Hypothetical HDI ranks	Countries	HDI score
Kerala	0.7117	104	Maldives	0.706
Himachal Pradesh	0.6701	116	Uzbekistan	0.675
Tamil Nadu	0.6663	118	Philippines	0.668
Maharashtra	0.6659	119	South Africa	0.666
Punjab	0.6614	124	Bolivia	0.662
Haryana	0.6613	125	Kyrgyzstan	0.655
Jammu and Kashmir	0.6489	128	Iraq	0.654
Karnataka	0.6176	137	Tajikistan	0.624
Andhra Pradesh	0.6165	138	Tajikistan	0.624
Gujarat	0.6164	139	Honduras	0.606
ALL INDIA	0.6087			
West Bengal	0.6042	142	Bhutan	0.605
Rajasthan	0.5768	151	Ghana	0.579
Odisha	0.5567	154	Bangladesh	0.57
Madhya Pradesh	0.5567	155	Bangladesh	0.57
Assam	0.5555	156	Cambodia	0.555
Uttar Pradesh	0.5415	161	Pakistan	0.538
Bihar	0.5361	163	Myanmar	0.536

Sources: UNDP 2015 Human Development Report; RBI (for state per capita income); Desai, Sonalde, and Reeve Vanneman. India Human Development Survey-II, 2011-12 (for education indicators); SRS Based Life Tables 2009-13 and Mint calculations

Figure 5. Ranking of Indian States in the World According to 2015 Human Development Report (figure copied from Kundu 2015).

There is very little commercial or industrial activity in Kerala. Despite having one of India's highest indicators for gross state domestic product (GSDP) per capita, the net state domestic product, which measures the volume of all goods and services produced within the state, is much smaller than any of the other ones studied (Tamil Nadu, Rajasthan, and Gujarat). This is partially due to the small size of the state geographically and in terms of population, but also demonstrates the lack of industrial base in the state: more than one-third of Kerala's gross domestic product in 2016 came from remittances from people moving to the Persian Gulf states for manual labor, accounting, and nursing jobs (Weiner 1982; Jaffe and Doshi 2017). Political elites discouraged private sector investments early on in the state's history, as it was seen as a means to exploit workers and waste natural resources (Jeromi 2005).

In terms of energy policy, the low population growth means that demand for energy is not increasing at the same rate experienced by other Indian states. The state has a 94.4% electrification rate, one of the highest of any state in India (GoI and GoK 2016, 7). Kerala has already "been on a 24x7 footing" for the past decade, mostly because "the peculiar socio-economic conditions of the State demanded it" (GoI and GoK 2016, 1).

However, because of active environmental movements, high density of people, and lack of available land, the State experiences a severe power deficiency. Kerala is India's 13th largest by population as of 2011 (GoI and GoK 2016, 6). However, in terms of installed capacity by state, Kerala ranks in the 16th position, with 1.66% of the total installed capacity of India, making it an energy deficient state (GoI and GoK 2016, 6). On average, roughly half of the State's energy consumption is supplied by the Central Sector Allocation grid (GoI and GoK 2016, 6). Moreover, this number is highly variable: In 2017, the state had a daily demand of 61.9

million units; to meet demand, 13.75 million units are generated from hydroelectric sources and 48 million units are imported, 26.2 million of which from the Central grid, and 12 million from long-term contracts, and 5.51 million units from short-term contracts (*The Hindu Business Line* 2017). Hence, the major challenge for Kerala is "Meeting the twin objectives of energy security and clean energy" (GoI and GoK 2016, 38).

Table 6. Overview of Economic and Energy Indicators in Kerala (sources: Roy 2013; GoI Census 2011, MoSPI 2018).

Land Area	38,863 sq. km
Population (Census 2011)	33.39 million
Human Development Index (HDI)	0.79
Gross State Domestic Product (GSDP Per-capita INR) RBI Statistical Review Handbook 2010-11	62,339
Net State Domestic Product (NSDP) (Billion Rupees) RBI Statistical Review Handbook 20111-12	1,854.34
Per-Capita Energy Consumption (kWh)	525.25
Statewide Energy Installed Capacity (percentage of total installed capacity) (2017)	Hydro: 1.88 GW (73.72%) Thermal: 0.33 GW (12.94%) Nuclear: 0 GW (0.00 %) Renewable: 0.34 GW (13.33%) **Total: 2.55 GW**
Renewable Energy Potential (Utilization rate: total capacity divided by potential) (2017)	Wind: **837 MW** (6.15%) Solar: **6,110 MW** (1.21%) Small Hydro: **704 MW** (30.26%) Total RE: **8,732 MW** (3.88%)
Percentage of Electrified Households (Census 2011)	94.4%
Density of people per square kilometer (Census 2011)	860
Population Growth Rate (Census 2011)	4.91%

Literacy Rate (Census 2011)	94% (96% for male, 92% for female)
Motor Vehicles per 1000 people (Ministry of Road Transport 2011)	182
Credit Rating of State Electricity Board (Ministry of Power)	B

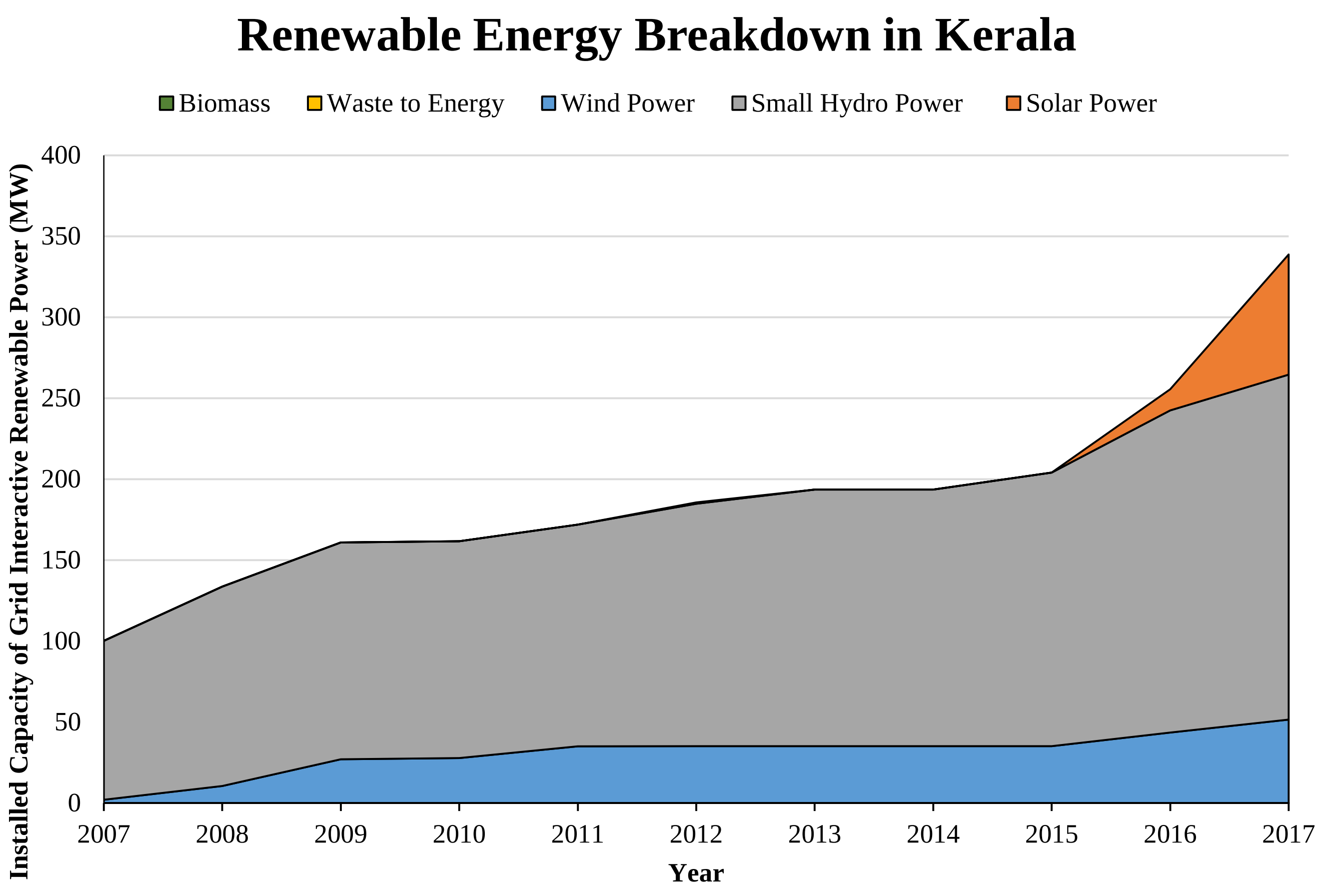

Figure 6. Renewable Energy Growth by Year in Kerala (MoSPI 2007-2018).

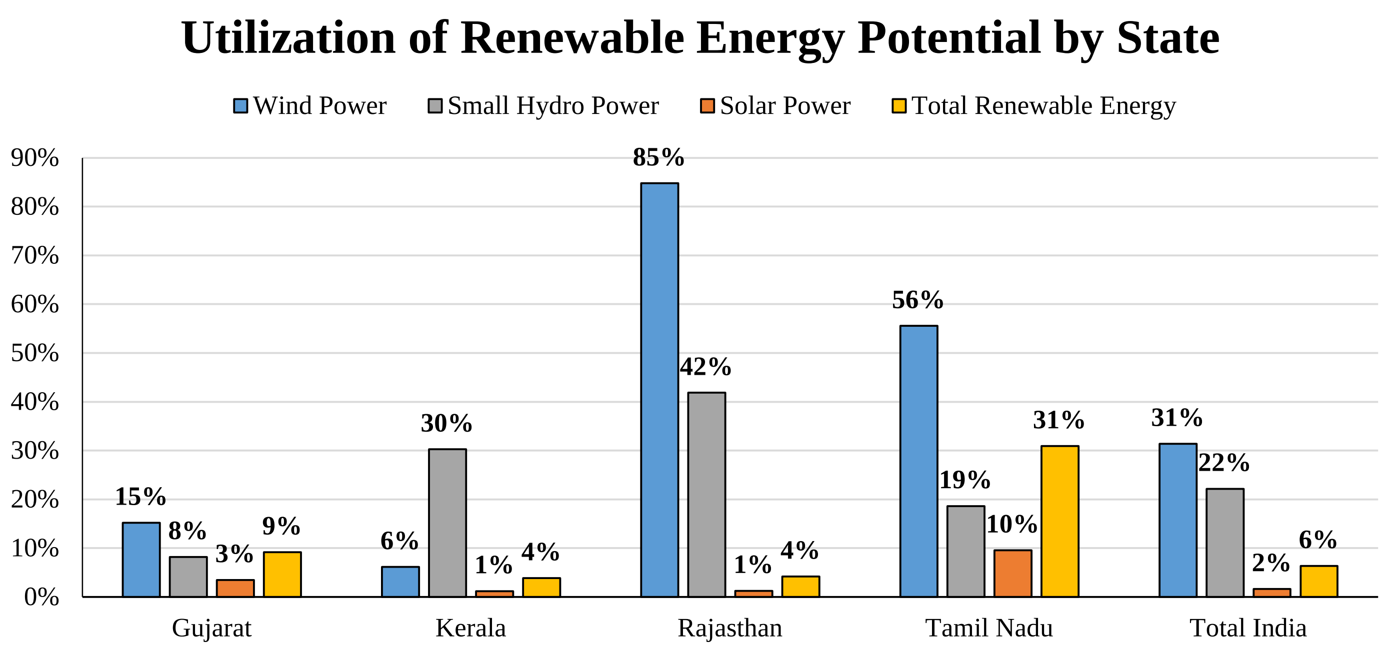

Figure 7. State-level Utilization Rates for Renewable Energy Potential (MoSPI 2018; MNRE 2017).[8]

History of Renewable Energy Development in Kerala

Kerala uses very little of its renewable energy potential, especially that of solar and wind, in comparison to other states in India (see Figure 6). The policymaking process is characterized by Central Government-led initiatives that incorporate the public sentiments of local non-governmental organizations (NGOs) but were not effectively implemented in the State.

In 2002, the Government of Kerala developed a renewable energy policy, making it one of the first states in India to do so. Yet, when contextualizing this policy, it is clear that it was not introduced for the sole purpose of addressing energy security. The policy was introduced by the regional elites in Kerala in response to a near default on its payment obligations. After receiving a loan from the Asian Development Bank, the Kerala state government began introducing reforms to agriculture, industry, infrastructure, tourism, and renewable energy to increase income and investment in the state by 50,000 crore INR of private investment from 2001- 2006 (Jeromi

[8] Utilization rate is calculated as a percentage of the total installed renewable energy capacity divided by the renewable energy potential.

2005). The policy document mentions that Kerala had been depending solely on hydro-power for electricity, availability of which were limited due to a lack of technically favorable sites and environmental degradation from ecosystem change (GoK 2002, 2). The document cites that "Owing to widespread popular opposition, because of high population density and fragile ecology, nuclear stations could not be installed in Kerala" (GoK 2002, 2). Although energy security is the primary concern, activist opposition groups protesting against development projects negatively influence the motivations of energy policy in Kerala. Another motivation to drafting the policy is "it is widely accepted that fossil fuels are limited, that its price will go on increasing, that they do not offer a long term solution, that they contribute to global warming and that alternative sources are to be identified" (GoK 2002, 2). The objectives noted in the policy include to "avail cheaper power," "implementation of new projects with the long-term objective of substituting all non-renewable sources," and "decentralized and microlevel power generation through renewable energy sources" (GoK 2002, 2). The Renewable Energy Policy of 2002 created an attractive ceiling rate of 2.5 INR per unit and favorable 100% banking and a 5% wheeling charge for captive power (GoK 2002).

Wind Energy Development

Kerala began coordinating with the Central Government in 1990 to determine sites of high wind power potential. The Centre for Wind Energy Technology (C-WET) was instrumental in identifying potential sites for wind power generation. The first wind mill installed in Kerala was a 100 kW project installed by KSEB at Kottamala of Palakkad district in 1995 (Nair 2012). The KSEB installed a 2 MW wind farm in Kanjikode in Palakkad district with Central Government financial assistance. Afterwards, two additional wind farms of 14.25 MW and 18.6

MW were installed by independent power producers (IPPs). The first wind projects were successful because of synergistic links between the State and Central Governments.

Wind policy was first introduced by the Central Government's MNES guidelines for the states to facilitate windfarm development to encourage private sector participation (Sinha and Ramana 1995). Following the Central Government's guidelines, Kerala introduced the suggested 2% wheeling of energy generated, 2% banking charges for 6 months, allowed the KSEB to determine the rate for buy electricity from the private sector, and 15% capital subsidy for the installation costs up to 5 lakh INR, and no policy relating to leasing or allotment of government-owned land (Sinha and Ramana 1995). Despite creating fiscal incentives for renewable energy developers, in implementing the policy Kerala did not make the state favorable for developers.

In 2005, the Agency for Non-Conventional Energy and Rural Technology (ANERT) developed an application form for the submission of technical proposal for development of wind farms on private land in Kerala. The policy acknowledged the sites identified by the Central Government in conjunction with ANERT that are "suitable for economic exploitation" (ANERT 2005). However, the policy specified that "the Developer at their own cost and responsibility shall carry out development of necessary infrastructure facilities such as approach roads, improvements to existing roads" (ANERT 2005, 6). This policy puts most of the onus on the developer for exploiting the wind energy resource, which led to investors looking to other states to develop wind energy projects. In 2007, Kerala released guidelines for the development of wind farms on private land; By 2009, Kerala had introduced more enticing policies to ensure 5% wheeling policies, banking of 9 months of energy, and a buy-back tariff of 3.14 INR/ kWh for 20 years (MNRE 2009). However, during interviews with civil servants in Kerala, the major obstacle identified was regarding the remoteness of the high potential wind sites and the difficulty of acquiring already-inhabited land: “we’ve not been able to install any wind turbines so far in the last 10-15 years mainly because of the difficult terrain. It’s very hilly and so you cannot take these huge wind machines with their long blades-- up to 50 meter blades” (Civil Servant 4 2018, transcript in appendix). In addition to the hilly terrains, the land acquisition was troublesome: “On the way there is a lot of private land, they also do not allow us there – the roads are very small and very curved. It’s not a straight road so it’s very difficult to take equipment there so that’s why wind had not happened so far (Civil Servant 4 2018, transcript in appendix). Although the hilly terrain in Kerala constrained development, the State Government did not introduce any policy solutions to the issue.

Solar Energy Development

In 2012, the state nodal agency of Kerala, ANERT, launched a scheme to install solar power systems on 10,000 rooftops across the state (Civil Servant 2 2018, see appendix for transcript). The systems were only 1 kilowatt each, so from the 9,837 installations completed, the state achieved roughly 9.8 MW in solar power installed capacity (Civil Servant 2 2018, see appendix for transcript). A state-level bureaucrat in Kerala remarked that “No other state in India or in Asia achieved such a big target of decentralized power generation” (Author’s interview with Civil Servant 2 2018, see appendix for transcript). Although this program was successful in achieving its targets, it did not produce a large amount of installed solar capacity in the state and was criticized for not being encouraging enough for industry.

In 2013, the State of Kerala implemented the Kerala Solar Energy Policy of 2013 to “mainstream the use of solar energy in the energy mix of Kerala” (GoK 2013, 2). The goals of the policy were to “increase the installed capacity of the solar sector in the State to 500 MW by

2017 and 2,500 MW by 2030," and assist the "long term energy security of the State of Kerala as well as ecological security by reduction in carbon emission" (GoK, 2). The Kerala State Electricity Regulatory Commission (KSERC) was given the authority to notify a feed-in-tariff for solar power for commercial installations. The preamble of the Kerala Solar Energy Policy of 2013 notes that "there is popular perception that solar energy could be a key part of the solution to the energy crisis in the State" (GoK 2013, 2). Hence, popular support and environmental movements played a role in the decision to draft a policy. In addition, the policy notes that a "Forward looking Government needs to have a structured approach to seriously evaluate the possibilities of harnessing renewable energy sources" (GoK 2013, 2). Much of the motivation to draft a more effective renewable energy policy comes from Kerala's involved civil society and reputation for being a "forward looking Government." The policy also allows for 20-25% Central Financial Assistance from the MNRE to install 500 MW of rooftop solar (Civil Servant 6 in Kerala 2018). Therefore, the Central Government continues to provide support for the State's renewable energy schemes.

However, the policy notes several barriers to increased renewable energy generating capacity. These barriers include: the high cost of panels, non-compatibility of transmission infrastructure, limitations of land availability, inadequacy of fiscal incentives, and lack of standardized quality of solar powered equipments (GoK 2013, 2). Moreover, during discussions with civil servants and journalists in Kerala, I found that they all agreed that land acquisition and the high population density was a major hurdle for utility-scale solar parks. These concerns have led to solar policies that focus exclusively on rooftop solar installed capacity; however, critics argue that no such program has achieved the scale required for adequate climate change mitigation (Policymaker in Bangalore 2019).

Applying the Analytical Framework to Kerala

In applying the analytical framework developed in Chapter 2, we see that the lack of private sector engagement in the state, especially relating to energy projects, the unwillingness of the state-nodal agency in deploying wind energy projects and large-scale solar energy, the inefficiency of the State Electricity Board (KSEB) and the lack of private sector demand for reliable energy slowed the subnational elites in devising renewable energy policies. The four variables of 1) State-level Party Politics, 2) Financial Space/ Indebtedness of the State Distribution Companies, 3) The Institutional Knowledge of the State Nodal Agency, and 4) the Private sector linkages explain the poor implementation of renewable energy policies in Kerala.

State-level Party Politics

In terms of electoral politics, Kerala has maintained policy certainty despite electoral changes. Since the early 1980s, Kerala's ruling political party has switched off every five years between the Indian National Congress (INC) and the Left Democratic Front (LDF) Communist Party of India. In terms of cohesion between the State and Central Governments, the two only shared the same governing party from 2004-2006 and 2011-2014, when the Congress Party (INC) was in power under the leadership of PM Singh. More recently, contrary to Rajasthan, whose solar energy policy introduction was influenced by a BJP government eager to implement the policies of the Central Government, Kerala only had one BJP member of 140 members in the state parliament as of 2016 (Parussini 2016). In addition, Kerala has maintained its own distinct culture from the other states, which has produced its unique development approach (Singh 2011).

In addition, the active participation of NGOs negatively impacted the political will to increase installed capacity for energy in the state, even for renewable forms of energy. NGOs are very active in the policymaking process in Kerala. In particular, the Kerala Sastra Sahitya Parishad (KSSP), or “people’s science movement,” has advocated for popular education, environmentalism, and decentralized planning (Heller 1999). The KSSP was instrumental in the opposition to the Silent Valley hydroelectric dam project, which became India’s first major environmental movement. In 1976, the Kerala State Electricity Board announced plans to construct a 240 MW hydroelectric project over the Kunthipuzha river in the Palakkad and Mallapuram districts, which triggered a massive wave of protests. The development threatened the biological diversity of a rich and pristine forest in the Western Ghats and would have encroached on the habitat area for the endangered lion-tailed Macaque (*Macaca silenus*), the Nilgiri Tahr (*Hermitragus hylocrius*) and John’s Langur (*Presbytis johnii*) (Oza 1981). The opposition to the dam sparked a larger debate on the conservation of tropical forests and sustainable land management. In 1980, then PM Indira Gandhi asked the government of Kerala to abandon the project, and the area was declared a National Park, which was formally established in 1984. The threatened destruction of this ecosystem, known as the Silent Valley, led to the first major environmental movement in India and changed the subnational elites’ motivations on navigating the balance between economic growth and protecting the environment for energy projects (Chengappa 1977).

Although the campaign was seen as a win for the environmental movement in Kerala, it did not resolve the ongoing concern over energy security within the state. At the same time, Kerala became an energy deficient state in 1983. For two decades from 1962 to 1983, Kerala State Electricity Board had the guiding philosophy of “abundant hydro-power/ export of energy/

profit" (Parameswaran 1990, 2089). However, after the Silent Valley protest, the development of hydroelectric plants slowed as demand increased. This shift in policymaking was best described by a local journalist in Kerala:

> Development should not be at the cost of environment, that is the general thinking pattern whether it is the UDF government or LDF government. UDF is the government led by Congress and LDF is the current government led by the CPM, Communist Party of India, Marxist. I think both of them agree with the fact that development should not be at the cost of environment. So whenever there is a development initiative that goes drastically against environment there are concerns and the concerns will be well reflected. You can search for Athirapally project, Athirapally is a hydro electric project, it's a proposed project which was supposed to be a mega hydro electric project and there are stiff opposition from both the environmentalists and a section of people including politicians against the project. And at the same time there are people including those from government who think that the project has to be implemented, this Athirapally project. Similarly there were earlier the Silent Valley project. (Interview with Journalist in Kerala 2018, see appendix for transcript)

Regardless of the party in power, environmental concerns are important for the governing coalition to stay in power. Following the Silent Valley protests, the Forest Conservation Act was passed in 1980, which required stringent new regulations for newly-created hydroelectric plants. Although historically, the majority of energy in kerala was powered by hydroelectric plants, after the Silent Valley event, thermal energy became the most cost-competitive form of energy generation (KSEB 2019). This thinking led to slowed increase of generating capacity, hestitance by private sector actors, and created a large energy deficit. This energy shortage resulted in "severe curtailment of industrial production and employment" (Parameswaran 1990, 2090). In addition, the Silent Valley controversy "vitiated the environment and both KSEB and pure environmentalists began to harden on unrealistic and unscientific positions" (Parameswaran 1990, 2090). Such positions include that "large amounts of electricity are required only by the capitalists and imperialists to exploit the majority" (Parameswaran 1990, 2090). Another proposal by the KSSP advocated for a major thermal power program in response to the state's power shortage. In a paper presented at the KSEB Workers Association, the author argued that "demand cannot be met by hydel power alone. By 1981 Kerala will enter into an era of power shortage...From all practical considerations this cannot be nuclear power. On the western coast, north of Cochin, a super thermal station of 1,000 MW should be constructed. Coal from Orissa or oil from Bombay High can be brought for this" (Parameswaran 1990, 2090). Moreover, the politicization of energy generation projects negatively impacted the policymaking process in Kerala: the governing coalition was less willing to diversify electricity generation after the Silent Valley movement.

