EVIDENCE REPORT
No 104

Policy Anticipation, Response and Evaluation

The Political Economy of Low-carbon Investments: Insights from the Wind and Solar Power Sectors in India

Chetan Krishna, Ambuj D. Sagar and Stephen Spratt

January 2015

The IDS programme on Strengthening Evidence-based Policy works across seven key themes. Each theme works with partner institutions to co-construct policy-relevant knowledge and engage in policy-influencing processes. This material has been developed under the Policy Anticipation, Response and Evaluation theme.

The material has been funded by UK aid from the UK Government, however the views expressed do not necessarily reflect the UK Government's official policies.

AG Level 2 Output ID: 546

THE POLITICAL ECONOMY OF LOW-CARBON INVESTMENTS: INSIGHTS FROM THE WIND AND SOLAR POWER SECTORS IN INDIA

Chetan Krishna,[a] Ambuj D. Sagar[a] and Stephen Spratt[b]
[a] Indian Institute of Technology, New Delhi, India
[b] Institute of Development Studies, Brighton, United Kingdom

January 2015

First published by the Institute of Development Studies in January 2015

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Abbreviations

ADB	Asian Development Bank
AF	asset finance
AIM	Alternative Investment Market
BNEF	Bloomberg New Energy Finance
CAI	country attractiveness indices
CDC	Commonwealth Development Corporation
CEEW	Council on Energy, Environment and Water
CLP	China Light & Power
CPV	concentrated photovoltaic
CSE	Centre for Science and Environment
CSP	concentrated solar power
c-Si	crystalline silicon
EPC	engineering, procurement and construction
Exim	Export-Import
FIT	feed-in tariff
GBI	generation-based incentive
GIS	geographic information system
GmbH	Gesellschaft mit beschränkter Haftung [company with limited liability]
GUVNL	Gujarat Urja Vikas Nigam Ltd
GW	gigawatt
GWEC	Global Wind Energy Council
IDFC	Infrastructure Development Finance Company
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
IPP	independent power producer
IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
IRR	internal rate of return
IT	information technology
IWTMA	Indian Wind Turbine Manufacturers Association
kW	kilowatt
kWh	kilowatt hour
LLP	limited liability partnership
M&A	mergers and acquisitions
MNRE	Ministry of New and Renewable Energy
MW	megawatt
NAPCC	*National Action Plan on Climate Change*
NEG	Nordtank Energy Group
NEPC	Natural Energy Processing Company
NGO	non-governmental organisation
NRDC	Natural Resources Defense Council
NSM	National Solar Mission
NTPC	National Thermal Power Corporation Ltd
NVVN	NTPC Vidyut Vyapar Nigam Ltd
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares
PCG	partial credit guarantee
PE	private equity
PPA	power purchase agreements
PV	photovoltaic
PwC	PricewaterhouseCoopers

R&D	research and development
REC	renewable energy certificate
RPO	recovery point objective
RVPN	Rajasthan Rajya Vidyut Prasaran Nigam Limited
SBI	State Bank of India
SCB	scheduled commercial bank
TN	Tamil Nadu
TW	terawatt
UNEP	United Nations Environment Programme
US	United States
VC	venture capital

1 Introduction

The primary motivation behind this research is the need to accelerate the supply of renewable energy because of the important role that it plays in mitigating climate change and in fostering sustainable development.

Understanding past drivers for low-carbon investment can help us identify those for the future, and what could accelerate such investment. Investment in renewable energy can be modelled as a problem of technical asset allocation or optimisation at the firm or sectoral level, but is not entirely explained by this approach – the context in which actors are involved, their motivations and the wider systems in which they operate must also be taken into account. The interactions between actors may sometimes accelerate investment and sometimes prevent it; however, understanding the dynamics of these processes is crucial if we are to shape them. This study, which focuses on the wind and solar power sectors in India and China, aims to find and compare drivers for investment in renewable energy.