Between 1996 and 2000, Kerala's Left Democratic Front (LDF) government initiated power sector reforms. Contrary to other states in India, these reforms were not initiated by the World Bank and did not involve privatization. Reforms had two major components: to increase power generation capacity to meet current and future demand, and to enhance the efficiency of the Kerala State Electricity Board (KSEB) (Santhakumar 2003). Kerala experienced severe electricity shortages through the mid-1990s, requiring the importation of one-fourth of its consumption from other states. Roughly 40 percent of households did not have electricity connections in 1998 and several estimates had that the increase in electricity demand for the following 7-8 years would require nearly doubled generating capacity (Santhakumar 2003). The KSSP was a major stakeholder in the 1996 LDF reforms (Isaac, Franke, and Parameswaran 1997). The KSSP blamed the "unscientific planning and inefficient management of the Kerala State Electricity Board" for the severe power crisis (Isaac, Franke, and Parameswaran 1997, 39). In 1990, only roughly half of the state's domestic consumers received enough power to run electrical appliances. To increase generation capacity, the KSSP proposed to construct a 400-kilovolt connection to achieve more electricity from the Central Government's electrical grid. As a result of power reforms, the installed capacity of power in Kerala significantly increased between 1996 and 2000 from 1,500 MW to 2,391 MW. However, during the five years of Left rule in Kerala, the first thermal power plants were constructed in Kerala; All the increased capacity was from thermal generation, a source of energy detrimental to mitigating the effects of climate change, even though it may protect the natural habitats of endangered species.

Financial Space/ Indebtedness of State Distribution Companies

The persisting vertical integration and poor financial sustainability of the Kerala State Electricity Board (KSEB), founded in 1958, has slowed the state's transition to renewable energy (KSEB 2019). Although the Electricity Act of 2003 mandated the unbundling of state electricity boards, Kerala, along with several other states, got an extension. In 2005, the Electricity Minister claimed that the "KSEB has disproved the basic premise of the Electricity Act," saying that privatizing the sector could be dangerous to the interests of the consumer. Moreover, as a small state, Kerala claimed that it could manage more efficiently without unbundling (*The Hindu* 2005). Therefore, KSEB obtained "special permission" to defer the unbundling process indefinitely. By 2013, KSEB was still vertically integrated; this unwillingness to implement Central Government directives is emblematic of a larger theme of Keralan governance distinct from rest of the states (Singh 2013). As a result, a government bureaucrat in Kerala told me that "no large changes have been the result of the Electricity Act of 2003" in Kerala (Civil Servant 7 in Kerala 2018). KSEB was rebranded into the Kerala State Electricity Board Limited (KSEBL) in 2013 to adhere to government regulations, but remained a vertically integrated entity (GoI and GoK 2016). Moreover, the same government bureaucrat in Kerala noted that KSEB would benefit from becoming "more business minded" (Civil Servant 7 in Kerala 2018).

Although the Electricity Act of 2003 “does not approve of cross-subsidies,” the state of Kerala (as well as many other states), charges more for commercial consumption than domestic consumers: 80% of the KSEB’s customers are domestic and charged at 5 rupees per unit and 20% are commercial consumers and charged from 8 rupees per unit (Civil Servant 2 in Kerala 2018). This high distribution of domestic consumers when compared to other states explains Kerala’s poor fiscal sustainability. In 2018, KSEB received a B credit rating from teh Government of India’s Ministry of Power (Prabhu 2017). In terms of the electricity consumers, only 30 percent was for electricity-intensive industries. Another 15 percent was used by other industries, service and trade establishments, and only 4 percent was used for agricultural purposes. Santhakumar (2003) finds that in 1998 the KSEB was giving a 650 crore INR subsidy to domestic consumers. The higher rates for industrial consumers to subsidize agricultural and domestic consumer was a major reason for the financial difficulty of KSEB. Although competitive populism plagued the power sector in other states like Tamil Nadu, Kerala’s uniquely low proportion of agricultural consumers made the subsidization of power for farmers less important than in other states, even though the domestic subsidies remain (Santhakumar 2003).

As KSEB sees the costs of generating renewable energy decrease significantly, investing in thermal power plants have become less financially appealing. A civil servant in Kerala said that the government was not using the diesel-powered thermal power plants because the cost per kWh was seven rupees, much higher than the estimated 3-3.5 rupees per kWh of solar power (Civil Servant 2 2018). However, given the vertically-integrated nature of the KSEB, the shift towards most cost-competitive sources of energy generation will take longer than neighboring states.

The Kerala State Electricity Regulatory Commission (KSERC) was created under Section 17 of the Electricity Regulatory Commissions Act, 1998 (KSERC 2019). Much like other state-level electricity regulatory commissions, KSERC is responsible to determine the tariff for generation, supply, transmission, and promotion of the cogeneration of electricity from renewable sources (KSERC 2019). Kerala has found it difficult to meet its RPOs because of its need to import power from other states (Sengupta 2017).

Institutional Knowledge in State-level Nodal Renewable Energy Agencies

The lack of institutional knowledge in the state-level nodal renewable energy agency slowed the diffusion of renewable energy in Kerala. The Government of Kerala established the Agency for Non-Conventional Energy and Rural Technology (ANERT) in 1986 to gather and disseminate knowledge on non-conventional energy. ANERT is the state-nodal agency for MNRE and supports the schemes and projects initiated by the Central Government. In particular, ANERT identifies, formulates, and implements projects for Kerala to harness solar and wind energy (ANERT 2019). ANERT began coordinating with the Central Government's Department of Non-conventional Energy Sources (DNES) in 1990 with the "Wind Monitoring Project," which involved technical help from the Field Research Unit of the Indian Institute of Tropical Meteorology (IITM). Technical assistance later came from the Centre for Wind Energy Technology (C-WET) in identifying potential sites for wind power generation. As a result, 17 sites were determined in the eastern mountainous regions of Kerala bordering Tamil Nadu (Nair 2012). Some of these sites have the second highest wind density in India, only after Jogimatti in Karnataka (Nair 2012).

Although sites were identified, there was little governmental initiative to turn the wind into electricity. As Programme Manager Madhu Nair of ANERT notes in an article, "even though the wind energy potential of Kerala was identified years ago, there were no remarkable efforts made to harness it" (Nair 2012). Nair acknowledges that the hilly terrain and lack of paved roads was a major obstacle to wind energy development in Kerala. The terrain also makes the erection of cranes for installation more difficult. Nevertheless, instead of suggesting pragmatic reforms to ensure higher utilization of existing wind energy potential, Nair notes the 2011 policy decision that 5 percent of income generated from the sale of electricity generated from windmills installed in tribal lands would be paid to the respective tribal land owners (Nair 2012). This is a laudable goal of distributing the gains of technological development; however, the reform makes no further progress in encouraging private sector development and infrastructure development in rural areas, which are the main barriers of wind development in these sites.

These concerns over the institutional knowledge of actors in ANERT and KSEB have been proposed by scholars. Benecke (2011) has found that in Kerala, "public actors, especially the KSEB, have the necessary human and financial resources and experience but lack the interest, staff qualification, and political will to promote wind power" (34). Despite individual leadership attempts to promote wind energy from ANERT, the organizational culture and characteristics of institutions within the rest of the Kerala State Government remain unfavorable to wind (Benecke 2011). The public actors in Kerala exhibit a low interest and staff quality as demonstrated in organizational routines and cultures (Benecke 2011, 34).

In terms of solar energy programs, ANERT has targeted high-end consumers for rooftop solar diffusion, a strategy that slows growth. The rationale was explained to me during an interview with a government bureaucrat in Kerala: "apart from giving a general awareness we focus our program on the high end consumers because when we invite investment we have to focus on the people who can invest. The common man may not be able to invest much. So we focus our programs on the high end consumers" (Civil Servant 5 2018, see appendix for transcription). Hence, government officials in ANERT are making significant efforts to formulate renewable energy policies tailored to "the common man" rather than diffusing the largest amount of renewable energy capacity possible. Of the 6,000 applications received from consumers the scheme, the majority are from Kochi, a more prosperous region of the state (*ET Energyworld* 2018). The process begins with an application, and once the KSEB authorities go through the applications, two officials from each section in the district go to each applicant's house or institution and conduct a feasibility study. Based on this feasibility report, the board will decide whether or not to approve the proposal (ET Energy World 2018). The consumers then have three options for varying financial support from the KSEB. This long process leads to many bottlenecks and delays in government bureaucracy, which creates long wait times for the implementation of these programs. A second project bureaucrats highlighted was the solar installations on the roof of the Cochin International Airport, which "has installed a 25 kilowatt system and they're now working to add 15 kilowatt so they say that their full power requirement is met" (Civil Servant 5 in Kerala 2018, see appendix for transcription). When compared to the solar parks introduced in Rajasthan, Gujarat, and Tamil Nadu, Kerala's projects are much less scalable and cost-effective, even if they involve more community engagement.

Linkages with the Private Sector

One major inhibitor to renewable energy development in Kerala relates to what Sen has noted in *Development as Freedom*: "Kerala has suffered from what were until recently fairly anti-market policies, with deep suspicion of market-based economic expansion without control"

(Sen 1995, 91). When considering Kerala's socio-political and developmental trajectory driven by the world's first popularly elected Communist government, it is not surprising that Kerala experiences a disconnect between the state and the private sector. A state-level bureaucrat in Kerala candidly told me that "Kerala is not in support of the private sector" (Civil Servant 7 in Kerala 2018). This lack of state-market relations has significantly slowed renewable energy development and has undermined policies intended to diffuse renewable energy.

The poor performance Kerala's encouragement of renewable energy development is emblematic of the state's lack of liberalization efforts more generally. Although the Indian government began economic reforms in the early 1990s, Kerala was slow to liberalize its economy. However, after a near default on its payment obligations on account of poor fiscal position, the political elites in Kerala began initiating a number of measures to accelerate economic growth after receiving a loan from the Asian Development Bank (Jeromi 2005). After fiscal reforms were initiated by the Government of Kerala in 2001, private sector actors were still concerned over the frequent strikes, production targets, and administrative slowdowns. Only 5.6% of installed energy generation capacity in Kerala is owned by the private sector (GoI and GoK 2016, 6). Jeromi (2005) warns that "Policy statements alone will not lead to more private investment. Follow up actions have to be taken for realising the objectives" (3275). Ideally, the government would have prepared detailed action plans for implementation of various reform measures. Kerala's failure to do so on renewable energy helps explain its inability to partner with the private sector and diffuse wind and solar energy more widely across the state.

Benecke (2011) finds that private actors have little experience in Kerala despite the State's human and financial resources. The lack of leadership by public actors to provide an attractive investing environment for both wind and solar energy has hindered renewable energy development in Kerala. Many of Kerala's renewable energy programs focus on engagement with NGOs rather than private investors: "NGOs play an important role in creating awareness and attracting people to this area" (Civil Servant 5 2018, see appendix for transcription). Moreover, civil society actors show negative attitudes towards wind energy and private actors display low experience, which curtails the advocacy and lobbying for more favorable policies (Benecke 2011). In Kerala, the lack of relations and interactions between stakeholders explain the slowed renewable energy development.

Kerala is an outlier among other Indian states in its inability to attract wind energy investment. Other states that had wind energy potential had coordinated with the Central Government in the 1990s to install demonstration projects to accelerate the commercialization of wind in each state. By 2004, only 2.6% of installed wind power capacity across India was from demonstration projects, which shows the rapid commercialization of wind power technology. However, state-wise totals differed significantly: the ratio of demonstration projects to private sector projects shows each state's attractiveness for private sector development. In 2004, while Tamil Nadu had 1,361.6 MW of installed wind capacity, only 1.4% of which was a demonstration project, other states like Gujarat had 202 MW (8.6% demonstration), Rajasthan had 178.5 (3.6% demonstration). By 2004, in Kerala the total wind power installed capacity was only 2.0 MW, 100% of which was installed as a demonstration project (MNES 2004).

Conclusion

In Kerala, subnational elites did not implement renewable energy policies until policy support was initiated by the Central Government. The introduction of renewable energy policies was initiated by the state government in an attempt to encourage economic investment, but the poor implementation was due to the poor institutional capacity of ANERT and the distinctive inefficiencies in the KSEB slowed renewable energy development. In particular, the absent links between the state government and private sector led to very little wind power development. Motivations in initiating and implementing policies were focused more on a desire to ensure environmental justice and bend to the will of grassroots non-governmental organizations, which had a negative impact on renewable energy development.

This chapter finds that slow renewable energy development in Kerala was the result of poor discom financial health, the lack of industry, ineffective state-nodal agency bureaucrats, and environmental movements. In addition, environmental movements and engagement with NGOs did not facilitate faster renewable energy diffusion. Moreover, this chapter demonstrates that even when there is policy support from the Central Government, renewable energy development is slow when there are no linkages with private sector actors.

6

Gujarat

Introduction

As of 2017, Gujarat has the second most wind energy installed capacity (5.3 GW) and fourth most overall renewable energy installed capacity of any state with 6.7 GW (Ministry of Power 2018). The state was a unique first-mover in the solar development industry and holds the distinction of introducing the country's first solar energy policy in 2009. Based on the superior financial position of the state distribution companies, Gujarat had additional resources to invest heavily in solar energy starting in 2009, resulting in a larger amount of installed solar capacity than any other state.

The state's implementation of solar energy policies was one-directional and Chief Minister Modi mobilized an already effective government bureaucracy and close linkages between the state and the private sector to incorporate solar power generation in the industrial trajectory. Effective government planning led to investor confidence, which allowed renewable energy to grow and become over 35% of the state's installed capacity by 2017 (Nesamalar 2017). In terms of motivations of regional elites in devising policies on renewable energy, Gujarat provides a striking example of how state-level government-industry linkages motivated by political ambitions led to a large installed solar and wind energy capacity. Similar to Tamil Nadu, environmental concerns were not the primary driver of renewable energy development; instead, renewable energy was an unintended outcome of private sector actors and state elites coordinating with the Central Government to address the pressing needs of ensuring energy security for industry leaders, which was positioned as a strategy to mitigate climate change efforts.

In this chapter, I first provide a brief summary of economic development in Gujarat; second, I chronicle the history of renewable energy development; third, I apply the analytical framework developed in Chapter 2 to analyze the motivations of regional elites in devising renewable energy policies.

History of Economic Development in Gujarat

Gujarat provides a distinct and persuasive subnational developmental trajectory in India. Home to a culture of commerce and a history of ocean trade, Gujarat has long been a hub for domestic industry and been relatively wealthy since its formation in 1960 (Sareen 2018b). After independence, the State of Gujarat pursued growth-oriented industrial policies, which were managed in a flexible and efficient manner by its bureaucracy. While the Central Government moved towards an overly regulatory direction until economic liberalization in the 1990s, Gujarat pursued industry-friendly policies and institutionalized a sub-national developmental state (Sinha 2005). Gujarat has only five percent of India's population and six percent of the country's land mass, but contributes to 16 percent of industrial and 12 percent of agricultural production and has well established manufacturing and infrastructure sectors (SAPCC 2014). As of 2014, state level GDP growth has hit 15.5%, which was even higher than national GDP growth (Power for All 2016). The Gujarat Electricity Board (GEB) was established with the state of Gujarat in 1960. By 1991, Gujarat was the first Indian state to achieve near-full electrification (17,940 of 18,028 villages).

Gujarat has massive renewable energy potential, with 35,770 MW of wind power and 72,726 MW of solar power potential (MNRE 2017). However, 73% of the current energy supply is sourced from fossil fuels, making the state is dependent on importing coal both domestically and from abroad (GEDA 2019). In addition, the state has high wind potential sites, especially near the 1,600 km long coastline, without much existing development (GEDA 2019).

Table 7. Overview of Economic and Energy Indicators in Gujarat (sources: Roy 2013; GoI Census 2011; MoSPI 2018).

Land Area	196,244 sq. km
Population (Census 2011)	60.43 million
Urban/ Rural	42.6%/ 57.4%
Human Development Index (HDI)	0.527
Gross State Domestic Product (GSDP Per-capita INR) RBI Statistical Review Handbook 2010-11	60,499
Net State Domestic Product (NSDP) (Billion Rupees) RBI Statistical Review Handbook 20111-12	3094.09
State GDP growth rate (FY 2013-14) (Power for All 2016)	15.5%
Per-Capita Energy Consumption (kWh)	1,615.24
Statewide Energy Installed Capacity (percentage of total installed capacity) (2017)	Hydro: 0.77 GW (2.78%) Thermal: 20.25 GW (73.10%) Renewable: 6.67 GW (24.08%) **Total: 27.7 GW**
Renewable Energy Potential (Utilization rate: total capacity divided by potential) (2017)	Wind: **35,071 MW** (15.23 %) Solar: **35,770 MW** (3.49 %) Small Hydro: **202 MW** (8.22 %) Total RE: **72.726 MW** (9.17 %)
Percentage of Electrified Households (Census 2011)	90.4%
Motor Vehicles per 1000 people (Ministry of Road Transport 2011)	215
Credit Rating of State Electricity Board (Ministry of Power)	Uttar Gujarat Vij Company Limited: A+ Dakshin Gujarat Vij Company Limited: A+ Madhya Gujarat Vij Company Limited: A+ Paschim Gujarat Vij Company Limited: A+

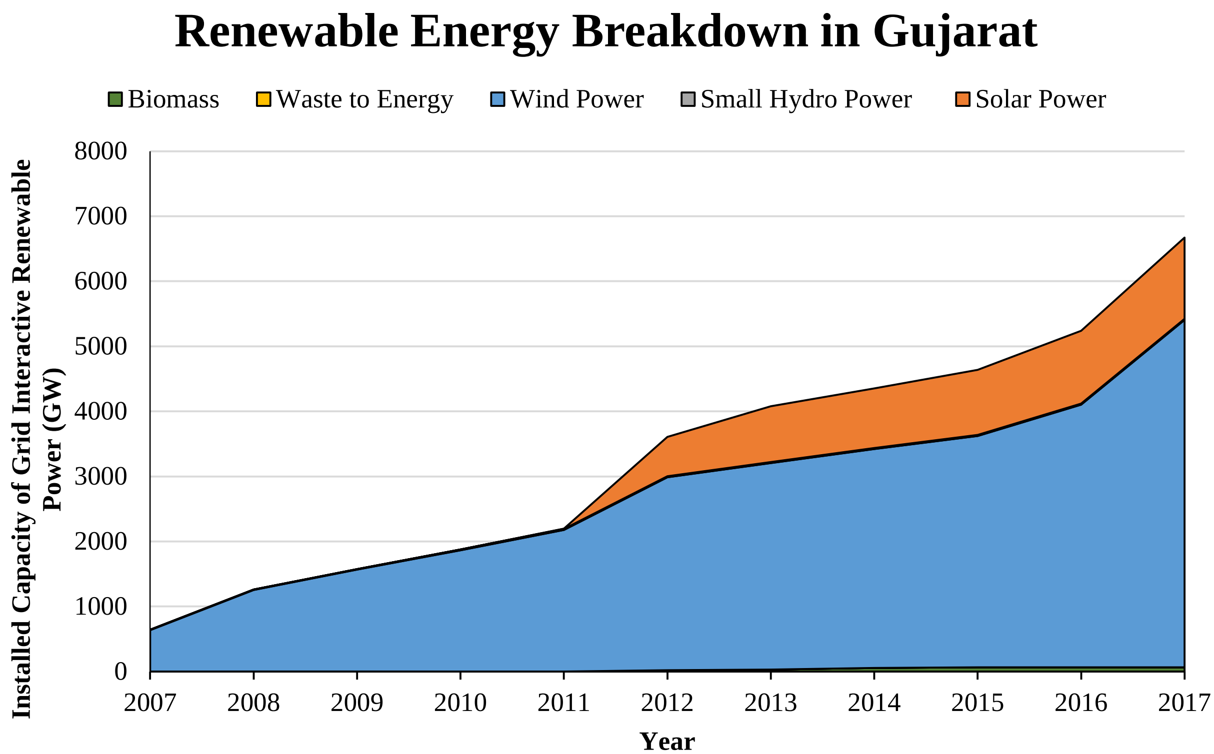

Figure 8. Renewable Energy Growth by Year in Gujarat (MoSPI 2007-2018).

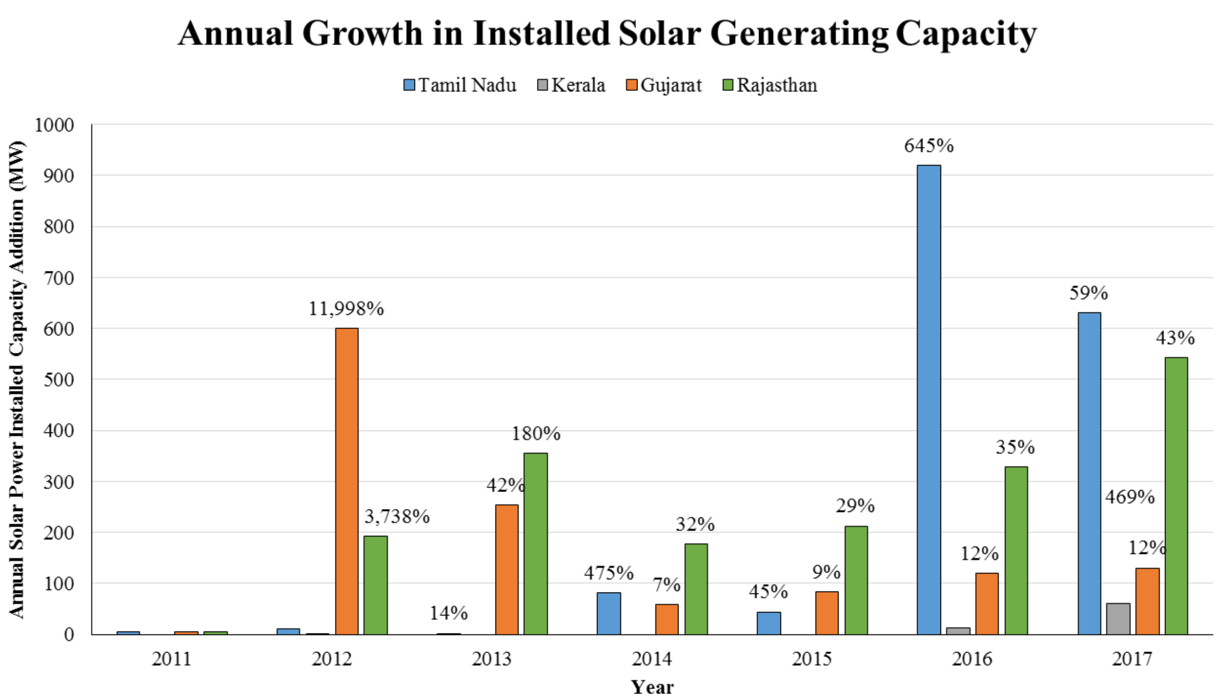

Figure 9. Annual Growth in Installed Solar Power Generating Capacity (MoSPI 2007- 2018).

History of Renewable Energy Development in Gujarat

Gujarat has been successful in the diffusion of renewable energy: As of 2017, Gujarat had the second largest state-wise installed wind capacity at 5,340 MW (See Figure 8, MoSPI 2018). The renewable energy development policies are coordinated by the Government of Gujarat's Climate Change Department created during the tenure of Chief Minister Modi (CCD 2019). The Government of Gujarat introduced wind energy incentives in 1993, 2002 and 2007. These include the New Wind Energy Policy 2007 in accordance with the Electricity Act of 2003. These policies preceded the BJP government, which shows that the renewable energy success was not solely attributed to CM Modi's leadership, as many news outlets suggest (Sareen 2018b). The Gujarat Electricity Regulatory Commission (GERC) passed the second tariff order for wind energy generation in January 2010, raising the tariff from INR 3.37 per unit to INR 3.56 per unit. GERC also allowed third-party sales without any cross-subsidy (IRENA & GWEC 2012).

In terms of the Central Electricity Regulatory Commission's regulation on Renewable Energy Certificates, Gujarat was the first state in the country to incorporate REC provisions in its state commission's (GERC) regulations. Therefore, the willingness of state-level bureaucrats played an important role in diffusing renewable energy in Gujarat.

Wind Energy Development

In the 1980s, Gujarat was faced with many power shortages, which had a large impact on the ability of small and medium-sized businesses to operate normally. In 1986, Gujarat became one of the first Indian states to install a wind power project. The project was a joint venture with the Natural Energy Processing Company and the Department for Non-conventional Energy

Sources (DNES), a 1.1 MW demonstration wind project was installed in Mandvi, Gujarat. In 1988, the Danish International Development Agency (DANIDA) helped support a 10 MW grid-connected wind farm near the coastal town of Porbandar (IRENA & GWEC 2012).

Gujarat benefitted from early support from DNES and the state nodal agency Gujarat Energy Development Agency (GEDA) to set up demonstration projects with private sector partners. Yet, the wind energy market did not witness continuous growth. There was a significant dip in 1997 due to reduced tax benefits to the sector and wider structural and regulatory bottlenecks. Concerns included inadequate grid capacity, permitting and siting issues, and inadequate technical expertise (IRENA & GWEC 2012).

The State of Gujarat introduced formal wind energy policies in 2007, 2009, 2013, and 2016 (GEDA 2019). However, the State has provided incentives for the sector as far back as 1993. Given the "dwindling resources of fossil fuels, increased threat of global warming and the concern on environmental protection" the State of Gujarat introduced its first wind energy policy in 2007 (GoG 2007, 1). The policy allowed for captive use in accordance with the Electricity Act of 2003, established the wheeling of electricity at 4%, and created the option of pooling substation capacity for wind farms (GoG 2007) The policy also acknowledged a GERC order made in 2006, which outlined the fiscal incentives, including feed-in tariffs at 3.37 INR/ unit for 20 years (GERC 2006). In 2009, the policy was amended and increased the tariff to 3.50 INR/ unit, increased the RPO from 2% to 10% and provided a mechanism to facilitate REC trading (GEDA 2009). The policy was then updated in 2013 and 2016 with increased emphasis on private sector engagement. The Wind Power Policy of 2013 created a target of installing 3,000 MW of wind capacity.

Solar Energy Development

With a solar policy introduced in 2009, Gujarat became the leader in installed solar energy capacity by 2012, with over 64% of India's total (see Figure 2). Gujarat was a first-mover in terms of solar energy development and devised policies before the Central Government in 2011 (Sareen 2018b).

Similar to the context of solar energy development across India, Gujarat's solar policies before 2009 were focused on off-grid electrification strategies; after 2009, solar policy focused on increasing the installed generating capacity. Beginning in 1979, the Government of Gujarat began implementing a program to diffuse solar-based stoves (*Surya Cookers*), which was administered by the Gujarat Energy Development Agency (GEDA) (GEDA Historical perspective 2018).

Moreover, the most curious aspect of Gujarat's solar development trajectory is the intensity but suddenness of the diffusion. Between 2011 and 2012, Gujarat installed 600 MW of solar energy installed capacity, nearly a 12,000% annual growth from the year previously, which has not been matched in the state since (see Figure 4?). After 2012, Gujarat's annual percentage growth has been below the national average and other states have surpassed in state-wide total installed capacity addition (see Figure 5).

The Solar Power Policy of 2009 prominently states that "the challenges of climate change and global warming continuously threaten the world community" and that "The Government [of Gujarat] recognized the urgent need to tackle challenges that arise on account of these impacts" (GoG 2009, 1). The policy also notes the primary policy goal is diversifying energy supply: "the exhaustible reserves of fossil fuels and their volatile market prices further contribute towards energy insecurity of nations" (GoG 2009, 1). Hence, the Gujarat policy effectively furthers the goal of energy security while framing it in line with international climate change mitigation efforts. The policy sought to produce 500 MW of solar power by 2014 through the incentives of 2% wheeling charges and a feed-in tariff of 13 INR/ unit for the first 12 years on projects commissioned before 2010 and 12 INR/ unit for projects commissioned after 2014 (GoG 2009, 4). The policy also acknowledged the 10% renewable purchase obligation (RPO) of obligated entities, which will be determined by the Gujarat Electricity Regulatory Commission (GERC).

Gujarat introduced a subsequent Solar Policy in 2015, which heralded the success of the former policy in generating over 1 GW of solar installed capacity (doubled the target) and investment of INR 9,000 crores in the state. The 2015 policy does not acknowledge climate change as a concern of the Government of Gujarat nor does it cite a responsibility to the global community; however, the policy notes that "The State recognizes that renewable energy can also significantly increase the State's and the Nation's energy security" (GoG 2015, 3). Although there is no specified target, the policy states that the state has the potential to achieve more than 10,000 MW of solar generation capacity (GoG 2015). In this policy, there is no major change in fiscal incentives for grid-connected developments, but it does introduce net-metering guidelines to encourage solar rooftop installations.

More recently, Gujarat released a subsidy program for residential rooftop solar plants in an attempt to facilitate the National Solar Mission's target of 20,000 MW by 2022 (GoG 2016, SOURCE 219). The Central Government provided a target for Gujarat to achieve 9,024 MW of solar energy, of which 3,200 MW should be from rooftop solar, by 2022 (GoG 2016, 1 SOURCE 219). As of 2017, Gujarat meets RPOs for solar specified under ambitious national sustainability targets. Next, I will use the four factors I identified to map out the motivations of the political elites in devising policy to promote a clean energy transition in Gujarat:

Applying the Analytical Framework to Gujarat

State-level Party Politics

In terms of electoral politics, Gujarat had a stable single-party rule, which facilitated by longer-range planning (Sareen & Kale 2018). The Bharatiya Janata Party (BJP) has been in power since 1998 in the State of Gujarat. Although wind energy policies were introduced to address energy security, the ambitious solar energy policy introduced in 2009 was during the tenure of then-Chief Minister Narendra Modi (current Prime Minister of India).

Cohesiveness and power of a governing coalition are key determinants of its capacity to implement policy. PM Modi was able to create a strong support base cutting across class and caste cleavages that oftentimes exist in India. The characteristics of Modi's government were similar to that of authoritarian regimes in East Asia: cohesive without strong opposition, fostering strong state-business relationships, and high governance and policy implementation capability (Roy 2013, cited in Isoaho, Goritz, & Schultz 2017).

When considering the quick turnaround times for solar power projects (roughly 18 months) compared to coal-fired power plants (~60 months) and nuclear power plants (~240 months), policymakers find solar energy policies politically expedient to implement to demonstrate the utility of their actions within electoral cycles (~60 months in India). In Gujarat, the introduction of its solar energy policy in 2009 was used both as a public relations exercise of forward-looking governance as well as providing leverage within the political party rivalry of power between Gujarat and the Central Government. The introduction of solar policies in Gujarat was shaped by incidental political configurations and personal ambitions rather than a concerted top-down target-led approach driven by the central government (Chaudhary et al. 2014).

Moreover, the strong financial performance of the Gujarat state distribution companies (see Table 7) allowed for more leeway in the State's political ambitions to invest in solar energy. In 2009, Gujarat signed 1GW worth of power purchasing agreements at rates as high as 15 INR per unit to encourage investments. This shifted to 5 INR per unit for the latter half of 25-year PPAs. As an official of the Gujarat Electricity Regulatory Commission (GERC) said in an interview, "In 2009 solar was at a nascent stage. We didn't have much data, but the Chief Minister [Modi] was very much keen. The levelised tariff was not that high but it was front-loaded to give developers returns in order to service debt on their capital costs" (Sareen & Kale 2018, 274). Such high upfront costs would have not been possible in a state with fewer resources. As a Gujarat Energy Development Agency (GEDA) official admitted, "now we are stuck buying solar at higher tariffs for the next decade" (Sareen & Kale 2018, 274). The robust fiscal health of Gujarat's electricity distribution companies allowed for the government to encourage solar energy development while attracting wind energy investment.

In 2009, Narendra Modi called Dr. Rajendra Pachauri, a member of the UN Intergovernmental Panel on Climate Change and head of the Energy and Resources Institute (TERI) in New Delhi, to request a briefing on climate change. After a two-day seminar with Dr. Pachauri, Modi returned to Gujarat and launched the first state-level ministry to address the issue of climate change (Antholis 2014). The Climate Change Department (CCD) of the Government of Gujarat became Asia's first sub-national government agency dedicated to mitigate climate change. GEDA became part of the newly-created department and quickly introduced India's first policy to encourage solar energy investment. Modi quickly capitalized on the creation of the

CCD, which furthered the developmental needs of Gujarat. In 2011, Modi authored a book titled *Convenient Action: Gujarat's response to the challenges of climate change* that cited climate change mitigation as a moral issue that would disproportionately impact the lives of future generations (Hall 2017).

The creation of the CCD, however, was not motivated by environmental concerns. The new policies attracted investment in the renewable energy sector from investors both foreign and domestic, which bolstered the status of Gujarat as a classical developmental state. During Modi's tenure as Chief Minister, Gujarat was declared the most polluted state in 2010 (Appa 2014). In 2010, the Central Government's Ministry of Environment and Forests even banned all new projects and expansion of existing ones in the industrial cluster of Vapi in Southern Gujarat. In 2012, the Central Pollution Control Board declared three Gujarat rivers to be the most polluted in India (Appa 2014). One illustration of Gujarat's concerning environmental record is the issue of illegal waste dumping on private and government lands and rivers. The Central Pollution Control Board of India declared Gujarat the most state in the country because it had the highest percentage (29%) of total hazardous waste in 2010 (Appa 2014). In 2011, the Central Government's Ministry of Environment and Forests imposed a ban on new projects in Vapi because of concerns over highly toxic waste dumping. Later that year, the Ministry lifted the ban after the Gujarat Pollution Control Board assured the state would implement an action plan to improve environmental quality, but no such improvement had occurred (Mehta 2013).

Financial Space/ Indebtedness of State Distribution Companies

One explanation for Gujarat's success in renewable energy development is the strong financial strength of the discoms, which attracted private developers to invest in the state. All of Gujarat's five discoms have A-plus credit ratings and a country-leading reputation for efficiency and professionalism (Sareen & Kale 2018).[9] The large number of high-tariff paying industrial manufacturers explains most of Gujarat's success. Despite having a large number of agricultural consumers with low water tables in desert regions, leading to high demand for power demand for irrigation pump-sets, Gujarat has implemented successful reforms to ensure effective water allocation. Gujarat has managed to address electricity theft through a feeder separation program, which separated electricity supply for agriculture from that provided to rural households, guaranteeing the latter while offering to improve the quality of supply to the former on a fixed and restricted schedule. A specially-designed transformer to prevent rural power theft based on improvised capacitors. The State Electricity Board in Gujarat is a successful model for the rest of India. By the 1990s, Gujarat had remarkably low AT&C losses: 21.1 percent during 1992-3 and 18.20 percent in 1996-7. Electricity for agriculture was split from the rest and farmers receive uninterrupted supply at normal rates. Officials also check to ensure subsidized power is going to places it should, which is often met with extreme and violent protests in other states (Katakey and Singh 2014, cited in Isoaho, Goritz & Schultz 2017). Reforms in the Gujarat power sector have allowed the state to produce a net energy surplus every year since 2009, with a net energy surplus of 25% in FY 2014-15 (Power for All 2016).

Subsequent to sectoral reforms initiated by the Central Government through the 1990s, Gujarat implemented gradual and rigorous efficiency reforms through the unbundling process.

[9] The five discoms include: Uttar Gujarat Vij Company Limited, Dakshin Gujarat Vij Company Limited, Madhya Gujarat Vij Company Limited, and Paschim Gujarat Vij Company Limited.

Following the corporatization of state electricity boards, the state implemented reforms and created the Gujarat State Electricity Corporation Limited (GSECL) in 1993 (Sareen 2018b, 99). GSECL began commercial operations in 1998 and the Gujarat Energy Transmission Corporation Limited (GETCL) was created in 1999. In 1999, the State of Gujarat also created the Gujarat Electricity Regulatory Commission (GERC), which established the current regulatory framework (Sareen 2018b, 100).

Moreover, Gujarat has managed to match power tariffs with reasonable supply costs. The state benefits from a large portion of high-tariff paying industrial consumers and has implemented supply-side innovations such as a celebrated feeder separation program to reduce distribution leakages (Sareen & Kale 2018).

Institutional Knowledge in State-level Nodal Renewable Energy Agency

Gujarat Energy Development Agency (GEDA), the state nodal agency for MNRE, had proven itself as an effective state-level institution and created unique policy innovations to help diffuse renewable energy in the state.

Along with a larger narrative of Gujarat's well-organized government agencies, GEDA played an instrumental role in developing renewable energy policy in the state and making the technologies economically and commercially viable. GEDA was instrumental in establishing wind power demonstration projects in Gujarat. By 2004, Gujarat had the second largest installed capacity of wind power demonstration projects, only after Tamil Nadu (MNES 2004).

From the early stages of solar energy development, GEDA led the country in effective coordination: GEDA was awarded the National Award for the Overall Best Performance in Popularizing Solar Cookers for its success in off-grid diffusion of solar cookers in 1998, 1999, 2001, 2002, and 2007 (GEDA historical perspective 2018). After the introduction of the 2009 solar policy, GEDA evaluated 350 proposals from developers and allotted small capacity systems ranging from 2 MW to 25 MW to diversify the projects commissioned (Sareen & Kale 2018, 274). In terms of wind energy policy, the Wind Energy Policy of 2007 outlined that GEDA would help developers identify potential sites based on the data they gather, which has improved the diffusion of wind technology (GoG 2007).

According to the Government of Gujarat, GEDA was catalytic in the formation of the Commission of Additional Sources of Energy (CASE) in 1981, which later became MNRE. The model of state-central coordination on policy was replicated in other state nodal agencies across the country.

Gujarat's solar policies had an emphasis on large solar parks combined with a competitive bidding process to attract investors and increase the economies of scale. All these developers were concentrated in a cluster called the Charanka Solar Park, which was used as a model for future policies. In 2014, the Central Government introduced a new scheme to make solar energy production more cost-effective through large-scale solar parks and generate 20 GW of power. In MNRE's fact sheet on the scheme, it cites the Charanka as a "first-of-its-kind large scale Solar Park in India with contiguous developed land and transmission connectivity" (MNRE 2016 SOURCE 206). Since then, the central government has sanctioned 33 solar parks, including a 700 MW government-financed public facility in Gujarat and five solar parks in Rajasthan with a capacity of over 3 GW (Sareen & Kale 2018).

In addition, Gujarat created several solar policy innovations, which included pilot projects set up jointly by State-owned Sardar Sarovar Narmada Nigam Limited (SSNL) and the Gujarat State Electricity Corporation Limited to place solar panels over a 750 meter stretch of a canal to generate 1.6 MW of energy every year while preventing the evaporation of 9 million litres of water annually (Dasgupta 2012).

Linkages with the Private Sector

Gujarat's industrial sector played an instrumental role in the need of captive power and renewable energy development in the state. Due to Gujarat's history as a major industrial hub, the state government has a progressive policy for the promotion of captive generation and has a large capacity of captive power plants. As of 2010, 60 captive power plants with an aggregate capacity of 3,337 MW were operating alongside the state network (IRENA & GWEC 2012).

Moreover, during the policymaking process the state government coordinated with the solar and wind industries to increase to diffusion of renewable energy development in the state. Emergence of solar power from 2009 onwards, starting with Gujarat where the solar industry was given significant influence in the policymaking process (Sareen & Kale 2018). Gujarat provided attractive fiscal incentives for private industry: One example is their higher plant feed-in tariffs than the National Solar Mission (CEEW-NRDC 2012, cited in Chaudhary et al. 2014).

Then Chief Minister Modi marketed Gujarat as an international solar power investment destination, where national and international solar businesses invested heavily (Isoaho, Goritz & Schultz 2017). Due to CM Modi's ability to market the industry as a global success story through favorable media coverage, investment followed. When CM Modi was elected as Prime Minister, the renewable energy was excited over the anticipation of additional policy and financial support from the Central Government. Given Modi's success in creating the policy environment to produce 900 MW of solar capacity, private sector actors involved in the renewable energy sector knew Modi’s policy goals for the sector well. Developers like SunEdison anticipated a “dramatic change” to the solar industry in India with Modi’s electoral win in 2014 (Ramesh 2014).

Conclusion

Gujarat was successful in diffusing renewable energy because of strong financial sustainability of the state electricity boards and effective institutional planning in the state-level nodal renewable energy agency. Although journalists often attribute then-CM Modi’s leadership in the promotion of solar energy in the state, Gujarat’s well-organized bureaucracy facilitated the implementation process and financially-stable financed the high feed-in tariffs. Gujarat’s civil service was already geared for industrial development; CM Modi mobilized the sector and retooled the effective bureaucracy for progressive solar energy policies. These institutional developments positively impacted investor friendliness and willingness by the regional elites to diversify the electricity sector.

Gujarat best explains how a state can capitalize on high renewable energy potential, favorable political factors, and established links with the industrial sector to implement effective renewable energy policies. Although Gujarat had already provided electricity to all villages by Modi’s term as Chief Minister, solar energy helped ensure energy security and stability, fulfilling the state’s developmental needs. Similar to Tamil Nadu, the motivation of state-level elites in Gujarat in developing renewable energy was not from environmental concerns. Moreover, one explanation for the brevity of solar power diffusion in Gujarat is the highly-subsidized feed-in tariffs, which soon leveled out to market prices and overinflated media coverage promoted by CM Modi.

Table 8. Timeline of Renewable Energy Policy Developments in Gujarat (adopted from Sareen 2018b, 238-9)

1991	First state to achieve 100 percent village electrification (17,940/18,028 villages)
1993	Start of the corporatization of electricity sector, GSECL incorporated
1998	BJP government comes into power in Gujarat, remains in power through 2019
2003	Central Electricity Act passed, Gujarat Electricity Industry (Re-organization & Regulation) Act passed
2005	GEC unbundled into six state electric companies under the holding company Gujarat Urja Vikas Nigam Limited (GUVNL) Generation Company: GSECL Transmission Company: GETCO Four Distribution Companies: Uttar Gujarat Vij Company Limited (UGVCL) Dakshin Gujarat Vij Company Limited (DGVCL) Madhya Gujarat Vij Company Limited (MGVCL) Paschim Gujarat Vij Company Limited (PGVCL)

7

Rajasthan

Introduction

By disaggregating the state, we see Rajasthan as slow-mover in terms of renewable energy development; however, following Central Government-led initiatives, the State has seen a rapid growth in wind and solar installed capacity since 2009. In 2017, Rajasthan had the fifth most renewable energy installed energy in India with 6.2 GW; the state has India's second most solar energy installed with 1.8 GW and fourth most wind energy with 4.3 GW (MoSPI 2018). However, in terms of the motivations of regional elites in devising policies to facilitate renewable energy development, Rajasthan provides a useful example of how renewable energy has been successful in addressing the developmental needs of the state. Developmental concerns such as providing electricity to roughly 33 percent of households in Rajasthan that lack electricity connections and solving power outages have been addressed through increased development of renewable energy (Census 2011). Although Rajasthan used to be an energy-deficient state, increased renewable energy capacity has increased the reliability of energy supply while being environmentally sustainable. The Central Government was key in providing a framework of policy change and support for renewable energy development in Rajasthan despite the barriers of a financially-troubled discom and lack of industrial consumers in the state.

As a successful case study in India's renewable energy deployment, Rajasthan is blessed with high levels of solar radiation and wind potential. Following the creation of the Jawaharlal Nehru National Solar Mission in 2010, Rajasthan quickly followed by introducing a state-level solar energy policy in 2011. Rajasthan's renewable energy policy is one-directional and predominantly vertically aligned. Upon introduction, the state began exceeding national solar power capacity targets. Moreover, similar to insights from the other Indian states, environmental concerns in Rajasthan weren't the primary driver of renewable energy development; instead, environmental benefits were an unintended outcome of private sector actors and state elite development strategies.

If Rajasthan is now emerging as a leader in renewable energy development, why did it take so long for subnational elites in devising policies and facilitating investment in the state? What changed to motivate policymakers to devise the policy in the first place?

In this chapter, I first provide a brief summary of economic development in Rajasthan; second, I chronicle the history of renewable energy development; third, I apply the analytical framework developed in Chapter 2 to analyze the motivations of regional elites in devising renewable energy policies. I find that the delayed initiation of renewable energy policies was the result of lack of industry and poor discom financial health; however, with support from the Central Government, subnational elites devised effective policies allowing Rajasthan to rapidly increase its renewable energy installed capacity.

History of Economic Development in Rajasthan

The main vocation of people in the state is agriculture. Rajasthan remains one of India's least developed states and faces many developmental challenges. According to the 2015 Human Development Report, Rajasthan has a Human Development Index (HDI) below the Indian average (Kundu 2015). When compared to countries across the world, its level of development is analogous to the sub-saharan African country of Ghana. Rajasthan still has an electrification rate of 67%, female literacy rate of 52.12%, and a child sex ratio of 888 females to 1,000 males

(Census 2011). In addition, Rajasthan has experienced one of India's largest population growth rates at 21.31%, which further strains the resources of the state government (Census 2011).

In terms of the power sector, Rajasthan has made substantial improvements over the past decade with increased generation capacity and strengthened network infrastructure. A major policy goal of the state is to increase generating capacity to ensure power for all. The demand for energy has increased dramatically over the past decade: 19.6% every year between 2012 and 2014; This increase reflects increased demand in urban areas and efforts to provide electricity to all in Rajasthan. Most connected customers in the state currently have at least 21-22 hours of power supply a day; however, of the 6145.15 MW of capacity addition in 2018-19, only 625 MW is from non-conventional energy sources, which shows that increased renewable energy generation will not outpace increase in traditional fossil-fuel generation.

The Central Government's Power for All initiative demonstrates knowledge sharing and policy coordination between the Central and State governments. Under the 24x7 power joint effort, the state seeks to provide 24x7 power to all consumers within three years of the 2014 start date. The overall goals of the 24x7 Power for All initiative include: 1) providing power supply to all households, 2) ensure adequate capacity addition at affordable prices to meet increased demand, 3) strengthen the transmission and distribution network, and 4) monitoring the timely commissioning of generating plants (GoI and GoR 2014, 6). Moreover, the joint initiative aims to "enhance the satisfaction levels of the consumers, improve the quality of life of people, and increase the economic activities resulting into inclusive development of the State" (GoI and GoR 2014, 6).

Table 9. Overview of Economic and Energy Indicators in Rajasthan (sources: Roy 2013; GoI Census 2011; MoSPI 2018).