Why China and India? Firstly, China and India are now among the world's highest emitters of carbon (although India emits far less than China and the United States (US), Olivier *et al*. 2013), and most of their emissions come from the power sector which is heavily reliant on thermal power generation for energy (for India's case, see Planning Commission 2012). According to the International Energy Agency's (IEA's) World Energy Outlook 2011 (IEA 2011), India's energy demand is set to increase by a compound annual growth rate of 3.1 per cent from 2009 to 2035 (which is more than double the world's energy demand growth at a compound annual growth rate of 1.3 per cent for the same period). The IEA predicts that India's share of world energy demand will increase from 5.5 per cent in 2009 to 8.6 per cent in 2035. Indeed, in 2012/13, 90 per cent of the growth in energy demand came from emerging economies, led by India and China (IEA 2013). Thus, any significant shift and low-carbon intervention undertaken by these countries is likely to have a significant global impact.

Globally, the IEA estimates that US$45tn of investments are required between 2012 and 2050 to reduce global carbon emissions by 50 per cent, and that 85 per cent of this investment will need to come from the private sector. Annually, this averages at a little over US$1tn, half of which will fund the replacement of existing technologies, largely in developed countries. The remaining US$530bn is for investment in new capacity, the bulk of which (US$400bn pa) will be in developing countries (IEA 2008). Given their relative weight in the global economy, a large proportion of this will be needed in China and India. This investment becomes doubly important given that more developed countries are still reeling from the effects of the global financial crisis and continue to struggle with policy paralysis and political deadlock.

Our point of entry for this piece of the study is that India is already seeing significant investment activity in renewable energy. During 2010/11, investment in renewables grew by 62 per cent to US$13bn (although it slowed drastically in 2011/12 to US$6.5bn – see UNEP/BNEF 2013). In 2010 the Indian government announced a National Solar Mission (NSM)[1] that aimed to add 20 gigawatts (GW)[2] of solar power generation capacity by 2020; wind power capacity has grown steadily at a compound annual growth rate of 17.9 per cent since 2007 (Ernst & Young 2013) and now contributes more than 20GW (Indian Wind Turbine Manufacturers Association 2013), or just over 70 per cent, of total renewable energy capacity. Almost all of this is private investment. However, these levels will need to increase sharply in the coming years and decades if India is to reach China's levels (who, in 2013,

[1] Also known as the Jawaharlal Nehru National Solar Mission.

[2] The abbreviations kW, MW, GW and TW refer to kilowatt, megawatt, gigawatt and terawatt respectively. The relationship between them is: 1 TW = 10^3GW = 10^6 MW = 10^9 kW = 10^{12} watts.

became the world leader with US$67bn invested in renewables) and make a greater contribution to the US$1tn needed.

1.1 Core idea and primary research question

Given the time-crucial nature of the climate question, many have assumed that a binding global deal is a necessary precursor to achieving the level of investment needed. This, however, remains elusive, and the political class in most countries continues to struggle with prioritising climate concerns above wider issues of welfare, development and competitiveness. More developed economies continue to press for the inclusion of emerging economies from the start, whereas the latter, citing the developed economies' historical responsibility for emissions and their greater capacity for change, make the ethical and practical argument that developed nations must take the first and greatest steps.
However, this deadlock aside, another dynamic of climate action has been suggested that offers a more optimistic alternative, which does not rely on a global deal and follows a far more bottom-up approach (Rayner 2010). It is clear that renewable energy in many countries – both developing and more developed economies (such as the US) – is now attracting significant investment and may continue to grow. As countries invest in becoming low-carbon economies, they will have less to lose as global emissions cuts are agreed upon, making them more feasible. This process is already unfolding as a multiplicity of pressures from international and local regimes spurs modes of climate action (Keohane and Victor 2010). However, the precise drivers of this transformation are far from straightforward, for example, the policy regimes of both India and China do not show clear goals to mitigate climate change. Indeed, in India the development of renewables long predated talk of climate change and has been tied to questions of energy security, sufficiency and access. The question we pose is: what exactly drives the investment in renewable energy?

For investors to commit large sums of money into projects whose timelines run into decades, they will need to be certain of the viability of the low-carbon sector – a certainty, which, as we have seen in the case of the European Union, even the most committed governments may struggle to provide through policy measures alone. This research suggests that an alignment of interests of the various actors involved is required to keep the politico-economic dynamic of policy, policy implementation and investment on track. Hence, an understanding of the full range of actors (federal, state-level, private and civic), their motivations and strategies is required. We focus on wind and solar power as they make up the bulk of new capacity added to renewable energy in India (UNEP/BNEF 2012, 2013), and we expect these two industries to provide fertile ground for our exploration.