Land Area	342,239 sq. km

Population (Census 2011)	68.62 million
Human Development Index (HDI)	0.434
Gross State Domestic Product (GSDP Per-capita INR) RBI Statistical Review Handbook 2010-11	29,787
Net State Domestic Product (NSDP) (Billion Rupees) RBI Statistical Review Handbook 20111-12	1781.84
Per-Capita Energy Consumption (kWh)	736.2
Statewide Energy Installed Capacity (percentage of total installed capacity) (2017)	Hydro: 1.09 (6.68%) Thermal: 8.99 GW (55.09%) Renewable: 6.24 GW (38.24%) **Total: 16.32 GW**
Renewable Energy Potential (Utilization rate: total capacity divided by potential) (2017)	Wind: **5,050 MW** (84.79 %) Solar: **142,310 MW** (1.27 %) Small Hydro: **57 MW** (41.84 %) Total RE: **148,518 MW** (4.20 %)
Percentage of Electrified Households (Census 2011)	67.0%
Density of people per square kilometer (Census 2011)	200
Population Growth Rate (Census 2011)	21.31%
Literacy Rate (Census 2011)	66.11% (79.19% for males, 52.12% for females)
Motor Vehicles per 1000 people (Ministry of Road Transport 2011)	116
Credit Rating of State Electricity Board (Ministry of Power)	Ajmer Vidyut Viran Nigam Limited: B Jodhpur Vidyut Vitran Nigam Limited: B Jaipur Vidyut Vitran Nigam Limited: B

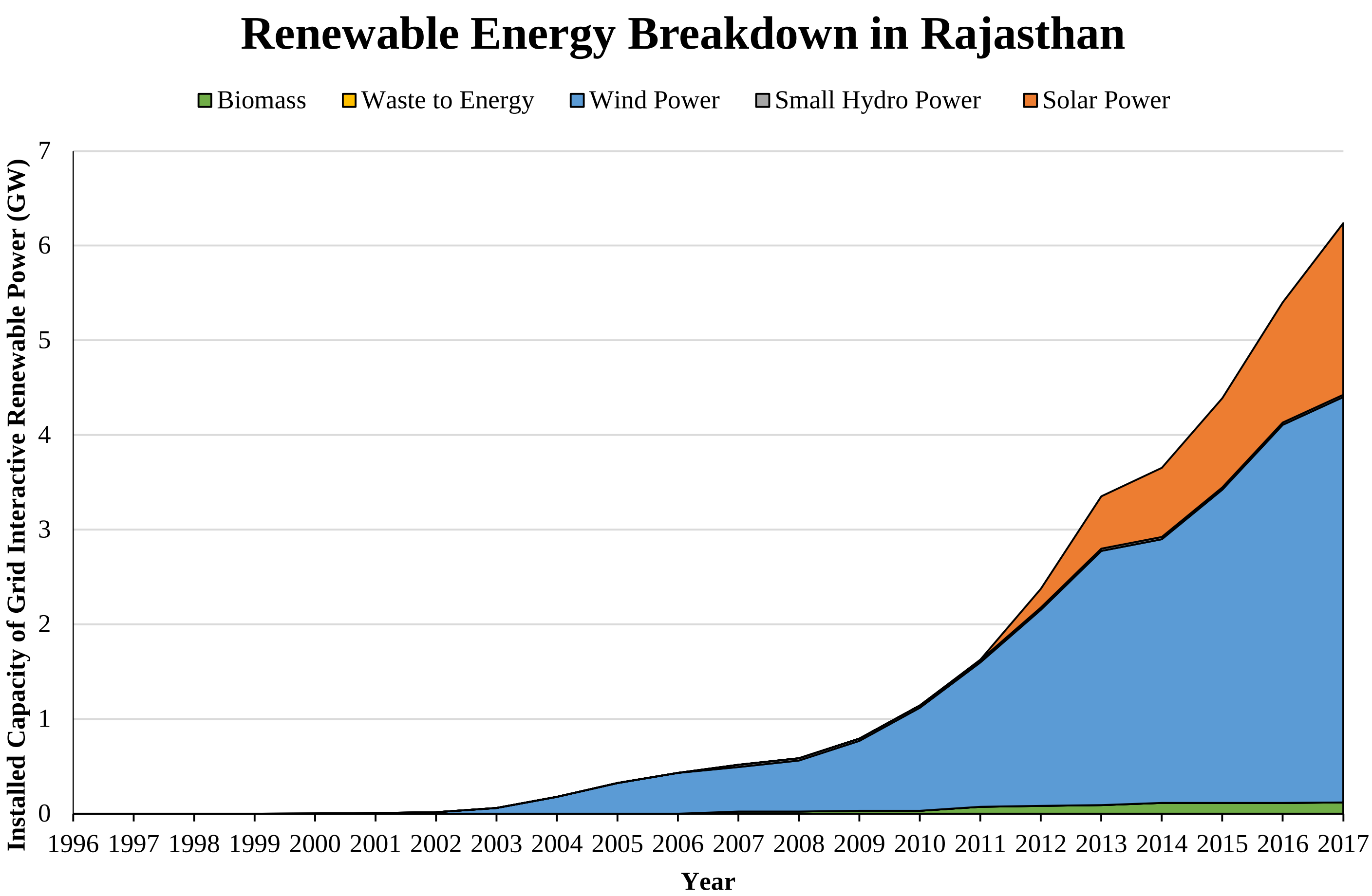

Figure 10. Renewable Energy Growth by Year in Rajasthan (MoSPI 2007-2018).

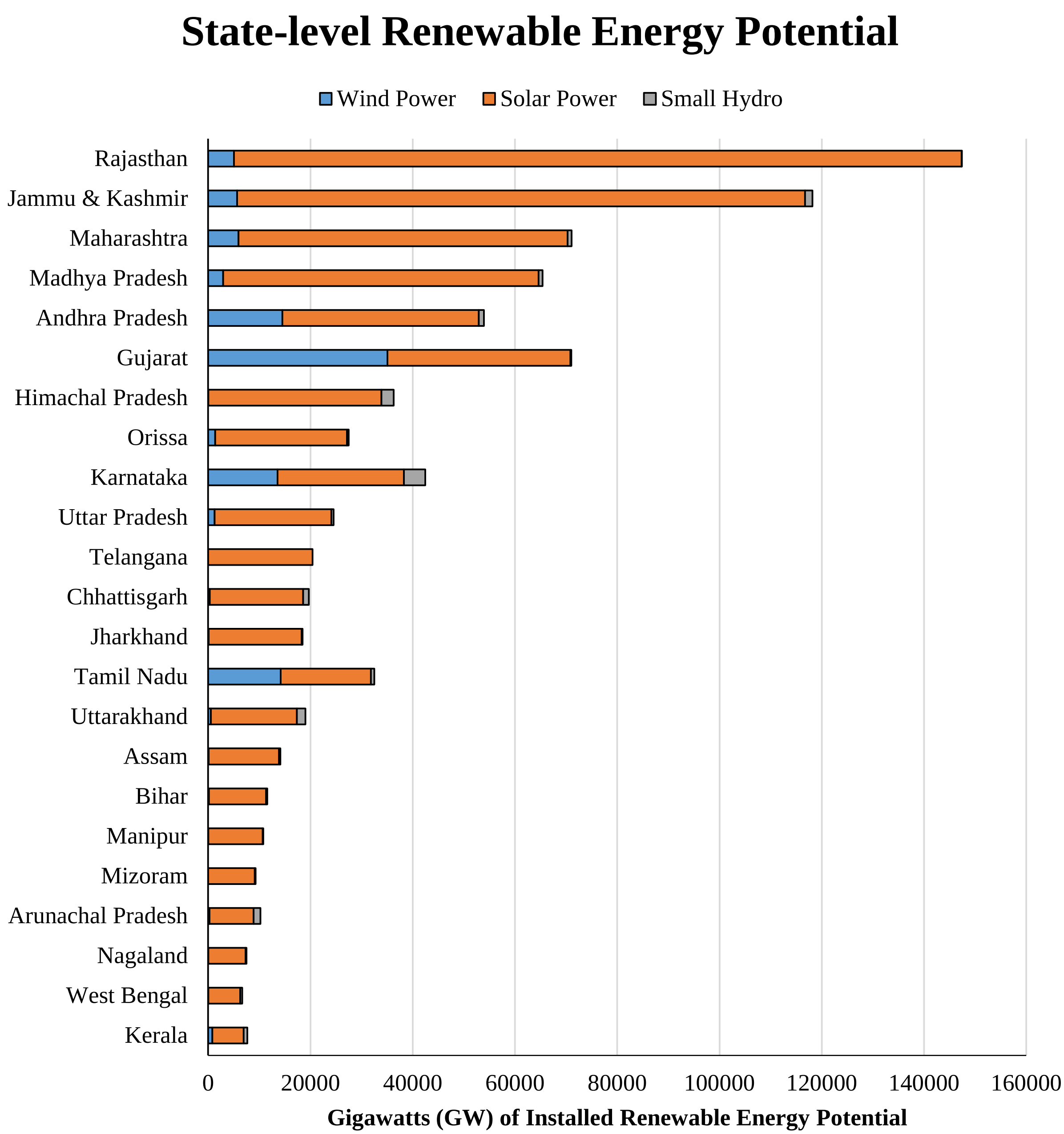

Figure 11. State-level Renewable Energy Potential (MNRE 2017).

History of Renewable Energy Development in Rajasthan

As of 2017, Rajasthan had the fifth most renewable energy installed energy in India with 6.2 GW; the state has India's second most solar energy installed with 1.8 GW and fourth most wind energy with 4.3 GW (MoSPI 2018). The state has used its wind power potential very well and has one of India's highest utilization rates for wind (see Figure 3). However, subnational elites were slow to introduce renewable energy policies. Policymakers in Rajasthan waited until the establishment of the Jawaharlal Nehru Solar Mission and subsequent obligation from the Central Government for utilities to add solar energy sources to their mix before amassing the gains from the increasing affordability of solar technologies.

As of 2017, Rajasthan met its Renewable Portfolio Obligations (RPOs) for solar specified under ambitious national sustainability targets (although the state doesn't meet overall RPO targets, including wind and biomass).

In terms of generation of electricity, Rajasthan has 15,201 MW of installed generating capacity: 56% from coal, 11% from hydro, and 24% from renewable energy sources (GoI and GoR 2014, 12). Rajasthan is India's largest state in geographical area and is mostly arid and desert. The state has vast potential for wind power (5,050 MW) and solar power (142,310 MW) and low population density in the state at 200 people per kilometer helps facilitate renewable energy development, especially large-scale solar, because of the large tracts of uninhabited land in the state (Census 2011).

In terms of renewable energy generation plans, Rajasthan has proposed to set up 10,240 MW capacity of renewable energy by 2018-19. Of this, 7,500 MW would be sourced from solar and 2,740 MW would be sourced from wind. Of this solar target, 1,000 MW will be awarded through the Viability Gap Fund (VGF) based competitive bidding process. This will be based on Rs 2.5 Crore/ MW to make solar power at a lower rate and ensure less burden on state discoms. The other 6,500 MW will be developed through IPPs: either as an open access scheme within the state, REC (solar) mechanisms or the National Solar Mission guidance (GoI and GoR 2014, 19).

In terms of the Central Government's involvement with this increase in capacity, the 6,500 MW solar and 2,740 MW wind based renewable energy projects in the state will not require any grant or financial assistance form the Central Government: all will be projects developed by private investors.

The national policy push of Renewable Purchase Obligations (RPOs) has been implemented by the RERC in Rajasthan. In 2006-7, RERC directed an RPO of 2 percent for wind-sourced power; by 2010-11, the RPO went up to 8 percent. Compliance was initially lax because of the lack of enforcement. As a result, Rajasthan's compliance only peaked at 3.02 percent for wind. However, a Supreme Court ruling from the Rajasthan-based case of *Hindustan Zinc Ltd. v. RERC* mandated RPO compliance nationally, which resulted in a major increase in implementation by both dicoms and captive power plants across India.

Wind Energy Development

As opposed to other states with high levels of wind power potential like Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu, Rajasthan did not begin installing wind power projects until 1999 (MNES 2003). In 1995, after the success of Tamil Nadu in promoting innovative guideline to encourage wind energy investment, the Central Government's MNES formulated guidelines to help other states learn from Tamil Nadu's example. Although subnational elites in Andhra Pradesh, Karnataka, Gujarat, and Kerala were involved in devising policies, Rajasthan's officials were not (MNES 1995, 59). By 2002, wind energy development began to steadily increase, but Rajasthan's wind energy installed capacity was still less than 2 percent of India's total in 2003 (MNES 2003).

Rajasthan introduced its first major wind policy in 2012, which followed a state-level policy on the promotion of non-conventional energy sources in 2004. The 2012 wind energy policy outlined the competitive bidding process to determine the tariff for wind projects and set targets for capacity installation at 300 MW (from 2013-14), 400 MW (2014-15), and 500 MW (2015-16). In accordance with the Electricity Act of 2003, Rajasthan vowed to promote wind power plants of unlimited capacity for captive use and sales to third parties at mutually agreed rates. The policy outlined the renewable energy certificates introduced by the Central Government and establishes that RPO for the discoms are determined by the Rajasthan Electricity Regulatory Commission (RERC).

Solar Energy Development

Rajasthan first introduced a solar energy policy in 2011. With an aim to "combat climate change by reducing the emission of green house gases," the Government of Rajasthan sought "to establish itself as a leader in solar power generation and a pioneer in providing energy security and sustainable growth to India" (GoRED 2011, 1). The policy hoped to establish a "global hub of solar power" by installing 10-12 GW of installed capacity in the next 10-12 years (GoRED 2011, 1). The main policy goals were to achieve energy security as well a reduction of carbon emissions. The policy lays out the Central Government's fiscal incentives including the Generation Based Incentive introduced in 2008, the setting up of solar power plants under the National Solar Mission, and the use of tariff based competitive bidding processes for 100 MW of solar systems. The policy also introduced a solar certificate mechanism. Moreover, the policy hoped to develop large solar parks of over 1,000 MW capacity in less inhabited areas of Rajasthan (GoRED 2011, 9). Acknowledging that "climate change and global warming continuously threaten the world community" the Government of Rajasthan recognizes the "urgent need" to tackle these challenges (GoRED 2011, 2). The policy notes that the Central Government's support through the National Action Plan on Climate Change (NAPCC) and Jawaharlal Nehru National Solar Mission (JNNSM). These Central Government support mechanisms played an important role in developing the state-level policy support for solar energy (Civil Servant in Rajasthan 2).

In 2014, Rajasthan updated its solar energy policy and announced an ambitious target to install 25,000 MW of solar energy. The "forward looking" policy hoped to "usher in an environment that is congenial to investors" while lessening the state's dependence on fossil fuels and act as an important step in "mitigating the deleterious effects of climate change" (GoRED 2014, i). Rajasthan has the highest level of solar radiation, abundant land availability, and "business friendly policies that make it a unique opportunity for solar energy development (GoRED 2014, ii). As the preamble states: "Energy Security is key to economic growth to any country and state" and fossil fuels are quickly depleting (GoRED 2014, 1). The policy acknowledges the Jawaharlal Nehru National Solar Mission launched by the Central Government, which led to the State's revision of the Rajasthan Solar Energy Policy, 2011 (GoRED 2014, 1).

The 2014 policy expanded on the progress of the 2011 policy by removing key obstacles in financing and land acquisition, which show the state's ability to further facilitate private sector engagement to promote solar energy development (Hsu 2017). In addition, the generation of electricity from a solar power plant is treated as eligible under the industrial development scheme, which further facilitates private sector engagement (GoRED 2014, 11). Moreover, because climate change and global warming "continuously threaten the world community," the

Government of Rajasthan notes a “global shift towards sustainable renewable energy generation” (GoRED 2014, 1). Rajasthan hopes to “emerge as the global hub for solar power in the country” with its renewable energy policies, which will help the state attain energy self-sufficiency primarily through Public Private Partnerships (PPPs) (GoRED 2014, 2).

The tariff for projects is determined by the Rajasthan Electricity Regulatory Commission (RERC) through a competitive bidding process. Both policies acknowledge the importance of decentralized and off-grid solar systems to expand energy access to rural villages. As a result of effective policy support from the Central Government, Rajasthan benefitted from sustained growth in solar energy since the first state policy was introduced in 2011 (see Figure 8 in Chapter 6).

Applying the Analytical Framework to Rajasthan

In applying the analytical framework developed in Chapter 2, we see that the poor fiscal health of the discoms and lack of private sector demand for reliable energy slowed the subnational elites in devising renewable energy policies. The four variables of 1) State-level Party Politics, 2) Financial Space/ Indebtedness of the State Distribution Companies, 3) The Institutional Knowledge of the State Nodal Agency, and 4) the Private sector linkages explain the delayed implementation of renewable energy policies in Rajasthan. However, once the benefits of renewable energy were established and cost-competitiveness as achieved with thermal power, subnational elites quickly devised policies that encouraged private investment in the state, which led to a large influx of renewable energy installed capacity.

State-level Party Politics

In terms of electoral politics, Rajasthan's alternating but stable party rules have meant there was little incentive for long-term planning (Sareen & Kale 2018). Ever since a single-party rule dominated by the Indian National Congress between 1949 and 1990, Rajasthan has experienced healthy electoral competition with regularly alternating transitions between the two main national political parties, the Indian National Congress (INC) Party and Bharatiya Janata Party (BJP). Despite the benefits of increased dialogue in a two-party system, the constantly alternating state regimes has meant that the incumbent party has little incentive for long-term planning (Sareen & Kale 2018). Both parties have failed in their attempt to provide effective reforms to Rajasthan's troubling power sector more generally (Sareen 2018a). However, once the Central Government devised a solar energy policy and shared the party governing as the state level, there was more cohesion in the policymaking process, which facilitated top-down implementation of renewable energy development and creation of political will on the state level.

The electoral party in control of the Rajasthan government had a large impact on the willingness of subnational elites in introducing solar energy policies. When the first solar policy was introduced in 2011, the INC controlled both the Central Government and the Rajasthan government under the leadership of Prime Minister Mahmoud Singh and Chief Minister (CM) Ashok Gehlot respectively. The state level policy was the result of the Jawaharlal Nehru Solar Mission on the Central Government level. By having the same party in power in both the Central and state level, there was more cohesion in the governing coalition, which created more capacity support for the state government. As the direction of policy introduction was primarily top-down, the state government, given its same party alignment, was willing to introduce the solar energy policy. In addition, there was popular support for increasing the generating capacity of the state during CM Gehlot's tenure. During a seminar on solar energy organized in Jaipur, CM Ashok Gehlot said that "We are committed to making Rajasthan a power surplus state... The Government of Rajasthan is determined to developing the state as a big solar energy hub for making Rajasthan the leading state in solar energy" (*New Global Indian* 2012). Therefore, Rajasthan's political elite furthered their policy goals by implementing the Central Government initiative of expanding renewable energy capacity.

When Rajasthan's second solar energy policy was introduced in 2014, the Bharatiya Janata Party (BJP) was in power in both the Central and State governments as well, under the leadership of Prime Minister Narendra Modi and Chief Minister (CM) Vasundhara Raje respectively. Following Gujarat Chief Minister Modi's success in introducing progressive solar energy policies in 2009, BJP CM Raje attempted to replicate his success in Rajasthan (Parihar 2014). CM Raje was elected in 2014 "intent on emulating governance and political strategies that… brought Narendra Modi four successive wins in Gujarat" on an agenda for economic development (Parihar 2014). Many of the policy reforms introduced by CM Raje's government involved the promotion of public-private partnerships. In particular, Raje's Power minister Gajendra Singh Khimsar, a key member of Raje's 12-person Cabinet, introduced the 2014 solar policy to produce 25 GW of solar power in the next five years, all of which would be constructed by the private sector. The 2014 state-level 25 GW target even exceeded the national target of 22 GW; however, the Central Government soon revised the target to 100 GW of solar capacity by 2022 under PM Modi's leadership.

Financial Space/ Indebtedness of State Distribution Companies

The poor financial sustainability of the state-level discoms in Rajasthan was a major inhibitor to renewable energy development in the state. Rajasthan is a primarily low-income state with a large proportion of low-tariff consumers, especially agricultural consumers. Rajasthan has maintained stagnant tariff rates through political modulation during the late 2000s despite escalating supply costs, which has negatively impacted the financial sustainability of the discoms. In addition, Rajasthan is a very arid region, with a low water table, which requires power agricultural pumps. Population density is also very low, which leads to dispersed loads and requires additional resources to maintain and monitor infrastructure. The consumer mix explains the lack of financial performance. Contrary to Gujarat, Rajasthan has a much smaller large high-tariff industrial manufacturing base. The share of industry in the total sale of power for the Rajasthan Electricity Board was only 40% in 1998 (World Bank 2000). In addition, Rajasthan suffers from high technical and commercial losses, partially due to rural theft (Sareen & Kale 2018). Contrary to neighboring Gujarat, which capitalized on its fiscally sound discoms to provide fiscal incentives and attract investment in renewable energy, Rajasthan faced several financial challenges which delayed the deployment of renewable energy capacity until the cost per kilowatt hit the point below thermal power.

The large population growth and subsequent increase in demand for electricity was one major inhibitor of the financial sustainability of the discoms in Rajasthan. As with most Indian states, Rajasthan’s increased energy consumption had made planning the sector difficult. In 1990, per capita power consumption was 201 kilowatt hour (kWh), which increased by two thirds to 335 kWh in 2000. Even compared with the unbundling process, RSEB had a total installed capacity of 1,972 megawatts (MW) compared with 17,924 MW by mid-2016, representing a nearly ten-fold increase (Sareen 2018a). The share of domestic and agricultural customers increased from 39% to 52% between 1992 and 1998, while industrial consumers decreased. This increased the RSEB's reliance on subsidies and impeded its long-term financial sustainability. The persistent high costs and low revenues experienced by the power sector in Rajasthan has led to massive financial troubles and debt restructuring, including a massive bailout exceeding 80,000 crore INR in 2015-16 (Sareen 2018a). The lack of generating capacity has created many energy shortfalls, which reached 7.8% in 1991 and 15% in 1998 (World Bank 2000). By the mid-1990s, the share of power purchases from outside the state exceeded 50% of total grid availability (World Bank 2000).

In terms of the unbundling process, Rajasthan went through a single-stroke structural unbundling, which led to structural inefficiencies that lingered from the outmoded process of the era of bureaucracy state electricity boards, which the Electricity Act of 2003 sought to change (Sareen & Kale 2018). Rajasthan also neglected supply-side innovations such as a feeder separation program to reduce leakages in distribution in order to maintain artificially low tariffs for political populism (Sareen & Kale 2018). National power sector reforms began in 1990, and Rajasthan decided to follow suit in 1993 and soon later revised a Broad Reform Policy Statement in 1995, which was revised twice before the Rajasthan Power Sector Reforms Act was passed in 1999 (Sareen 2018a). With the establishment of the Rajasthan Electricity Regulatory Commission (RERC) in 2000, and subsequent unbundling of the Rajasthan State Electricity Board (RSEB), Rajasthan became one of the first states to restructure its power sector. The reforms led to the creation of one generation, one transmission, and three distribution utilities for Rajasthan.

Subsequent to sectoral reforms through the 1990s, Rajasthan retained the old institutional tendencies of a bureaucratic large-scale public utility, while neighboring states like Gujarat implemented more gradual reforms (Sareen & Kale 2018). These tendencies made small reforms more difficult to implement. Rajasthan was slow to install equipment necessary for rooftop solar such as bi-directional meters from discoms. These conditions are exacerbated by low feed-in tariffs and abundant red tape to access national subsidies. In 2012, the Rajasthan discoms, having accumulated debt and facing bankruptcy, had withheld 6,000 crore INR it owed to private power producers, much of which was owed to the solar sector (Parihar 2012).

The high power purchase costs of the three discoms of 4.38 INR per kilowatt hour is a major concern in terms of financial sustainability, in addition to high interests costs and defaults. However, as the cost per kilowatt hour of solar has decreased rapidly, increasing the share of solar power generation for these discoms has actually improved financial sustainability. In Rajasthan, all three discoms improved their credit rating from a C+ in 2016 and 2017 to a B rating from the Government of India's Ministry of Power (Prabhu 2017). This increase can be partially attributed to the Central Government's UDAY scheme; however, increased generation of solar power is a major contributor. However, the recent 250 MW Bhadla Phase-IV Solar Park auction, with a solar tariff rate below 3 INR/ kWh shows that the incorporation of solar power can improve profitability (Prabhu 2017).

Although the poor fiscal performance of the Rajasthan discoms was initially an impediment to renewable energy growth, as the cost-competitiveness of renewable energy has dipped below that of thermal power, increasing the share of renewable energy has improved the financial sustainability of the discoms.

Institutional Knowledge in State-level Nodal Renewable Energy Agency

Effective institutional support from the state government for solar and wind development helped facilitate the rapid commercialization of renewable energy technology in Rajasthan. The Rajasthan Energy Development Authority (REDA) was established in 1985 with the objective of promoting and developing the use of non-conventional energy resources. In addition, the Rajasthan State Power Corporation Ltd (RSPCL) was established in 1995 with the objective of developing power generation capacity within the state from alternative sources of energy like solar thermal, wind and hydro. REDA and RSPCL were merged in 2002, which created the Rajasthan Renewable Energy Corporation Limited (RRECL) (RRECL 2019). RRECL remains the state nodal agency for the MNRE and coordinates programs and engages awareness among people to conserve energy and prevent environmental degradation.

Under clause 5.4.2 of Rajasthan’s 2011 Solar Energy Policy, the state created a separate entity known as a Special Purpose Vehicle, the Rajasthan Solar Park Development Company Limited (RSPDCL), to facilitate faster development and management of solar parks (*Business Standard* 2013). The organization was established to develop solar parks and produce over 1,000 MW in capacity in certain identified areas in Rajasthan. Under the policy, the creation of the RSPDCL aimed to “act as the facilitator to attract global investment in Rajasthan and will provide the necessary infrastructure, regulatory and other Government support required through the Nodal Agency to rapidly ramp up Solar Power generation capacity in the State” (GoR RRECL 2019). The creation of the RSPDCL, housed under the RRECL’s existing institutional capacity, significantly accelerated the commercialization of solar power. As of 2013, 899 companies had registered with the government to set up solar power projects with a combined 18,476 MW of electricity (*Business Standard* 2013). The creation of the RSPDCL allowed for additional collaboration with the Central Government's MNRE to implement schemes and create more investor confidence to facilitate solar energy development in Rajasthan (GoR RRECL 2019).

RRECL's implementation of wind and solar projects has focused on spatially concentrated large-scale solar parks. This approach, emphasizing infrastructural development is opposed to a distributed generation model. Stakeholders have noted that 1-10 MW project developers have been shut out of the solar market while large-scale 10s and 100s of kilowatt (kW) have been left to the private solar companies to promote rather than being supported by state schemes. RRECL has focused on 37 W and 100 W solar modules to target households in remote villages to bridge the gap to expand energy access to rural areas. Moreover, the majority of RRECL's programs demonstrate a rapid liberalization of the energy sector more broadly and encouragement of private sector participation. Although recent net-metering policies have been introduced in 2015, the implementation of feed-in tariffs is rare, with discoms remaining resistant to updating technology like bidirectional meters (Sareen 2018a).

Rajasthan began attracting investors in solar energy after the National Solar Policy of 2011. Rajasthan's government adopted a reverse e-auction strategy to have solar developers bid using competitive bidding to avoid rent-seeking. The initiative was praised in national headlines in 2015 for producing 420 MW of solar plants at a then-record low rate of 4.34 INR per unit, a data point low enough to compete with coal-based generation (Sareen & Kale 2018, 274). For Rajasthan, framing its policy in context of India's high-profile solar targets helped draw investment from private investors. This policy innovation initiated by the state in implementing solar energy deployment was skillfully deployed by RRECL to overcome the fiscal constraints of the discoms and attracted increased investment in the state.

Linkages with the Private Sector

One explanation for the delayed implementation of renewable energy deployment was the lack of linkages between the policy elites and private industry in Rajasthan historically. Contrary to more developed states like Gujarat and Tamil Nadu, Rajasthan has a lower proportion of industrial consumers. According to the Ministry of Statistics and Programme Implementation, Rajasthan had significantly fewer factories than states like Tamil Nadu and Gujarat in 2017 (8,820 versus 37,378 and 22,876 respectively) (GOI MSPI 2017). The low economic opportunity costs for reliable electricity never created a captive generation market like what happened in Tamil Nadu and Gujarat. This dearth of demand for reliable electricity from industry made the state less concerned over energy security; therefore, the subnational elites in Rajasthan were less likely to introduce renewable energy policies.

The price of solar has continued to decrease at a remarkable rate; most recently, Rajasthan has attracted bids to install hundreds of MW of solar at a rate of 2.44 rupees per unit, which is below the national average power purchase cost for thermal power plants. Adani, a multinational Indian conglomerate that develops solar parks, has plans to install 10 GW of solar capacity in Rajasthan alone by 2022 for the 100 GW national solar target (Sareen & Kale 2018). This commitment underscores the attractiveness of the Rajasthan solar market for the private sector. Of the existing 15,201 MW of installed capacity in Rajasthan, the private sector owns more generating capacity than any other sector, including the State and Central Governments (6,416 MW versus 6,331 MW and 2,454 MW respectively) (GoI and GoR 2014, 13). Hence, subnational policymakers have been remarkably effective in encouraging private sector engagement, which has rapidly increased renewable energy development in Rajasthan (GoI and GoR 2014, 13).

Conclusion

In Rajasthan, subnational elites did not implement renewable energy policies until policy support was initiated by the Central Government. The introduction of renewable energy policies was one-directional from the top-down and both solar energy policies were introduced when the same party was in power in both the central and state governments. Motivations in initiating policies were focused on energy security, a desire to facilitate economic growth in the state, and mitigating climate change.

This chapter finds that the delayed initiation of policies was a result of poor discom financial health, the lack of industry, and the lack of demand for industrial power and insufficient linkages with the private sector more generally. However, once the state-level political will was activated by the Central Government, effective institutional support from the Rajasthan government and policy innovations facilitated large-scale solar developments that reduced the per-unit cost of renewable energy and facilitated its rapid commercialization. The solar energy tariff per unit is below that of thermal power, so increasing renewable energy development may in fact improve the fiscal health of the discoms going forward.

Before Prime Minister Modi’s 2015 announcement of expanded national goals of installing 100 GW of solar capacity by 2022, Rajasthan’s 2011 solar power target of 25 GW exceeded even the national goal of 22 GW. Rajasthan reinforces the national policy which benefits its subnational interests, while also distinguishing itself from other states for solar energy development to attract private sector investments. Rajasthan’s solar energy policy is closely aligned with the Indian government's ambitious targets. For Rajasthan, framing its policy in context of India's high-profile solar target helped draw investment from outside groups.

Table 10. Timeline of Renewable Energy Policy Developments in Rajasthan (table adopted from Sareen 2018a, 238-9).

1990	State's first BJP government, Power sector reforms commence
1998	Congress back in power, Central Electricity Regulatory Commission Act
1999	Rajasthan Power Sector Reforms Act passed
2000	Rajasthan Electricity Regulatory Commission (RERC) established; RSEB unbundled into five state electricity companies Generation company: Rajasthan Rajya Vidyut Utpadan Nigam Ltd. (RVUN) Transmission company: Rajasthan Rajya Vidyut Prasaran Nigam Ltd. (RVPN) Three regional distribution companies, each serving 10-12 of 33 districts Jaipur Vidyut Vitran Nigam Ltd. (JVVNL) Ajmer Vidyut Vitran Nigam Ltd. (AVVNL) Jodhpur Vidyut Vitran Nigam Ltd. (JdVVNL)
2003	BJP back in power, Central Electricity Act Passed, RERC poised to play more significant role
2007	RERC Renewable Energy Obligation Regulations Passed
2008	Congress wins power back
2010	RERC (Renewable Energy Certificate and Renewable Purchase Obligation Compliance Framework) Regulation
2011	Rajasthan Solar Energy Policy
2013	BJP back in power, approval of PPAs signed for 1,975 MW with power companies
2015	Rajasthan becomes first state to adopt the Central Government's UDAY scheme, helping achieve financial sustainability.

8

Conclusion

The central aim of this thesis is to determine the motivations of subnational elites in introducing renewable energy policies. Moreover, understanding the policy motivations of subnational actors in India is crucial to projecting the ability of the Indian state to implement the Central Government's ambitious targets for renewable energy capacity and the international community's ability to slow warming to two degrees Celsius below pre-industrial temperatures. In this concluding chapter, I refocus on the driving questions introduced in the introduction. I first return to the analytical framework to show how the four key concepts (state-level party politics; financial space/ indebtedness of state distribution companies; institutional knowledge in state-level nodal renewable energy agencies; and state-level linkages with the private sector) provide a useful way to conceptualize the motivations of subnational policymakers in devising renewable energy policies. I then draw out the high-level conclusions that emerge from a comparison across states. Lastly, I provide recommendations for future research.

Revisiting the Analytical Framework

I now revisit the four variables to summarize major takeaways after applying them to the four states of Tamil Nadu, Kerala, Gujarat, and Rajasthan.

State-level Party Politics

State-level politics play an important role in motivating regional elites to implement renewable energy policies in India. Cohesion between the Central and State Governments played an important role in initiating policies. In Rajasthan, when the parties aligned on both levels, policy coordination was faster and more effective. Moreover, in the absence of political will or alliances, the Central Government policy frameworks provide ideas to the state-level officials.

Financial Space/ Indebtedness of State Distribution Companies

Many state-level distribution companies in India remain in large amounts of debt. One major contributor is the high subsidization of electricity for rural consumers, especially farmers. Tamil Nadu continues to struggle with this concern given its high political mobilization. Kerala's vertically-integrated state electricity board leads to less innovative thinking and less investment in renewable energy. For Gujarat, having a financially sustainable distribution company allowed it to use its resources to invest in renewable energy. For Rajasthan, as renewable energy has become more cost-effective than thermal power, the state has benefitted from increased installed capacity. Moreover, the success of state distribution companies in managing their finances leads to increased private investment in renewable energy.

Institutional Knowledge in State-level Nodal Renewable Energy Agencies

This variable is one of the most important, yet most unpredictable variable in analyzing the motivations of subnational elites in devising renewable energy policies. Institutional knowledge can quickly bolster or inhibit the diffusion of renewable energy in a state. In Tamil Nadu, effective coordination led to large amounts of wind energy. In Kerala, the lack of institutional knowledge slowed wind energy development. In Gujarat, the efficient bureaucratic apparatus led to effective coordination. In Rajasthan, strategic planning to install large solar parks led to rapid commercialization of renewable energy. Institutional knowledge in less-developed states like Rajasthan was especially important for helping the state move towards a clean energy future.

State-level Linkages with Private Sector

Most surprisingly, the private sector linkages with state-level bureaucrats were an important variable in assisting the diffusion of renewable energy. Rather than seeing renewable energy development as addressing climate change mitigation policy goals, in many of the Indian states analyzed (Gujarat, Tamil Nadu, and Rajasthan), renewable energy was instrumental in the industrial policies promoted by the governing elites. In all states besides Kerala, environmental concerns were not the primary driver of renewable energy development; instead, environmental benefits were an unintended outcome of private sector actors and state elites coordinating with the Central Government to address the pressing needs of ensuring energy security for industry leaders, which was positioned as a strategy to mitigate climate change efforts.

Major Takeaways

The most innovative finding of this thesis is the poor effectiveness of environmental movements in diffusing renewable energy. Environmental concerns weren't the primary driver of renewable energy development; instead, environmental benefits from renewable energy development were an unintended outcome of private sector and state elites coordinating with the Central Government to address the pressing needs of ensuring reliable energy for industry leaders. In particular, Kerala demonstrates that even when active environmental movements and popular support exists for renewable energy, unless there are active private sector linkages, renewable energy development will remain slow. These findings may be very helpful for central government officials in India and state-level bureaucrats trying to devise climate change mitigation policies on the subnational level. Moreover, international climate change negotiators could use these findings to engage with India more to accelerate renewable energy development to slow anthropogenic climate change.

In all of the four states analyzed—Tamil Nadu, Kerala, Gujarat, and Rajasthan—subnational elites have devised renewable energy policies and taken advantage of the incentives, policy ideas, and framework provided by the Central Government. Hence, in the absence of local level or state level regional political support for renewable energy policies, Central Government initiatives can energy local efforts, even if delayed. This is especially relevant in the absence of state-level efforts like in Rajasthan.

Recommendations for Future Research

Role of Environmental Movements in Renewable Energy Diffusion

Perhaps the most surprising finding in this thesis is the ineffectiveness of environmental movements in diffusing renewable energy installed capacity. Unlike in China, where people are beginning to protest in response to poor air pollution, there are few protests in India. Although 13 of the 20 most polluted cities across the world are located in India, environmental standards are seen as an inhibitor to economic growth and job creation (Chauhan 2015). In fact, a city located in Gujarat called Vapi experienced protests in response to higher environmental standards, mainly as a result of the area's dependence on high-polluting pharmaceutical and chemical companies. Although this example is extreme, it demonstrates larger priorities of large parts of Indian society. Contrary to people living in China, those living in India place health issues and environmental degradation second to economic needs. Perhaps with raising incomes, the Indian populace will become more concerned about air pollution in the coming 20 years; however, researchers should further examine this concerning trend.

Soft Power Implications and Linkages with Hindu Nationalism

In 2011, PM Modi authored a book titled *Convenient Action: Gujarat's response to the challenges of climate change*, in which he deemed climate change mitigation a moral issue and argued that the ancient Hindu *Vedas* (especially the *Prithvi Sukta* in the *Arthava Veda*) in addition to Mohandas Gandhi's thought leadership "contain a whole spectrum of knowledge" on the issue of climate change (Modi 2011, 11-12; cited in Hall 2017, 129). Modi continued this justification for climate change leadership as motivated by Hindu nationalist beliefs during a 2014 speech to the UN General Assembly, in which he reiterates the longstanding belief of "common but differentiated responsibilities" and that "for us in India, respect for nature is an integral part of spiritualism" and that Indians "treat nature's bounties as sacred" (Modi 2014; cited in Hall 2017, 130). These actions are emblematic of PM Modi's promotion of Indian "soft power" in terms of Hindu nationalism. Modi often visits Hindu temples during visits abroad and reiterates the spiritual contributions India has provided to humanity throughout history. Many scholars and academics in India criticize Modi's Hindu nationalist beliefs because of the BJP's discrimination against Muslims; in terms of climate change policy, tying the two matters together could lead to dangerous outcomes. Moreover, with the establishment of the International Solar Alliance, India will play an increasingly large role in the mentorship of developing nations, potentially boosting its soft power as a responsible rising power.

Appendix A

Interview with Policymaker in Prominent Think Tank in Delhi, November 16, 2017

[0:00:00]

Respondent: So you should also be conscious when you're talking about the Indian electricity sector. You should be taking into account the political economic space in India. Because all the development that have happened in the past in terms of the setting up of power plants in the country, in terms of decisions to site the power plants in the country and the distribution network and the transformers etc, etc have been dominated not by a scientific study to site those infrastructure projects but more about the political gains out of siting those infrastructure projects by the powers that are maybe in power in that state, the political party which is in power in the state and the center and so on and so forth. So it's very important to understand that the decision is not purely economical. Once we get that out of the way we need to now understand that we have inherited, India has inherited a lot of legacy coal plants which are very, very old. And we just started kind of setting up additional capacity around 2000, in the early 2000 is when they launched all these programs of dedicated capacity building and there were a lot of changes. 2002 is when the new Electricity Act came in and that changed the game a lot because there are lots of open access. That made a slew of recommendations to change how energy is being accessed by retail consumers, by industry and by the agriculture and the various key consumers in the state. However these reforms it also kind of put in place setting up of the regulatory mechanisms to deal with it. So there was a national State Electricity Regulatory Corporation, SERC and National Electricity Regulatory Corporation which adjudicates on matters related to pricing, or matters related to figuring out at what rate the people need to be compensated for rise in tariffs or rise in their costs of generating and so on and so forth. So there is no goldplating, there's no costless basis because a lot of power plants are set up in that point of time on a costless basis. There was not much competitive bidding, so if for example if I'm a state in Punjab and I want to ensure power in my state even though I don't have a coal mine to supply power and that's the predominant source in the country right now because coal is cheap, and there is a lot of central government involvement in the supply of coal as well because the coal supply behemoth CIL is owned by the government. So when I'm a Punjab I would want to have a power plant in my state so I can control that power plant. Before they trifurcation of the electricity supply department in a particular state we used to have a single department which used to supply for the entire state. It had integrated transmission generation transmission and distribution, it was all integrated and then they were separated by World Bank's kind of reforms which were ushered in pushed in by World Bank and then we agreed to trifurcate all of them. Now we have a generation system, we have a Genco, in a state we have a state Genco, we have a central Genco, we have a transmission company, Transco and we have a distribution company as well. So all of these now, all these three are kind of separate from each other. So the evolution has been such that the government has taken the initiative of setting up power plants through a central company called NTPC, National Thermal Power

Corporation. So the central government cognizant of the fact that in a federal structure when the entire electricity is in the state schedule, the state builds its own laws for monitoring and distribution for electricity so the central government has very limited powers. There are two schedules of the constitution, one is the concurrent list, one is the state list and one is the central list. But things in the central list are exclusively under the purview executive domain of Center to legislate upon. The states legislate on certain other issues and there's a concurrent list on which both of them, the center and the state can legislate upon. So electricity lies unfortunately in the state subject so it's something that state legislate upon. So to build capacity because scale in terms of money, in terms of resources are available with the center much more than states, most of the states are perennially in debt and they have a high deficit in their budgets and all. And the borrowing capacity is also limited for those states because they don't have a rating or sovereign guarantee in some way so they need to go back to the center to guarantee if they're floating bonds or they're raising funds for a long term investment in the capital assets, capital asset creation.

[0:05:09]

So the central government started the NTPC, developing all these power plants. It also invited private sector to develop it's own power plants. But there's a key difference between NTPC and the private sector power plants is that the last mile and before I come to the difference I'll probably want to elaborate that the discounts in a particular state are responsible for the last mile transmission of electricity to the stakeholders that may be industry, agriculture consumers, people the normal retail household level etc. These discounts are in the red, deeply in the red in most of the states right now. So that reform of actually making them a business viable entity and most of the case they're held by the state government. Delhi for example has a private public partnership so Delhi government holds 51 percent stake in the distribution company Adani or there are two distribution companies in the state and 49 percent is held by the private party. So this is our norm, I mean this is typically what has happened. Most of the states discounts however still are owned by the state government and it is very difficult to make a business case out of them because of again the political kind of a defense. So the NTPC supplied power is tagged by a federal guarantee that they will be reimbursed on the power they supply. Private supplies unfortunately don't have that kind of a guarantee. So in some ways NTPC will never be in the red because even if they supply to a discount which is financially I won't call it insolvent but it's in deep distress the money that it owes to the discount that discount moves to the NTPC generating company is being third party guaranteed by the federal reserve of the country. So that gives them much low risk in selling to these discounts and through them to the various state consumers. The second big – so that one is the reforms which are eluding the Indian luxury space, that is a big deal from the discount's perspective because those are the ones who are in some way the agency to transfer the electricity from the generation to the consumption side. And consumption side again there are vested interests in terms of political interference for setting of tariffs. So India has an inverted tariff structure which you would probably already know. We have higher tariffs for the people whose cost to serve is probably the lowest and we have a lower tariff for those people that the cost to serve to them is much more high. So that's the inverted tariff which doesn't make any sense but again we have to be cognizant of the political space in the country. So it's deeply entrenched in the psyche of the people that this is a service given by the government and elections are fought based upon this. So if I'm a Punjab or a Rajasthan and the election is forthcoming I'll again announce deep discounts with no way of covering them by any kind of budgets that I'm going to make. So I will announce deep discounts on selling cheap electricity, cheap water, cheap whatever is in my hands which I can control basically. So state governments are resistant in letting go of the discounts and being a viable entity because that will in some part involve reduction in industrial tariffs and increase in retail tariffs. So that's one thing which is a political hot potato, no one wants to address it. Second is the agricultural consumers, so agricultural consumers in the country are typically free. They're I think by far around 30 percent of the total consumption of the total generation that we have in the country but they're not charged a penny. And for this kind of dole that the government is giving out we need to compensate by charging higher from various other consumers, so that's the reason for the inverted tariffs. Agriculture has typically been a touchy subject, a lot of voting happens in those areas and they don't want to upset that vote economics so it's highly unlikely – they've not even started measuring. So what happens though because of this subsidy, heavy subsidized rate of power to these consumers, they don't have quality of supply. So they will probably get power in the night when they're off peak hours. They will not have it in the early morning and early night for sure. They will have sometimes in the middle when there is again a slump when the power is cheaper and there's non peak and various other consumers in households or industries or industries doesn't really matter because they're more or less depending on the shifts they operate. I think they're more or less stable but retail consumers and others who are paying customers when there is a low point that's when these guys get power. So that kind of also hinders – so what that has done is spawned an entire diesel based generation system for those farmers who can afford it or have go to solar sub grids in all those areas or have solar pump sets which in turn has also affected the ground water supply in those areas. So if you're running on solar pump sets you'll be watering your fields during the day and because you would want to flood the fields you'll probably use excessively the ground water. There have been multiple study which relates to pumpsets usage within depletion in ground water in especially in the area that's ***[0:10:37] [Inaudible]*** in the country.

[0:10:37]

So that's a given, I mean that's something which has been studied a lot. Now so the problems are twofold. One is the political interference in the tariff, no one wants to, none of the government state or central government wants to spend their entire capital in kind of reversing the situation on the ground. What they're doing now and they're constantly kind of moving in that direction is ensure more and more capacity consumption which is not a very good idea because then your're tying a private and public capital on projects which may go down in the future without giving substantial data because there's lot of uncertainties in the next 10-

15 years horizon. So the growth rates and the consumption and people moving because of the unlevel supply premium with people moving themselves off the distribution company the discounts or the utilities is a cause of concern. The extent of that will determine the survivability in some ways of the power plants that we're setting up right now. And of course at the same time the government has also a very high ambitious target of setting up renewable in the country which includes solar and wind in some ways but more focused on solar which shouldn't be I think solar. We don't have enough domestic capacity to manufacture solar, it's typically we are making in China and importing and then there's a lot of cost ***[0:12:15] [Inaudible]*** foreign exchange. But so in addition to that I think we should probably be incentivizing more and more wind however that is something which is not happening on the ground. So solar is something that is taking a lot of public as well as private spending right now. But that does complicate the situation going forward even more because people going off the grid decentralizing will mean assets which are typically financed by public sector banks not getting the return on their assets and going into non performing assets category which will weigh the banking system down essentially leading to possibly a crisis in the future. So I think that's the thing but talking about decentralized options of grid there are a lot of micro grids already in operation in the country. There are a couple of them in UP, entrepreneurial people who know that people will pay higher for ensuring quality supply are setting up their micro grids and selling power to consumers much higher than the grid rate and they're willing to purchase. And that ensures that there is power in the night when needed. Otherwise the grid is very unreliable. So ***[0:13:32] [Inaudible]*** is the key of course and that's increasing more and more. However state support to the idea of decentralization is limited to only rural areas or areas which are difficult to reach. Wherein there cannot be a utility setting up last mile distribution would be too expensive, that is the only area the government has suggested that there will be independent micro grids which help take the load of the grid and also ensure there is electricity available. There are some policies around that as well to ensure private investment in those areas for setting up those and there's a return viability cap funding so and so forth. A lot of things are happening in that space. But other than that I don't think from future perspective the government is in any way considering in general which I think to my mind and I think you heard Victor the other day. I think he is anti, he says that he is not in favor of distributed generated system or grids. In my personal opinion I think that's a great idea, we should explore more and more distributed grid infrastructure because that and to my limited mind I think that is the scale or the bulk investment required and breaks it down to smaller pieces which can be financed locally in certain ways but that needs a lot of changes to the way municipalities or state governments function. That would require some level of investment which I don't think the governments, state governments at least, are even aware of or thinking consciously to kind of arrange for. So I think that's a challenge that needs to be met.

[0:15:28]

In terms of people in general I think many of the people who already are at the higher end of the tariffs for example within consumption as well if you look at the electricity bill you'll see it has been a level of subsidy for lower consumption and a higher consumption. That is more of an efficiency subsidy, for example if I'm supplying to a consumer and he is consuming 100 units per month the bill will be subsidized, I think at cost or slightly below cost of service, that will be the rate at which we charge. And then it goes on from there upon to within slabs of 100 or 200 units as you consume higher and higher your per unit charge for the consumption goes up. So those consumers typically who have a lot of consumption they see a lot of value in government subsidies for going off grid and having a solar or a ***[0:16:23] [Inaudible]*** tariff. So all those incentives compound to give them an incentive to move away from grid and those are the people typically who are sustaining and supporting the grid in some ways by paying their fair share or higher than fair share of the cost to serve them. So if those people keep on going off grid then the challenge for the grid would be bigger and bigger to remain profitable in some ways.

Interviewer: Interesting.

Respondent: Because you have to either wean the farmers of subsidies which is going to be very difficult to do or you have to raise your tariffs for everyone whose on the grid which is the utility that ***[0:16:59] [Inaudible]*** talking about. So those things are something which need to be concerned, they're actually a cause of concern and they need to be taken more and more into account when you talk about any distributed grid structure as well.

Interviewer: Do you think net metering would be viable?

Respondent: So net metering is already existing in certain areas, it's not universal but that is actually a problem, the rate at which net metering was happening earlier was heavily skewed towards incentivizing people to go in for their own kind of generation from solar and a lot of people moved towards that area. But now I think the policies have substantially scaled down in terms of incentivizing people and they're not doing as much, they're not doing as much net metering kind of tariff for various reasons. I think that that's not a profitable exercise for them anymore. And I don't have the numbers in my mind right now but I think it has to be done right in the sense the net metering we haven't spent a good amount of thought in limited coverage areas even if you want to do net metering in limited coverage area I don't think we have spent enough time thinking through in terms of what would be a good rate for net metering kind of a infrastructure. So I think that's something which needs more thought upon. But again as I said the government is putting its money in a certain direction and when you have a leg in the business you're betting in a certain direction I think the alternatives would be considered as favorable as they are considering the ***[0:18:51] [Inaudible]*** right now. That's the usual – often that's what happens.

Interviewer: And what I'm looking at as well is in terms of sustainable development goes when we look at energy access and affordability as like only 300 million people currently in India without access to energy and I'm sure you already know like the Indian government has this really goal of electrifying every village by 2018, every household by 2022, do you think that's --?

Respondent: We're falling very short right now by the way.

Interviewer: Yeah, exactly. So I was going to ask do you think they'll meet these targets and also do you think coal will primarily be the main contributor to that energy or do you think it will be more renewable based?

Respondent: Is the question that you're asking is about having a micro grid in these villages or vis a vis having them connected to the utilities, is that what you're saying?

Interviewer: Yes, that's part of the question. And also where do you think the energy will come from like will it come from coal plants or --?

[0:20:00]

Respondent: So we already have around 70 percent of our mix coming from coal right now or even more if I remember correctly. So if that is the rate that's not going to change any time soon for sure. It's going to take some time, by 2020 also we predict that there is certain offtake and there are certain factors that we take into account and predict that this is ***[0:20:16] [Inaudible]***. So coal is not going away from the Indian grid any time soon. So that needs a massive amount of infrastructure overall in terms of transmission network which is something that they're talking about right now but I don't know if they have the money to do it. But wishing away coal is not in any way practical. So it's going to be coal and if I were to hazard a kind of a opinion on this I think it will be the majority coal for at least next 10-20 years. And of course renewable will set up will increase in capacity, there's no denying that, but battery storage is some time away so it's going to be very tough for us to survive entirely on renewable based generation. So coal is definitely going to be around for next 15-20 years, there's no denying that. Having said that though the villages, I think the question that you're asking from the villages electrification it depends on two factors. One is – so let me address it part by part. So the first part of the question which talks about will they be able to do it, see, there are two separate things here. Electrification by definition you can put up wires, you can put up transformers and you can put a line but if there is no electricity on that if you still define it electrified I think sure, you can always build up infrastructure and just let it rot over there, that's something that can always happen. But if you want to supply to these people and give them incentives to also if not pay but consume in some ways that needs to be thought of. I think that's something which is still missing from the last mile areas and many of those they've already electrified I think most of them there are going to be some which are still going to be left out for various reasons but achieving the target of electrification just by defining it access to grid I think that is the easy part. The more difficult part is ensuring that there is consumption and ensuring that there is juice on those lines that they've set up and people are actually meaningfully electrified. So we need to talk about that target, that is more important, I think no one is talking about that. I think there's a new scheme which Prime Minister launched from August which spoke about viability cap funding for some money for getting the first connection which includes wire, meter and some basic electrification I think. But I don't think – I'm still to see the exact numbers on that, I don't think they have the sufficient amount or sufficient quant of money to subsidize for that scheme. So it's going to be tough, that's what I think. But the grid is going to remain coal based for a long time, that's not going to change and most of the consumption is going to be through it. So what are you doing in Jaipur, what exactly is going on in Jaipur?

Interviewer: So it's a program through SIT which is Science for International Training. So it's American University students in Jaipur and we're doing, we're learning Hindi, we're taking classes on sustainable development and so the focus is looking at social change as well as economic change in India. And then we're for the last month, for the last four weeks we're doing independent studies. And so I'm in Delhi looking at electrification and then some people are all around the country looking at different social issues and economic issues.

Respondent: Okay, sounds good.

Interviewer: Yeah, so it's been really amazing so far.

Respondent: Yeah, so it's more of a learning experiment as opposed to any implementation per se in terms of micro grid or anything of that, right?

Interviewer: Exactly. So we'll do like one or two field visits it's mostly to just kind of talking to policy experts and understanding, this is only four weeks.

Respondent: Absolutely, yeah, yeah, you cannot – sorry.

[0:26:09]

Interviewer: Yeah, so it's been really amazing so far. So we went to Sikkim like a field visit and learned about the agricultural sector there. And so it's been really interactive so on our field visits and our trips.

Respondent: Very nice. So Sikkim is actually the only state which is completely ***[0:26:25] [Inaudible]*** India so it does a lot of ***[Inaudible]*** farming which is very interesting. It's really tough to manage an agricultural produce at that level in the country in general but they've done a great job.

Interviewer: Yeah, it's been really interesting so far. One other thing that I wanted to ask you though, they're actually two more things, was one of them was the Make in India scheme. You mentioned that like in terms of solar production most of it is coming from China or other countries. How do you see the make in India scheme factoring in in electrification efforts.

Respondent: So that's a very component of the plans of the government to generate jobs in the country. If you're looking to go for -- right now we're at how much, I think 15-20 gigs of solar if I'm not wrong. So if that's the level we're at we have to go to around 100 solar of which 60 is the grid scale and 40 is your rooftop solar basically. So you need to have capacity for that, I think we don't even have – even if we have we have very limited capacity for production right now. And setting up a renewable facility for doping and for making those solar production units, photo voltaic units basically, so for making those PUs I think we are costlier as opposed to China. So the government of India needs to ensure that there is availability of infrastructure for manufacturing because we don't have capacity right now. And if we're looking at 2022 it's just four years away, it's going to be very tough to kind of ensure by the time we have sufficient amount of capacity for solar manufacturing in the country which is also absorbed by the consumers. So I think from the perspective of solar based manufacturing, solar panels manufacturing in the country I think Make in India is not going to work. It's just too short a time and people did raise concerns upon a time that this is going to happen but --

Interviewer: It's the same thing for time after time.

Respondent: And everybody is concerned upon time but nobody kind of had the guts so to speak to tell the government that this is not possible and you should focus more on wind based production because we have more than sufficient capacity of wind in the country, energy producing capacity which can also be augmented because we already have the scale it can actually be developed on top of the capacity that we have right now. But solar it's going to be tough, I don't think we can ***[0:29:22] [Inaudible]***. In fact I think [Redacted name] knows somebody who did not set up a unit in India and set it up in the US because it's cheaper to manufacture in the US and port to India as opposed to manufacturing in India itself.

Interviewer: Interesting. Wow. And that's because of --?

Respondent: It's mainly because of the -- not the labor cost but the price of electricity and the other variable costs.

Interviewer: Yeah, it's natural gas, it's really interesting to look at especially from that looking at electricity in California ***[0:29:53] [Inaudible]*** solar is huge there and natural gas. That's really changed the energy rates.

Respondent: Absolutely.

[0:30:00]

Interviewer: That's fascinating. So is he successful in the US.

Respondent: Last I heard from them is he made the decision based upon a long enough assessment of the situation in India and betting on the fact that it's not going to change any time soon in India. So I think he would have set it up in US, the facility and probably import it into India. I don't know.

Interviewer: That's interesting.

Respondent: But he made a decision to not invest in India and invested in the US at that point of time. So we need to take giant steps on this phase, ease of doing business, cost of doing business, all these are we're in some way struggling right now.

Interviewer: That's like manufacturing infrastructure that's like building infrastructure that will last longer or what's the kind of major component of making it easier to manufacture here?

Respondent: So making it easier to manufacture is more to do with the ***[0:30:56] [Inaudible]***. When you have to take so many permissions when the availability of land, the major burning issue in the country right now with respect to manufacturing is the availability of land. So we have a lot of land which is typically maybe from heavily populated to land which is not appropriately compensated. And people do depend on land still for their sustenance in some way. So if you take away the land you take away the means of livelihood. And they cannot go to an alternative means even if you compensate them fully they will not be able to be gainfully employed elsewhere to ensure that they sustain over a period of time. So that becomes a challenge because they will come back to the land and there will be protests and there will be issues around it. So we haven't been able to take a lot of people into confidence when you're kind of acquiring land from people and the state in some ways has failed to assure the people that they will continue to get a decent compensation and also some kind of opportunities to be gainfully employed in some ways. I think that's the double whammy. In China they don't have that, you can just go and acquire land wherever you want to. In India very challenging land I think and then of course from thereupon you have various approvals, clearances, from environmental agencies, multiplicity of those agencies setting up a factory, setting up a unit in India of course it's not as costly as other economically developed world but I think the challenges with respect to time overruns. You will have time and cost overruns because of approvals pending or red tape and wherever there is need to get an approval and various permits to ensure that you are having a facility up in time.

Interviewer: Interesting.

Respondent: Those things take a lot of time. That's where India needs to improve a lot. If you see the world rankings on these Business World Bank I don't put a lot of trust on those rankings but India has kind of improved a couple of notches but I'm not sure if that sentiment is shared by actual entrepreneurs on the ground. Second, these surveys only takes into account Delhi and Bombay. So you don't go to those areas where actual manufacturing takes place in Gujarat or in Rajasthan or in other states. So it's not representative at all.

Interviewer: Also one last thing that I was thinking about is I've done research in Rajasthan before about learning about the cost of solar and there are a lot of people who are very optimistic about saying that the cost of solar is cheaper per gigawatt now than coal and that it's a matter of time when the economics will sort itself out and people will invest more in solar but it sounds like it's actually more of a political issue and more of like a lack of political will. What do you think will change that kind of calculation in terms of --

Respondent: I think you cannot definitely fight economics part, political economy is typically concerned with areas where a decision needs to be made about citing of various projects. Legacy or political economy in the energy space in respect to the coal power plants apart I think for renewable most of the investment is happening and is driven by the private entrepreneurs in this space. So private entrepreneurs it's going to be very difficult, the difficulty level for influencing the decision for private entrepreneurs or private investment to invest not invest in one space and invest in the other because of political consideration is going to be very tough. It'll definitely play a part but not decisive role in that. So solar I think is going to be much more democratic in that sense and more grounded on economics of the project as opposed to any kind of rhetoric or any kind of political compulsions in some ways. So that's something that's a given for these projects because of private investment and the kind of backing that these projects have. In terms of the cost of solar comparative between the – I'm just going to talk about the grid scale solar. So grid scale solar versus coal right now I don't think it is cheap. I think there are hidden costs which are not taken into account when you compare them with coal. For example and that's a view that you'll find resonate across [this organization] I guess at least in India. If you talk to Rahul and somebody else they'll all say that there are hidden costs of land acquisition, so government is inviting people private parties to invest on land which are free of encumbrance in some ways and there is no legislation and there is not cost of that land. So land is given for free for those entrepreneurs to set up whatever units they're setting. They're just waiting for the power, the erection and commissioning of the unit and then setting up the power. So on that when you compare the power plants existing coal based power plants which have been set up for some time which have depreciated, which have their variable costs, land costs on its own in green in that tariff that they charge so I think if you compare them it's not a fair comparison. If you actually also include the hidden costs it will be much more expensive but yeah, so I think but the prices I agree I think they will fall down even further and it's time I think the subsidies in some ways if not right now in a couple of years subsidy should go from the enabled space and let it compete in whichever way it can. Let people come and setup and experiment with battery storage systems and see how that goes in areas and then that should kind of change certain stuff. One of the other important things is also because of the pollution. So we have seen this so the kind of situation that is prevailing in India in most of the northern Indian cities you will see lot of questions being raised on the upcoming and future coal based power plants. It may not necessarily shut down the support may not be enough to shut down the existing plants but the future plants will be much more difficult. So the delta of any future plant for being setup, the threshold for being actually commissioned is going to be more and more higher.

[0:37:06]

Interviewer: Interesting. It is that most of them are NGOs and activists?

Respondent: Yes, mostly from activists and people locally. So if you see now when you compare with olden plants the newer plants are now sited more and more close to the coal fields. In those areas there are typically rural population which are impacted and the air quality, there is not much monitoring of the air quality in those areas, the ground and water pollution so ***[0:37:31] [Inaudible]*** typically does not happen. You will have lot of media reporting happening in Delhi but not as many in rural areas. But people are protesting over there as well and once the awareness hits people the political system needs to kind of also be tested against the popular perception amongst people of the pollution causing agency. So if there is a ground well discharge or there is a power plant which is having problems so those can lead to be talked about.

[Cross talk]

Interviewer: So those are most of the questions I have. One last one was in terms of – you were talking about the publicly funded versus centrally government funded like the NTPC.

Respondent: National Thermal Power Corporation.

Interviewer: Right, do you see that in terms of distributed like micro grids in terms of risk.

Respondent: Not right now. They're not investing anywhere in micro grids right now. But who knows, in the future I think they are the investment agency for the government of India for the power sector in general. They're investing in renewable energy but not distributed systems, distributed infrastructure per se.

Interviewer: And do you have piece of risk because of the political calculation?

Respondent: I think more of a political calculation. So their appetite to take financial risk is in some ways also includes the political risk involved because there are public sector organizations so they'll never be delineated from the fact that they are governed by the ministry of power in some ways, the stakeholders in their decision making process. So political calculation will always be applied in their decision making process for renewables or distributed infrastructure. But private players don't have that encumbrance, they can go ahead and invest in whichever areas they want.

Interviewer: But those sound like it's still kind of a risky investment?

Respondent: From the distributed perspective, absolutely. I think we need to learn more from Germany, other countries who have worked upon distributed grid and they're continuously upgrading the infrastructure for next generation. The point is we're approaching this question from a different perspective, India is approaching this question from an access perspective. The primary requirement right now for us to have is to have access to everybody. We'll sort the other things out, the idea is that once you address this problem the other problems we'll get to them later. No one at the moment has the kind of view that we need to increase the scope of a problem and then address it simultaneously. So I think that's something which will be a challenge. There's another thing, distributed there's no financial model as such in India and so what happens because we're expanding what happens – exactly, there's no policy, there is nothing in terms of what direction the government is going to take, what direction do you want these people to be net metered or how do you supply and how do you consume, at what rates do you sell. So that needs to have a scale. Scale is easy to find, it's not that difficult. But the government needs to be conscious that there is something that we want to experiment with. And I don't think the government has done experimentation on this part, right, on distributed infrastructure.

For example micro grids and mini grids like there are three or four states who have like the mini grid policies. But the problem is the developers are not interested because the developer says what happens if after ten years –

So that's more about ensuring access.

Who is ensuring the investment.

In those far out areas where there is also risk of revenue, so we don't know how much could we earn from those areas. So they're not kind of insulated by the state government or assured by the state government that those risks are covered in some ways. So they're not going to go and do any kind of investment over there.

So the people for sure are going to move to grid once the grid is there because it will have certainty and quality.

Not the quality, certainty for sure, that is available. That's more of an ambitious wishful thinking in some ways I'd say.

The risk the developer thinks of is like this, the distributed developer in a remote area will develop a mini grid but risk is like what happens if there is a grid in two, three years.

Interviewer: And you think there's plans to increase the quality of that grid or do you think it will always kind of be --

Respondent: Because there is another problem, so the grid electricity will be cheaper, it will be subsidized. The developer will not subsidize it. People will move to grid because it is subsidized.

Interviewer: Interesting. Oh, yes, that's all the questions that I had.

Respondent: Cool.

Interviewer: Thank you so much for the hour.

Respondent: I really hope maybe for the four weeks you'll get better insights in this --

[0:43:07] End of Audio

Appendix B

Interview with Civil Servant 4, June 18, 2018

[0:00:00]

Interviewer: Thank you.

Respondent: Actually this program proposed for 10,000 numbers of systems from 10,000 rooftops. That means 10 megawatt from 10,000 rooftops. Initially we proposed for grid but due to the subsidy program of MNRE they have asked us to change it to off grid with the battery scheme. While giving proposal we thought that we could not achieve this target 10,000 numbers as a single project. Then we gave 2500 numbers, or four projects of 2500 numbers. But MNRE gave sanction for 10,000 numbers at a stretch. We started our campaign and we got an overwhelming response from the public. Initially around 6000 people registered through for this project and we started the implementation. Then central minister Dr. Farooq Abdullah inaugurated the program. During the implementation, we started the implementation while the program is getting implemented there is a issue we faced that scam of some solar scam that means some of the vendors collected money and not installed system. Not in our program, some other programs. In that issue some of the government and ministers were involved. Due to that we could not get the pace what we were expected. After we have waited for some one year and one and a half years after that again we started campaign. Within I think 3-4 months we could achieve a registration of 20,000 numbers. Out of this we have completed around 9,837 installations. That means rooftop we have achieved 9.8 mega watt by installing 1 Kilowatt each on such rooftops. This was the first project in Asia which is like this decentralized generation we could achieve a target of this much megawatt from this much rooftops in a decentralized manner. No other state in India or I think in Asia achieved such a big target of decentralized power generation. This was honored my central ministry by giving awards for innovation, like that. We got three awards from central ministry for this project. After that during ’15, ’16 we started the solar projects. In that projects even though we could achieve some initial registration of beneficiaries we could not complete the installation commissioning due to the delay in commissioning of the projects by that electrical utility and the chief electrical inspectorate. But during ’17-’18 we have announced this program and we were having a target of 5 megawatt but after announcing the program within 20 days we could achieve 7.5 megawatt in 20 days. That was another achievement for achieving this much in a very short span of time. Now we’re going for a target of 1000 megawatt within three years. That means by 2021 we’re planning to achieve 1000 megawatt, out of this 500 megawatts are rooftops only.

[0:05:03]

For that we’re planning and that is why she is also involved in planning and all, we’re trying to achieve that without subsidy, without any incentive from government we’re planning to achieve such a big target. That is the situation now.

Interviewer: Are those grid connected?

Respondent: Yeah, grid connected.

Interviewer: Is that for net metering?

Respondent: Net metering everything is there. For that [redacted name] could give you the details. We have established a e-marketplace, a project management flow like that, so many single window system, so many e-governance systems are enabled. This [redacted name] can give you the details and because of that we think it is not an unachievable target, it is we could achieve this target within the timeframe. Now we're planning for that and we're planning for some non conventional methods for installing such a ***[0:06:23] [Inaudible]***.

Interviewer: And you said that the central minister was involved with the planning, was this project for the --

Respondent: Some issue was there, some scam was there.

Interviewer: Okay, there was a scam.

Respondent: Yeah. Because of that only the projects was delayed.

Interviewer: Okay, got it. And so in terms of who initiated the project was it the state government or who kind of led the charge to start the program?

Respondent: State government only initiated, I was in charge of this program at that time. Now also I'm in charge.

Interviewer: Right. So what are the main motivations for having rooftop solar. Like what are the major benefits?

Respondent: Because Kerala is not having a land which can be utilized for this and the cost of land is very high in Kerala because of that –

In USA you don't have much, solar energy is much useful?

Interviewer: Also India has a lot of potential. We've got rooftop and utilities scale.

Respondent: What are the type of energy?

Interviewer: There's the hydro, nuclear, coal, natural gas.

Respondent: And you compare the USA and India or any comparison in your study, any comparison between USA and India.

Interviewer: A lot of the decentralized – because we're decentralized states as well. So a lot of the states are pushing for net metering and other policies. So net metering is huge benefit, that's a really good policy to have for solar. And then there's a big transition going from coal to renewables.

Respondent: Since we're not having land we've concentrated on rooftops. Since in Kerala almost all houses are pucca houses they are having a good terrace roof and it is suitable for installing solar plants. And around 10-15 percent of Kerala is a green committed, committed for green energy. Because of that only they came to install off grid program, even if it is costly also they were ready to install the solar plants on the roofs. That time after subsidy it was around 1,70,000 and now more for installing one kilowatt system. Even then also all these people had come, around 22,000 people registered for installing this thing, this power plant. After the scam only some of them backed out. even then we've installed around more than 10,000 numbers. I got the reports of only 9800 numbers. Already more than 10,000 numbers installation done but some of the agencies companies not submitted the reports.

[0:10:39]

Interviewer: Okay. Are those reports online?

Respondent: Yeah. Because of that only I could conclude this program by 9837 numbers. Otherwise it will be more than 10,000 installations. Now around 16,000 persons installed solar power plant through ANERT and total installed capacity is 22,000 mega watt from around 16000 rooftops.

Interviewer: And for a lot of these projects are people in Kerala willing to pay the upfront costs, so who pays the initial costs for the installation?

Respondent: Pardon, I couldn't get it.

Interviewer: So to install the systems does the customer pay that initial, how much do they pay at the beginning to install it?

Respondent: Yeah, they paid around total cost less subsidy, that means that time initial stage subsidy was around 92,000. Total cost was around 1,75,000 less 92,000. That means they paid around 90,000 odd per system after subsidy. Subsidy has been transferred to the agency installed system after inspection and commissioning.

Interviewer: And so in terms of the willingness to pay there are people willing to pay that because they save money in the long run?

Respondent: No, I think you're asking about the pay back and all.

Interviewer: Exactly. Yeah.

Respondent: But in terms of pay back it will take around 10-12 years, between that they have to change the batteries and all. That is what I told, they installed systems due to their green commitment only, not for profit.

Interviewer: Okay.

Respondent: Now also some we can say that for grid connected system we can get the pay back within 5-6 years but off grid systems it is still more than 10 years it will take.

Interviewer: So what's the main motivation for people to buy the systems?

Respondent: That is maybe the green commitment. Otherwise maybe after seeing somebody install the system they thought it is a – here for building a house they're spending around more than 1 crore and for their bathroom they're spending around more than 10 lakhs. Then for a solar system it will be only 2 lakhs, that maybe the reason they are ready to install the system.

Interviewer: And then the subsidies from the central government?

Respondent: Central government and state government were giving subsidy, now it is limited to central government only.

Interviewer: Okay. And why did the state government stop?

Respondent: Regarding state government now we've restricted pay subsidy through local self governments, that means panchayats. Through panchayats only we're giving subsidy.

Interviewer: And then in terms of floating solar?

Respondent: Floating solar initially one system was installed there in Wynad district, the cost is very high, around 19 crores per megawatt the cost comes. Now the solar energy corporation and they're going with a proposal that they will install floating solar and give the electricity to utility by a rate below three rupees per unit. If it is coming like that we can utilize our water bodies for installing more than land.

Interviewer: Right.

Respondent: It will be a good option for Kerala.

Interviewer: And I saw there's one in West Kollam, I'm thinking about visiting that on Wednesday. Is that possible to do a field visit, do you think?

[0:15:15]

Respondent: Pardon.

Interviewer: Is it possible to visit the floating solar system?

Respondent: I think if you want to see the installation at Wynad you have to get permission from the utility, KSEB. Better you may meet somebody here in Renewable Energy cell at Trivandrum Vydyuti Bhavan, KSEB headquarters is here. You can go and get permission from some of the officers here, then it will be easy for you to visit this floating and all.

Interviewer: Okay, so it's a possibility, I can do that.

Respondent: And also regarding floating you'll get more details from them. They only installed this.

Interviewer: Okay.

Respondent: Pattom Vydyuti Bhavan, nearby.

Nearby, around 2 kilometers from here.

Interviewer: Okay, sure.

Respondent: Headquarters of [institution redacted]. There is a Renewable Energy Cell there headed by [name redacted], chief engineer. He can give you the details.

Interviewer: Okay, sure. That will be great. And then so for the future of energy in Kerala how do you see the future looking?

Respondent: Future of energy means we're not having any other source other than solar. That's why we're focusing on solar. Now the limitation of penetration is 15 percent of the transformer capacity. It will be increased at least to 30 percent. If it is increased to 30 percent we could achieve this 1000 megawatt. Out of this maybe 300 megawatt on floating and balance from ground and 500 megawatt from rooftops.

Interviewer: And is storage a major concern?

Respondent: Storage [institution redacted] is going for a R&D project at Ramakalmedu, Idukki district. We've already started instead of solar power plants solar plant. And it will be a hybrid system with wind and storage of battery storage also will be proposed. Within three years we will be completing that project. This [name redacted] is planning for that, you can discuss with [name redacted] regarding this floating and hybrid system, not floating, hybrid system, the storage. He is in charge of that.

Interviewer: And you said 30 percent, is that 30 percent of all?

Respondent: Now 15 percent of the generated transformer capacity is allowed for penetration. It has to be raised at least to 30 percent for getting this achievement, to achieve this 1000 megawatt.

Interviewer: So it's 30 percent of all customers or 30 percent of all?

Respondent: 30 percent of the transformer capacity. Penetration allowed is 30 percent of the capacity.

Interviewer: Okay.

Respondent: And if you're coming with a smart grid and all more than 50 percent is not a problem. Already Germany and all proved this thing.

Interviewer: Right. And then so for the rooftop you said that – are there also battery cells connected to the rooftop or does it go straight to the grid?

Respondent: Regarding rooftops?

Interviewer: Yeah, for rooftops, do they just go into the grid like grid connected or do they go into batteries?

Respondent: Yeah, now onwards I think after 2015-16 most of the consumers are willing for this grid connected system only because maintaining battery is very difficult and also the life of the battery is maybe less than five years. That means the replacement cost of battery is very high and so the maintenance cost will be not affordable, will not be affordable. Because of that most of the people are going for grid connected only with net metering. But the stability of the grid is the problem, some of the places electricity is not stable and the fluctuation will be there and it is not continuously they're not getting the grid electricity. Some breakage of power is there.

Interviewer: Are there initiatives to help grid stability?

Respondent: Stability of the grid that upto 30 percent there is no problem, it can absorb. More than 30 percent there will be a problem of stability.

Interviewer: Okay, great. Thank you so much.

[0:20:55] End of Audio

Appendix C

Interview with Civil Servant 5 in Kerala, June 18, 2018

[0:00:00]

Respondent: What is your area of concentration, and are you concentrating on the implementation or you concentrate on the technology?

Interviewer: On the implementation. So I'm studying economics and environmental policy.

Respondent: So you want to hear my opinion, is it that?

Interviewer: Yes. To hear about the program and successes, difficulties.

Respondent: Now [institution redacted] and the government of Kerala, our government, state government is going in a big way to promote renewable power especially solar energy. The target is 1000 megawatt for the next three years. Add to the generation capacity 1000 megawatt within three years. Actually as per our experience of the previous years it is a very big effort. But as per the demand of the situation because of the importance of renewable energy and expansion of producing power from other sources not that much in our state solar is the true option we feel. The government also feel like that so we target to achieve this. It's a very big target I always said by getting maximum contribution from the public. We plan to install this 100 megawatt with the investment from the public, not government is investing. The solar energy is very suitable for distributed generation. So people who consume, the consumer can be a producer also. We promote that way. Each electricity consumer can become a electricity producer also. So the load on the distribution line also will become reduced considerably. So we plan very cautiously, creating awareness among the public, really large campaigns, campaign like through media, through multimedia we're using this TV, newspaper, print media, audio. All these mechanisms are being used to create necessary awareness among the public. And last year two three months before we have asked the media persons, the print media persons and the audio visual media persons to give proposals from their part how this massive awareness program can be done. We have invited their proposals. Some of the media persons gave good proposals. One among them is a road show which we started by next month in the middle of next month. And for doing this massive program we bring the NGOs, different residential associations. In our place we have residents associations, people in a locality form an association and like that thing is there. In our state there is these resident association can be a small NGO working like that.

[0:05:01]

Interviewer: Right.

Respondent: So these can – it's a means to go to the grassroot level, easy way to go to the grassroot level. NGOs are working among the people to propagate this idea of promoting renewable energy in a very good way, they can reach the grassroot level. And apart from giving a general awareness we focus our program on the high end consumers because when we invite investment we have to focus on the people who can invest. The common man may not be able to invest much. So we focus our programs on the high end consumers who are consuming nearly – our rooftop program is mainly aimed at the domestic consumers. In this 1000 megawatt target 500 megawatt is expected to be generated from the rooftop, top of the building. So our state doesn't have much open space barren land for installation of solar power plants. So we concentrate on the building tops, rooftops. So domestic sector can be a good contributor. In the domestic sector we concentrate on the high end consumers who consume about more than 10 units per day. And when we have gone through our study out of the total electricity consumers 5 percent of people come in this category. And we have made a simple calculation, 5 percent means about 1.5 lakh families out of the 1 crore total consumers in the electricity distribution licensee about 5 percent, that's 5 lakhs. Out of the 5 lakhs we can reach at least 1.5-2.5. If each beneficiary, each family can install a power plant of 2 kilowatt, 3 kilowatt our target will be easily achieved within one or two years. That is the focus of our campaign, all these campaigns.

Interviewer: And are there subsidies available, is there capacity to pay?

Respondent: I told you in this campaign we are focusing on the high end consumers, financially sound people. So they may not need subsidy. They need quality power, they need quality service, they need quality items. So subsidy is not a major factor and in this campaign we've not considered any subsidy. Subsidy may be given for the other 95 percent. For them subsidy incentive schemes can work. So through the print media we have initiated campaigns through the print media, there is one road show, there is one main newspaper, Malayala Manorama, they have promised to coordinate the program giving wide publicity through their newspaper.

Interviewer: What's the name of the newspaper again?

Respondent: Malayala Manorama. It is the first one in the number of circulation, first one in Malayalam. The second highest circulation daily Mathrubhumi, they also have given a proposal and we're next month simultaneously we're giving publicity through that media also. They will be giving a write up, articles, scientific articles in their special edition. They will give a four page pull out in the newspaper and give the technical details and experience of the eminent personalities who have installed this solar system. Like that write up will be given. And so in this way we're planning some national level seminars for these NGOs and resident associations.

[0:10:48]

Interviewer: And how much does it cost for a consumer to install the system?

Respondent: For installing a 1 kilowatt grid connected power plant the benchmark price is about 60,000 rupees, 1 kilowatt.

Interviewer: That’s without a battery?

Respondent: Yeah, we’re promoting mostly grid connected systems. The systems connected with the distribution lines. Battery storage system we’re doing that also wherever applicable, wherever the power failures is a problem for their operation. In that case we’re giving this battery operated systems also. The cost will be 1,35,000 for a 1 kilowatt system if it is battery storage.

Interviewer: How much, sorry?

Respondent: 1,35,000. But the battery operated system have some drawbacks like that when power is stored in battery and taken back there will be a loss of about 35-40 percent loss is there. And extra cost for battery and after 5-6 years we have to replace the battery, all those things are involved. So the best option is always the grid connected systems, battery storage is not that attractive costwise.

Interviewer: And are there issues with the reliability of grid connected electricity or is electricity through the grid very reliable. Is it reliable 24/7 access?

Respondent: The reliability of the distribution line, you mean?

Interviewer: Yeah, distribution of energy.

Respondent: Yeah, our distribution line is, we cannot say that it is very stable but when distributed and power is injected to the line the carrying load is reduced. When the power is generated at the user point the load of transmission, transmission load is reduced. So the line automatically will improve. But for this grid connected system as you have asked the stability is a problem. When the line is live then only the power can be injected, only when there is electricity in the line only at that time power can be injected.

Interviewer: And then also in terms of floating solar the floating solar on top of water, is that a viable option going forward too?

Respondent: Yeah, we’re trying that also. The rooftop out of the 1000 megawatt targeted 500 is set apart for the rooftop. The other 300 we expected to generate from the floating, from utilizing the surface of the water bodies. And we have done an experimental, not we, the KSEB electricity board has done an experimental project in Wynad district floating power plant of 500 kilowatt capacity.

Interviewer: I saw online that there’s one in West Kallada in Kollam district as well.

Respondent: No. We’re planning a power plant there in Kollam district.

Interviewer: So it hasn’t been installed?

Respondent: Not installed. In Kollam area there is a wasteland, actually it's a marshy land, almost flooded with water. There we're planning a floating solar power plant stage by stage, not investing it – first stage I think it is some 10 megawatt or something like that. And then it's a very vast area, we can generate more but investment is required. So this floating solar scenario is different, for the rooftop we attract investment from the common people. For the floating solar and the other big power plants investment has to be brought from the government or distribution licensee, electricity board or government. That is the difference. So that way also we're planning, we have enough water bodies, dams and other backwaters we have and all that we're studying the feasibility and in the other unused land though it is really small in area wherever there is free space we plan to install solar power plants like in the top of the canal, top of the bridges, top of the big playgrounds. The pavilion will be there, such areas are also being utilized.

[0:16:57]

Interviewer: And are there any projects for floating solar. Is there only one right now for the floating solar there's just only one project currently operating?

Respondent: Not one project.

Interviewer: Or how many projects, how many floating solar, do you know how many are currently operating?

Respondent: Floating solar projects it has not reached a stage where we can say the number. It is only on the initial stage. We propose 300 megawatt, out of that the Solar Energy Corporation it's a government organization created by ministry of New and Renewable Energy, government of India. They have given a proposal, two of our dams they have in their proposal they have mentioned three or four dams. If we utilize that it will be 100 megawatt. So the space availability is not at all a problem. The investment we have to find out. Water bodies are available, dams are available, technology is also available so investment is the next requirement.

Interviewer: And in terms of outreach to NGOs is that a lot of the business that you do for outreached NGOs, do they do a lot of the implementation or what's your relationship like with NGOs in Kerala?

Respondent: NGOs play an important role in creating awareness and attracting people to this area. NGOs role is only that much. Actually NGOs are not going to the implementation process.

Interviewer: Okay, got it.

Respondent: For the implementation we empanel manufacturers, we empanel system integrators and through them projects are being implemented. We insist on the IEC certification, we go for the IEC certification. Empanel the manufacturers and system integrators who have products which have confirmed to the IEC certification, IEC standards. So that way we ensure the quality of the products.

[0:20:00]

Interviewer: I also want to ask you about the hybrid systems, so like wind projects. What's the status of wind or hybrid?

Respondent: We just started only, started implementation of a hybrid project. In my home district Idukki we have a very windy area, Ramakalmedu which have shown the second highest wind speed in India. But the terrain is very uneven, hilly area. But still we have planned a 1 megawatt solar power plant, a 3 megawatt wind generator and almost 1 megawatt storage, battery storage. Because to make the supply of the renewable power even we suggest a storage also.

Interviewer: That goes back into the grid?

Respondent: Yeah, we'll be feeding to the grid. So the wind is mostly high in night time, solar is in the day time. So that phenomenon makes a little bit they're in some way complementary not fully.

Interviewer: Is that all together, solar together with the project.

Respondent: Yes, put together, all these sources are put together to get a steady power, steady output. Giving a steady output to the grid that is our aim. And there is another hybrid scheme because another hybrid scheme means in this rooftop plant itself we can give a provision for storage also. I told you this grid connected the rooftop solar power plant we are mainly concentrating on the grid connected system. That means without storage, there is no storage. The beneficiary gets power from the solar when there is solar, when there is no solar beneficiary can get the power from the grid. But during night time when there is say power failure the beneficiary will be in trouble, there is no solar, no grid. But the beneficiary has invested lot of money and installed a solar but in the night time when power from both the sources are not available it's a difficult situation. So we incorporate a small storage also, battery storage. So the inverter is a hybrid, we call it a hybrid inverter which can take power when there is no solar when there is no grid the inverter will take power from the battery only when the both of the source are not available. And that type of inverters are also called hybrid inverter. So we have included this year that type of grid connected systems in our scheme from this year onwards. Before that grid connected means there is no storage, storage means standalone, there is no grid and both are separate. This year we plan to combine this. If a hybrid inverter is used the inverter technology it is available, most of the manufacturers make this hybrid inverters.

Interviewer: And for the rooftop projects does ANERT subsidize, do they give any money for the initial capital, upfront can you say that consumers are willing to pay they're just 5 percent of customers are able to pay for the rooftop solar.

Respondent: For that 5 percent of customers there is no need of any subsidy but at present we're giving. Now we're giving subsidy about 30 percent, 30 percent subsidy we're giving for this rooftop power plant.

[0:25:26]

Interviewer: And do you need to have a certain income level to get the subsidy or what are the qualifications?

Respondent: No, no, no income barrier. Anybody who installs solar we give subsidy. There is a difference between the domestic sector and the commercial sector.

Interviewer: So is that just for domestic?

Respondent: Yeah. For domestic subsidy is available.

Interviewer: How about for commercial?

Respondent: Commercial profit making institutions doesn't have subsidy. NGOs, then the churches, like that, they can avail subsidy. This commercial sector we are not giving subsidy to the commercial sector.

Interviewer: And then so for the commercial sector are they also installing rooftop solar or do they just get it from the grid. How do they get electricity?

Respondent: Mostly they depend on the grid but there are many people are coming towards this solar because for the commercial sector the electricity charges are higher. So there is an economic advantage also. If the commercial sector come to the solar they have economical advantage. Now electricity board is charging about 8 rupees between 7-8 rupees per unit for commercial consumers. Our solar power when we calculate for 20 years life our solar power plant can give unit at the cost of 6 rupees. Domestic sector it is subsidized, the electricity is subsidized, government is giving subsidy to the domestic sector and charging more on the commercial sector. So if the commercial people install solar power they have an advantage.

Interviewer: Correct. They can pay for it.

Respondent: On the economic times there are the advantage.

Interviewer: And then what's kind of been the biggest success so far of your time here. What has been the most successful project would you say?

Respondent: Lot of – in Kerala we have now already installed 100 megawatt solar power plant is there. Our Cochin International Airport has installed a 25 kilowatt system and they're now working to add 15 kilowatt so they say that their full power requirement is met. And as such the international airport Cochin is a green airport, yeah, they're producing more energy than their requirement now from the solar. There they have connection to the distribution line. The excess power is given to the line and during night time they take from the line. In night time there is no solar so they take. But their total consumption, daily consumption or monthly consumption they produce more than their total consumption. And the net is they're giving power, that is the net result. And there are many hotels, many restaurants in Kumili, Thekady there are restaurants running fully on solar power. There are many consumers especially hospitals.

[0:30:27]

Interviewer: And is the main benefit reliable electricity in terms of why hotels would invest in rooftop solar?

Respondent: Reliability when connected with the grid the reliability becomes the same as what they get from the grid. So reliability can be increased only by storage but for large scale power plant the storage is not a good option. So reliability is not that much a factor but the cost is a factor. And green commitment, they're business people they have a commitment towards green, so green commitment is another factor. Cost is a factor. The hospitals, many of the hospitals do power plants, solar power plants.

Interviewer: For reliability or for to make sure that there's no load shedding?

Respondent: Not fully for the reliability. They have economic advantage.

Interviewer: Is it all pay back soon into the payback or what type of economic advantage.

Respondent: Five years we can say. The investment will be paid back within 5 years, 5-6 years as per the electricity tariff prevailing in our state a solar power plant can have a 5 year 6 year payback.

Interviewer: And our last question, has rural electrification a 100 percent electrified affected your operations at all?

Respondent: Yeah, we have achieved 100 percent electrification.

Interviewer: Right. How has that factored into the future of electricity here?

Respondent: That will increase the consumption, surely that will increase the consumption. But it is the responsibility of the state to give power to all, that's a responsibility. So the state government have initiated steps to bring power to all houses. And there was some difficulty in some areas, in some remote areas in our hilly region, our Eastern region is hilly mountainous forest region mostly especially Trivandrum district, then almost all district have some Eastern regions that are hilly forest area. In those places there are tribal people living kilometers inside the forest. In that places it is not possible to draw the distribution line and give power. There Anert have given power using solar energy. We have given almost 2500 houses, we have electrified almost 2500 houses in the state. You are a student or what is your area?

Interviewer: Yes, university student.

Respondent: What is your course?

Interviewer: Economics and environmental policy.

Respondent: You're graduate, post graduate?

Interviewer: Undergraduate.

Respondent: So in remote places where there is no electricity we have – that have changed a lot the lifestyle of the people in remote places. They're using kerosene lamps, candles. When they get this electric power they can operate their radio, they can operate television, it's an opening to the world for them. Getting power is an opening to the world. And there also we have tried different systems because it's a domestic home lighting system. That is each house will be getting a solar system panel, light unit and a power plug for operating their equipments and the storage. It's a home lighting system. Panel, battery, and the luminary and a power output point. And each house it will be installed in each house, so one system in each house and next house another system. And we have tried in another colony a micro grid. We have installed all the solar panels in one point and a storage battery in a battery house and distribution. And distribution lines were drawn to the all houses here and distribution we have given the street lights and lights to all houses. We have tried a micro grid. And we have tried a model like that also. And they have battery backup and they also have a small generator also if both the battery inverter everything goes they can use the diesel generator. So power is assured for 365 days. That system we have done as a model in Idukki district.

Interviewer: And how big is the micro grid, how many households?

Respondent: 20 houses.

Interviewer: That's in the rural hilly areas?

Respondent: It is in the hilly area inside the forest for tribal people, 20 tribal houses.

Interviewer: So how many micro grids have there been so far?

Respondent: Micro grid we have done only one.

Interviewer: Do you expect to expand to more micro grids or should one be sufficient?

Respondent: But micro grid is costlier than the distributed system so for experimental purpose for studying the inverter, the performance of the power conditioning unit actually for that study we have installed that system. It will automatically switch over to the generator batter, solar and the study of the performance was done.

Interviewer: And then last question for floating solar have you heard of the West Kallada, Non Conventional Energy Promote Private Limited.

Respondent: I haven't heard.

Interviewer: It's like a local organization in West Kallada. It's run by the panchayat in Kollam.

Respondent: Yeah, West Kallada I have heard. I have gone for their meeting also.

Interviewer: When is that expected to be completed?

Respondent: Actually the implementing agency is the NHPC, National Hydro Electric Power Corporation, government of India. They have given the project report and they are the implementing agency. In that the beneficiaries have formed a company for buying this power and distribution and distributing it to the beneficiaries. They have formed a company registration, all those things are on the way I think, not completed. I think within one year it will be through.

Interviewer: Because I was thinking of traveling there on Wednesday but do you think it would be useful to travel there for a field visit?

Respondent: But you will not be able to see anything on the field now.

Interviewer: But nothing will be completed yet.

[0:40:12]

Respondent: In the field nothing has gone to the field. They have identified the area, project they have prepared and others they haven't gone for implementation.

Interviewer: Is there anyone I can talk to potentially if I went there was there anyone who I could talk to about the future of the project?

Respondent: You want to talk to?

Interviewer: Yeah, is it possible?

Respondent: To any person?

Interviewer: Any person there who might be knowledgeable of the project.

Respondent: I will suggest that and the local panchayat is initiating this project, you can very well go to the panchayat and meet the panchayat secretary. He's a very good person, he's well involved in this project. The panchayat secretary will be – so that you'll get a local information than talking to any people here. You can go to the panchayat and talk to the secretary. And how they have organized the local company, all those things you will get from him.

Interviewer: Do you know if he speaks English?

Respondent: She will collect the phone number of this panchayat secretary, it is easy. How they plan to divide the – that's an area of interest for you, that will be an area of interest for you.

Interviewer: Exactly.

Respondent: How they divide the revenue from this project, that is a problem now they are dealing with. They're making it share and they're thinking of equally – so the water body is a very vast area. And the owners are so many people, 60, 70, or 100, so many people are the owners. Now they're doing the plant only in a certain area, say 10 megawatt, it will consume only less than one fourth of the area. So the revenue from this how do we divide it to the all people or issues like that is there.

Interviewer: Very unconventional, and not many projects like that in the area.

Respondent: So it's interesting how they've formed the society, how they formed the company and how they're going to divide this revenue and what is their expectation, things like that it will be interesting for you I think. So meet the local people.

Interviewer: And do you know if they speak English?

Respondent: The secretary will speak English.

Interviewer: Good. Anyone else you would suggest to talk to for the project?

Respondent: This NHPC I told. It's a government of India enterprise.

Interviewer: Is it located in Trivandrum.

Respondent: We have a office here in our building. You can talk to Walter. He can give you the details of the project, technical details, he's a technical man. He will give the technical details of the project.

Interviewer: Perfect. Thank you so much. I don't want to take any more of your time. You've been so generous with your time.

Respondent: Okay, thank you.

[0:44:20] End of Audio

Appendix D

Interview with Civil Servant 6, June 18, 2018

[0:00:00]

Interviewer: Yes. I just wanted to hear about your projects, what have been success stories?

Respondent: Remote electrification? Actually he was handling one remote. One thing [name redacted] missed mentioning was the remote village electrification. Kerala has very few unelectrified households, only a few remote areas like Edamalakudy and all. In some of these places last year we did it through using solar, electrification using solar. Joseph was handling that and especially in Idukki, Palakad, Wyanad, some remote districts on the Western Ghats hilly region. Mostly they're forest covered land and all that. Tribal people they did not have any electricity connection unlike India where a village is considered electrified if you have at least one household electrified here we're aiming at 100 percent electrification of houses. So almost we have been able to cover and some of them through solar. Then another area we're taking up a hybrid project again in Idukki district in the first we had some government land. It's one of the windiest locations in South India but we've not been able to install any wind turbines so far in the last 10-15 years we have not been able to install mainly because of the difficult terrain. It's very hilly and so you cannot take these huge wind machines with their long blades and all that, 50 meter blades and all that you cannot take it there. On the way there is lot of private land, they also do not allow – the roads are very small and it's very curved roads and all that. It's not a straight road so it's very difficult to take equipment there so that's why wind had not happened so far. So we decided to have wind and solar interlinked in between we'll have solar and wind in the same area avoiding the shadows and all that, shadows of the wind mill should not fall on the solar panel like that we'll design and put up. That's what we decided last year and we've just started the work of 1 megawatt solar power plant in that hilly region. So after this 1 megawatt we'll have a few small wind machines. Now they're not readily available, small wind machines, only very small in the range of kilowatt is available but you don't have machines in the range of hundreds of kilowatt, 250 kilowatt, 500 kilowatt. Such machines are now almost unavailable. So we're trying to source some such machines because only that can be taken to these regions. Otherwise you'll have to airlift it through helicopter or something like that and that will not be very much feasible. So these are some of the things we're taking up. Another thing is it may not be very innovative elsewhere but here we don't have such a thing, we have electronic marketplace also for renewable energy devices not just solar. For bio gas, water heaters, everything. An online marketplace we have put up just getting some orders. First orders are just being processed, that is another thing which we've taken up. And everything we're going to have in a paperless mode, everything electronic. Internally also we have all paperless, our approvals everything are in electronic file management. So all these external interfaces also now we're going to make it electronic. So these are some of the things. Then we also handle, ANERT handles the renewable energy certification and renewable purchase obligation, RPO and REC things also are handled by ANERT for Kerala. So the regulatory commission fixes and monitors the renewable purchase obligation. So three kinds of entities are now obligated in Kerala. One is the distribution licensee, electricity distribution licensee. That is we have about ten because you know about the KSEB the state utility is there. Then other small regional another nine or ten utilities are also there. Just looking for some area or within one industrial area there is a distribution licensee. They buy power from KSEB and then supply but still they're the distributor. So they are supposed to meet about 7.5 percent of their total electricity needs from renewable. And part of it should be solar, 2.5 percent should be solar, 5 percent should be non solar, it can be any, solar or non solar. So you know about RPO.

[0:05:31]

Interviewer: Right.

Respondent: So that is one kind of entity. Another is the open access consumers. Any entities having large power consumption like megawatt scale consumption factories and entities like that if they buy power from outside the state using the transmission network they're called open access consumers. So such consumers are also supposed to meet the same percentage of power they get through open access only that percentage of that power, same 7.5 percent of that power they have to meet from renewable. So that is the second type of entity. Third type is captive generators having 1 megawatt or higher capacity. Then they may have diesel generators or they may even have solar power plants. So whatever kind of self generation they have the percentage of self generation same percentage, 7.5 percentage of the self generation should be renewable. So if it is a solar power plant obviously they will qualify, 100 percent they will meet the requirement, obligation. If it is a diesel generator they will have to have some other – they need to have some other mechanism to have the percentage of solar or whatever renewable energy. Then the other thing is the renewable energy certificate is a national level mechanism so these obligated entities can compensate or meet their power renewable requirements by purchasing renewable energy certificates. And who gets these certificates is who is – generators of the certificates are renewable energy generators who have not any special benefits. They have set up their power plants without availing any special benefits. Earlier even captive generators could have this kind of certificate now it is only some special they don't enjoy banking. Banking means for example solar, you generate power during the daytime and export it to the utility. So utility banks it, they're not going to use it, they use it later on. So that is called banking of power. So such facility should not be availed by these generators, then they're eligible for getting renewable energy certificates, 1 megawatt hour of electricity generated is 1000 units, 1000 KWH. So for each 1 megawatt tower you get a certificate which can be sold in power exchanges. You know about power exchanges where electricity trading happens, day to day trading is there. Along with that electricity trading you can sell renewable energy certificates also. Who need it they can bid for the certificates and buy it, solar and non solar you have benchmarked prices base like that. They can operate within the range specified by the Central Electricity Regulatory Commission. So that if any agency or entity in any generator in Kerala has to get accredited for REC they've to apply to ANERT. So ANERT approves that, only if ANERT approves them they become eligible for RECs. And then they can sell it to RPO entities or any other entities who want to procure certificates. So these are some of the functions handled by ANERT.

Interviewer: And then how about for thermal plants and diesel power plants?

Respondent: Diesel and thermal power plants there are power plants, they're also obligated entities. If they sell to distribution – no, as a generator they are not obligated. And these three kind of entities if this diesel or thermal power plant is part of a consumer. For example here Cochin Refinery they're a big consumer, they have a big diesel power plant. Then they become obligated but if it is an independent power producer they're not obligated.

Interviewer: Okay.

Respondent: IPP is not obligated. Is that what you meant?

Interviewer: Yes, exactly. So if it's only generating?

[0:10:00]

Respondent: Yes, they're just generating and selling. So they're not obligated, only consumers are obligated.

Interviewer: Got it. And then for the how do you see the future of thermal and diesel as opposed to renewable energy in Kerala?

Respondent: I feel one problem we can say about renewable is you cannot exactly predict it's operation. You can predict it but still you cannot control it's generation. So just now half an hour back you had good sunlight now it has come down. So solar generation will come down. So at such times you can schedule it, there is now scheduling mechanism. Unless there is very cheap storage of electricity like very good batteries at lower cost and lower lifecycle costs I would say. So unless there is economical electricity storage solutions such thermal power plants may be especially gas stations may be required to quickly compensate for this loss of generation, this kind of loss of generation in winter. But Kerala currently as far as I know we don't have a plan to use these. There are many standard stations actually which thermal power plants which are not in operation at all.

Interviewer: And why is that?

Respondent: So Kerala currently doesn't have a plan to how to use these standard gas stations to compensate for renewable when the renewable penetration becomes high. Right now we limited it to something like a 15 percent and it will be something, the capacity wise it will be maybe less than 5 percent right now, not even 5 percent. I think it will be something like 1 percent or even lower. I think the total installed capacity of solar here is only around 130 megawatt or something out of the 3000 so it will be something like 0.5 percent. So when it reaches maybe 30, 40 or 50 percent Kerala will need to have a plan to how to use these gas stations to manage the grid in a better way. So that way it will be relevant.

Interviewer: And you said that there are thermal plants aren't completely used?

Respondent: No, at that time it may be used. Right now almost nothing is used, they're standard.

Interviewer: Why, just normal, no operation.

Respondent: Because it is costlier, the power from those stations are costlier so the utility doesn't feel obligated to buy it from them because they get much cheaper power from outside the state. Still it is thermal station but Kerala has diesel or gas, these are costly. What the utility buys from outside the state North India they're coal based stations. So it's much cheaper. Kerala doesn't have any coal based stations.

Interviewer: And why is it so much cheaper, just because it's --

Respondent: Because coal is cheap in India maybe because you don't consider the environmental costs of coal so that's why. The pollution effects during generation, during mining. None of these pollution or environmental aspects are considered in the cost. So just when you say the absolute cost of power it is cheap. Four rupees you get it means it's cheap. But we're adding lot of pollution where it is generated, where it is mined so nobody is considering that. The utility needed concern about that, that is their attitude.

Interviewer: Are there any efforts to maybe change that to have for either the state or the central government to mandate?

Respondent: Because central government will have to do something about it, I don't think state can do anything about it because it is a natural bidding kind of solution, whoever bids offers to sell cheap power they get offers. Nobody is worried about the total costs.

Interviewer: Yeah, perfect. These were all the question I had. Thank you so much for taking the time to speak with me.

Respondent: I just mentioned, we'll have a storage also integrated with that solar and wind. I said in between we'll have solar and wind. Along with that we're trying out some storage because world over some small grid level storage solutions are coming up. We also want to have some expertise on that. again it's not a very economical solution right now but we're trying for that.

Interviewer: And then for the micro grid project you said in the hills are you trying to scale that, have more, or is it just a pilot project for now?

[0:15:39]

Respondent: No, the thing is you see Kerala has very few unelectrified areas. So wherever it is there we will try for that micro grid project. And another thing we're thinking of, we're in discussion with some agencies this micro grid whether we can use that to support some tail end grids. Some grids where it is long distance away from the transformers or from the transmission grid. So there the problems in voltage, outages and all that. So whether we can have micro grids to support such things instead of strengthening the grid over some maybe 10-20 kilometers you need to increase the voltage levels, install a transformer for a small community. Instead of that we'll have electric power plus we'll have a micro grid locally, solar based micro grid, it will be interconnected, it will have some small storage, even some small diesel generator so that it'll be economical compared to expanding the grid or strengthening the grid.

Interviewer: Right. So it'll be a hybrid ***[0:16:48] [Inaudible]*** conventional grids.

Respondent: Linked to the conventional grid systems.

Interviewer: And then they could sell back electricity for net metering.

Respondent: Yes. Everything. So we're trying to have a pilot, we had one discussion, we'll need to take it forward. We may even get some government of India funding for such projects. So that's what we're thinking.

Interviewer: Will that be from MNRE?

Respondent: No. Even we can get funding from DST, Department of Science and Technology or even Department of Electronics they have some power electronics funding projects. Even all these are possible, even MNRE may do that but it'll be more supported maybe DST and the ET may be more interested in such projects.

Interviewer: And has the current Modi government been supportive of rural electrification and renewable energy more so than Singh, the previous Prime Minister or how is the current government done do you think in terms of renewable energy.

Respondent: This total electrification project was started by the previous government so they completed it, the current government. But still unlike Kerala there it is not total electrification in the sense of total electrification of households. It is only total electrification of villages. One connection per village is making the village electrified. So that definition is different for Kerala and the whole India.

Interviewer: And why is that, did Kerala just want to have completely electrified villages and households?

Respondent: We reached total electrification of villages long back, maybe I think ten years back. So this total electrification of households started some ten years back in Kerala. In many ways Kerala is different in the social and other indicator aspects you may be aware of that.

Interviewer: Right. Exactly. And you think that's really why it's had a such a strong push for electrification?

Respondent: Surely. Because the social factors also affected that because there is demand for electrification from the people so that way it's not just the government pushing it. people are also demanding electrification so that way it is very useful. In other places mostly electricity is considered important for pumping, water pumping for agriculture and things like that. Here it is actually a social aspect.

Interviewer: Are they also demanding renewable energy as opposed to nuclear and coal?

Respondent: Here there is lot of opposition, I don't know how much knowledgeable they are in opposing it but still there is lot of opposition in all environmental damaging projects there is severe opposition in Kerala.

Interviewer: Opposition against renewable energy?

Respondent: Not against renewable energy, environmentally damaging projects.

Interviewer: Oh, got it. So like nuclear power.

Respondent: They're favoring renewable energy but considering the cost and all not all the people are ready to install it but still now once it has become very economical many people are already – even without subsidy they're installing it. Even if it is not economical they're installing it.

[0:20:50] End of Audio

Appendix E

Interview with Journalist in Kerala, June 19, 2018

[0:00:00]

Respondent: Yeah, hydro electric power would be primarily used to depend on, Kerala used to depend on and now there is a quantum shift towards renewable energy because electricity corporation and the power department they have started focusing more on renewable energy and I think more measures for solar, wind, those kind of initiatives are coming up and the new electricity policy, the new power policy of the state government, the Left government in Kerala focuses majorly on renewable energy. That's a major shift from the traditional sources to the new one. Generally we used to depend on hydro electric power and that too small projects not the bigger ones but now the Left government has got a priority according to which I think by the end of this government that means by the end of 2021 they are aiming to have one million units of power to be generated in Kerala. I think one million is the exact number, that I need to check, I'll check with my colleague and I'll get back to you. Yeah, that's it. Power has always been a major issue particularly because Kerala is a small state we have got lot of rivers and all and like you said we are environment conservant and environment awareness is a bit higher here. So people are now looking towards renewable energy and Anert has been promoting wind energy, solar.

Interviewer: Has the new Left government decided to have new policies because of the people or why do you think that is the main motivation of the new government.

Respondent: The new government right from its beginning they have got an election manifesto and in the election manifesto they have clearly mentioned about their new power policy and the chief minister he was the power minister in 1996 and he has got very clear vision about energy sector. I think maybe because of that they are focusing more on the energy sector and there are multiple factors like they have got a vision about the sector and environmental concerns are there. Obviously people have started thinking about the new renewable sources and solar and wind gradually it's catching up. All this together they have come out with a policy. And in every sector they used to come up with their policy and power sector also there is a new policy that was placed about two weeks ago I think.

Interviewer: And would that be found online?

Respondent: I think that it'll be online. Otherwise my colleague can give you more details about the policy.

Interviewer: And how about the interaction with the central government. It sounds like Modi's government has been pushing renewable energy, there've been debates on whether or not that's a genuine push. What's the interaction between like Kerala state government with electrification and renewable energy and the Central government?

Respondent: That specific sector I don't know about the interaction part but I think Kerala has been getting particular share of energy from the central pool. Has been getting, about the exact quantity and whether there is an increase or decrease that again like I said my energy expert will be able to tell you. These are only general I will give.

Interviewer: Any other kind of big trends that you see, like people's response to energy.

Respondent: Yeah, people's response I think there is a very positive response from people like earlier they were not much awareness about solar energy, nowadays many apartments, many individuals are coming forward to try this new area like solar panels has become very common and we have got an airport in Kochi CIAL, Cochin International Airport and that has got -- its self sufficient in energy sector. It's completely dependent on solar. I think that could be one of the first such initiative anywhere in the country. CIAL's solar model has been widely accepted and the government is gradually moving towards getting people to think about self sufficiency in energy sector.

[0:05:05]

Interviewer: And how about kind of Kerala's development strategies is very unique as opposed to other states in India and how has that impacted it?

Respondent: As far as development is concerned Kerala has got its own development vision like the focus we have got a two pronged approach like we focus on the welfare sector and at the same time development also. Development should not be at the cost of environment, that is the general thinking pattern for whether it is the UDF government or LDF government. UDF is the government led by Congress and LDF is the current government led by the CPM, Communist Party of India, Marxist. I think both of them agree with the fact that development should not be at the cost of environment. So whenever there is a development initiative that goes drastically against environment there are concerns and the concerns will be well reflected. You can search for Athirapally project, Athirapally is a hydro electric project, it's a proposed project which was supposed to be a mega hydro electric project and there are stiff opposition from both the environmentalists and a section of people including politicians against the project. And at the same time there are people including those from government who think that the project has to be implemented, this Athirapally project. Similarly there were earlier the Silent Valley project. I don't know whether you're aware of Silent Valley, that's a national park in Palakad. Way back, that means in 1970s when there was an attempt to build a reservoir there there was stiff opposition and the then Prime Minister Indira Gandhi decided that there won't be any hydro electric power. Instead it has been declared as a national park, Silent Valley National Park. And same way there is opposition against this Athirapally also and Athirapally though the previous government and the current government they haven't decided or declared that they will give up the project but it's almost going in such a way that government does not want to do something that will affect the environment, that will be adverse to the environment. We're not going back on our developmental initiatives but at the same time I don't think development should be at the cost of environment. It should go hand in hand. There should be a proper balance and I think the government has been looking for that kind of balance between environment and development. And whenever there is a big ticket project like we have got this Vizhinjam Sea Port coming up and whenever there are such projects we ensure that there is something else done to compensate.

Interviewer: Like in terms of like environmental impact statements?

Respondent: Yeah, EIS are always there, environment impact studies are being carried out and only based on the studies clearances are issued and whenever there is a clearance issued we double check and we have got proper NGOs dealing with environment and we have got a Kerala state environment impact assessment authority which will look into all these aspects. Only if the environmental impact is minimal clearance will be issued. And of course I think you must be knowing that the Supreme Court has got a green bench which deals with all these environment related issues. And the green bench has got the bench sitting in Chennai, Chennai is the green bench at Supreme Court and green bench deals with all the cases related to environment and in general Kerala government has been taking a pro development and the same time a view that won't affect the environment. It's a balance between environment and development.

Interviewer: And who are the major NGO leaders?

Respondent: As far as Athirapally is concerned there is an NGO called River Protection Forum. River Protection Forum has been actively campaigning against the project for quite a long time and even now they're doing it. It was headed by Professor A Latha. She passed away just a couple of months ago, she was a nice individual. And there are a couple of NGOs like One Earth is there, that's an environmental NGO. There are a few and there are individuals also who take the environmental issue like there is Professor Vijayan he was heading the Kerala Biodiversity Board.

[0:10:10]

Interviewer: And then in terms of thermal plants I don't know if you know much about thermal plants.

Respondent: We have got a thermal plant in Kayamkulam, I think it has not reached it's optimal capacity till now, it's still in the processing stage. Again I would suggest you check with my colleague, he'll be able to give you more details about the thermal plant.

Interviewer: And I won't take up too much of your time. So I only have like one or two more questions left. But and I also want to ***[0:10:50] [Inaudible]*** nuclear and opposition nuclear, is that a popular assessment in Kerala?

Respondent: Like you said earlier there is no total resentment against nuclear but at the same time if it comes next door there'll be concern.

Interviewer: Why?

Respondent: Like the one in Koodamkulam, you'll have concerns but then not a complete no, no against nuclear project. That's my personal opinion.

Interviewer: Yeah. And in terms of the national government have you seen much of a difference in terms of Modi's current government and the BJP taking over the developmental strategies at first the previous ***[0:11:40] [Inaudible]*** previous administrations.

Respondent: See there are lot of developmental initiatives happening. At the same time developmental perspectives are different whether it is about the Modi government or the Left government in Kerala they have got different perspectives. And Kerala has always maintained its own character, its own different way of developmental approach which is kind of different from the entire country.

Interviewer: In terms of its own character say for education what type of unique development strategies does Kerala do would you say?

Respondent: Like I said instead of focusing fully on big ticket projects we go lot of small project, small initiatives whether it is about empowering people, we have got this micro finance initiatives, we have got this women's self help groups like Kudumbashree and all. We have got smaller initiatives which are the neighborhood area which can be implemented fast which have got a direct people connect instead of going for big ticket policies Kerala in general look for this kind of initiatives. But at the same time we do have major projects like the Kannur airport is coming up. We have this Vizhinjam seaport is coming up and the Kochi Metro Rail has already been commissioned last year. And Trivandrum Kozhikode Light Metro Projects are in the pipeline. So big ticket projects are there but at the same time – and we have got this coastal highway and hill highway projects in the pipeline. And laying of Gail pipeline is coming up, that's for the gasification project, a complete LPG-CNG connect. That project is also in the pipeline. So big ticket projects are there but at the same time to empower people I think small initiatives are being given more focus.

Interviewer: And do you think LPG is a popular project or is there any opposition to the LPG connect project?

Respondent: There is no opposition to LPG as such but when there is laying of this pipeline there are concerns not only about security concerns about whether they'll be able to use the land where the pipeline is being laid and the government is giving compensation to the land because they cannot go for any kind of constructions in that land like you must be knowing. So the government will be giving compensation or rather the issue related compensation is currently being negotiated and the Left government was able to address the issue to a great extent. We are moving forward.

Interviewer: And where is the proposed pipeline supposed to be?

Respondent: It's from Mangalore to Kochi.

Interviewer: And that would be to supply LPG to a thermal power plant?

Respondent: And there is one city gas project also that will be kind of to distribute piped gas to all households in the city.

[0:15:19]

Interviewer: And then that will kind of address the under capacity in the generation.

Respondent: And the distribution has to also be addressed like you don't have to carry it through road.

Interviewer: And then our last question about rural electrification, Kerala's very need to have so many people connect to the grid and having electricity access?

Respondent: No, Kerala has already declared itself as a total electrified state.

Interviewer: Exactly.

Respondent: Total electrification is already there so I don't think rural electrification as such is a major issue because in Kerala even in rural areas it's kind of having an urban connect. So there is no clear cut differentiation between urban and rural areas since almost all these areas are developed there is rural electrification is kind of a concept only.

Interviewer: And so do you think other states could learn from Kerala or do you think --?

Respondent: Yes, I think they have been learning from Kerala.

Interviewer: Do you think Kerala's success has been because of its unique topography and unique kind of population.

Respondent: Like multiple factors its unique topography is always there and people are more educated and broad minded, literate and they go out. I think you can find more Keralites outside Kerala than in Kerala.

Interviewer: Right, yeah.

Respondent: And we always joke that whenever even if you go to the moon there will be a Malayalee with a tea shop there.

Interviewer: Right, right.

Respondent: So people do go out and they have got this global view, that could be one thing.

Interviewer: I understand that a lot of Kerala people go to the Middle East to work and then send money back – this is a common thing in Kerala.

Respondent: Yeah, there was a Gulf boom in the end of 1970s-80s and all and there were lot of people going to Middle East. But I think nowadays that Gulf boom is not there because people are going everywhere. And obviously NRK returns are a major source of revenue for the state and now Kerala last January means this January the state government organized a Loka Kerala Sabha, that's a world global forum of Keralites, means people across the globe are representatives from there came to Kerala and it was a three day function. Now there are lot of new initiatives coming up. In fact yesterday the KSFE, Kerala State Financial Enterprises launched a Pravasi Chit Scheme. Pravasi means overseas Indians, for NRKs it's an investment scheme only for the NRKs. So there are lot of initiatives coming for them and they can invest money here and after ten or fifteen years when they come back they can get either a job or returns from the investment. There are lot of new initiatives specifically aimed at them.

Interviewer: Interesting. Yeah, so I don't want to take up too much of your time. Those are all the questions I have. Anything – you said that your colleague might be free though today?

Respondent: Yeah, let me call him once again. I think as far as energy is concerned it's better you speak to him. I used to cover energy long back but nowadays I have lost touch. Can I have your card or something.

[0:24:56] End of Audio

Appendix F

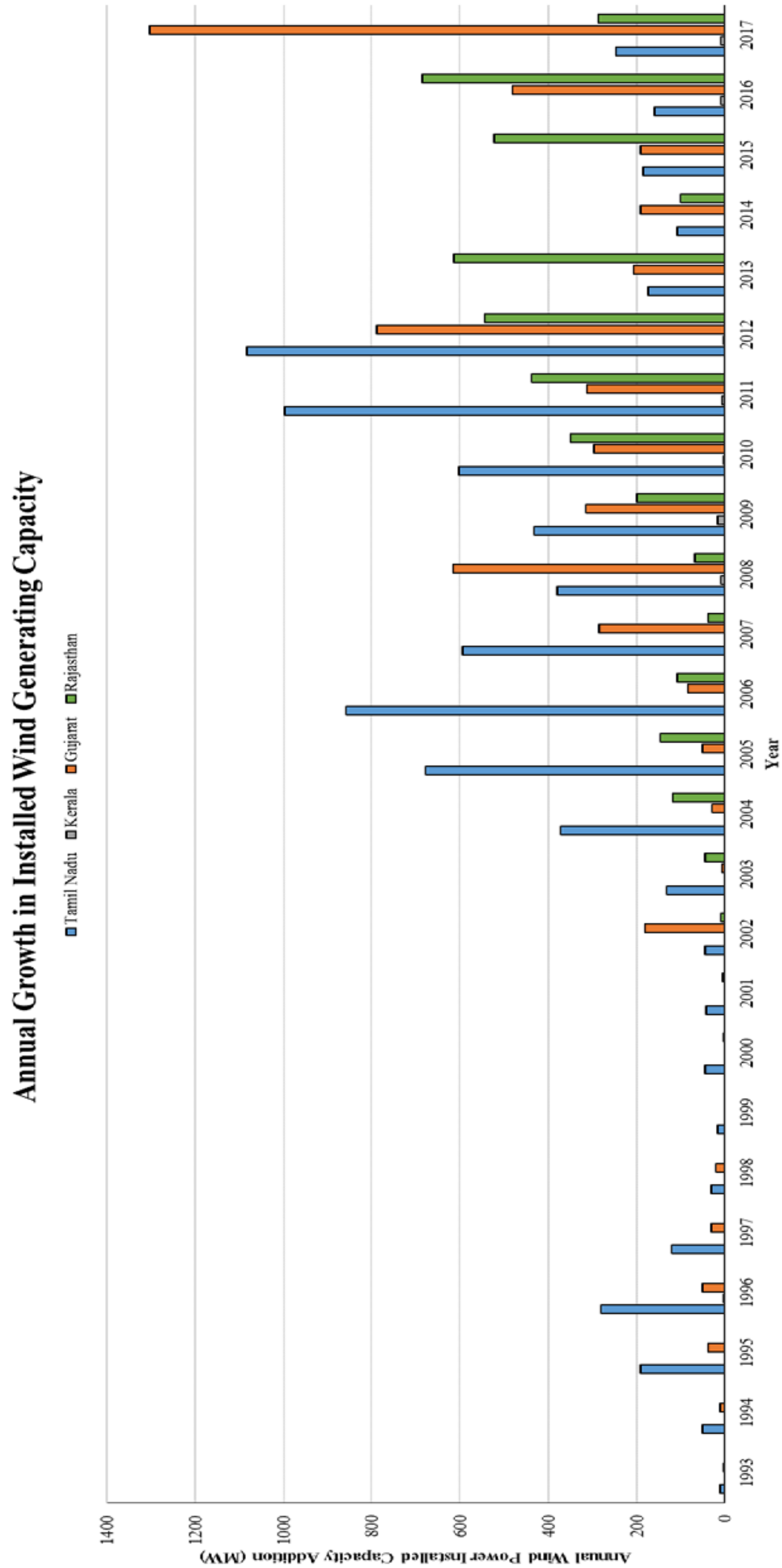

Figure 12. Annual Growth in Installed Wind Generating Capacity by State (MoSPI 2007-2018; Sinha and Ramana 1995).

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