1.2 Methodology

To investigate this question we rely on a mixed methods approach using desk research and semi-structured interviews to collect both qualitative and quantitative data. The information for our case studies was collected on the basis of desk research complemented by face-to-face 'snowballing' interviews with key informants (actors involved as well as observers). In particular, the determinants of investment decisions, the role of policy, and the factors that supported/opposed the various actors' interests and motivations were detailed and triangulated by confirming the facts through multiple sources.

1.3 Structure

The rest of the paper is structured as follows: Section 2 provides the overall context of India's renewable energy endowments, and the power sector's governance and structural ecosystem pertinent to our investigation, including an overview of the state of the technology, the wind and solar sectors, and characteristics of sector growth in the past ten years.

Sections 3 and 4 present the case studies. Firstly, in Section 3, the authors outline their analysis of the investment patterns and identification of the case studies that form the basis of their investigation. The sets of case studies are then laid out in detail – those for the wind sector in Section 3 and for the solar sector in Section 4. Section 5 contains insights drawn from the analytical sections in the case studies.

2 India: the context

This section provides an overview of the Indian economy pertinent to renewable energy, the policy and institutional framework relevant to both the wind and solar power sectors, and the sectoral landscape that will provide a useful background to consider the political economy of investments.

2.1 India's energy scenario

India's energy scenario is currently one of vast, unmet demand and demand growth. Nearly 300 million people in India lack access to basic energy services (World Bank 2014), and even electrified segments and areas experience intermittent supply with significant power shortages. The peak deficit in 2012 was nearly ten per cent nationally, and in southern India, 16.6 per cent. The current installed generation capacity of 283GW is expected to fall further short in the future as growth in demand outstrips growth in supply. The annual average demand for energy is estimated to grow at 5.1 per cent until 2017 and at 5.4 per cent between 2017 and 2022; most of this growth in demand is expected to be met by fossil fuels (Planning Commission 2012).

India has the third largest known reserves of coal (at 10 per cent of the world's reserves, behind China and the US), and just 0.4 per cent of the world's known hydrocarbon reserves. It relies on coal for nearly 54 per cent of its primary electricity supply. Together, coal, oil and natural gas constitute nearly 93 per cent of its total energy supply and are expected to be the primary sources for meeting future demand. However, production has always lagged behind demand and India is a net importer of fossil fuels, and as such, a pricetaker in global oil markets facing significant supply risks. Import bills also form a large part of the national budget – in 2012 the amount was US$140bn while the BP Statistical Review 2013 (BP 2013) suggests that this figure is likely to reach US$300bn by 2030. Furthermore, domestic prices (particularly for the general public) are insulated from global prices by the use of significant untargeted subsidies which are beginning to be seen as unsustainable and have been eroding over the course of the most recent National Five-Year Plan.

In this scenario, renewables are, potentially, an important tool to achieve self-sufficiency and to reduce both carbon emissions and imports. The share of renewable energy (which includes wind, solar, biomass and small hydropower) is currently approximately 5 to 6 per cent of the total energy produced (wind power contributes approximately 1 per cent) and under current projections the installed capacity is expected to more than double by the end of 2017 to 54,000MW. Although this share is comparable to other countries (both developed and developing), studies have shown that renewables can contribute much more (Planning Commission 2012).

2.2 Renewable energy resources

Renewable energy in India, as defined within the scope of the Ministry of New and Renewable Energy (MNRE), includes wind, solar, small hydropower and biomass (this study focuses on the former two). Of these, wind power has been assessed for its potential by multiple experts, including the government body the Centre for Wind Energy Technology,[3] and apart from large hydropower, it is the oldest utility-scale renewable energy source in India.

[3] Historically a research, certification and analysis body responsible for resource assessments, standardisation and fundamental research and development in the wind sector, and now also a nodal agency for solar power technology.

Table 2.1 Assessments of India's potential for wind energy

Study	Potential
Centre for Wind Energy Technology (2008–10)	First assessment: 49GW Revised estimate: 103GW at 80 metre hub heights (based on the identification of specific sites which are accessible and amenable to wind farm development)
Phadke, Bharvirkar and Khangura (2012)	1,006GW at 80 metre hub heights and 3,000GW at 120 metre hub heights (using geographic information systems (GIS) and computational methods)
Hossain, Sinha and Kishore (2011)	4,250GW at 80 metre hub heights (using GIS and computational methods)

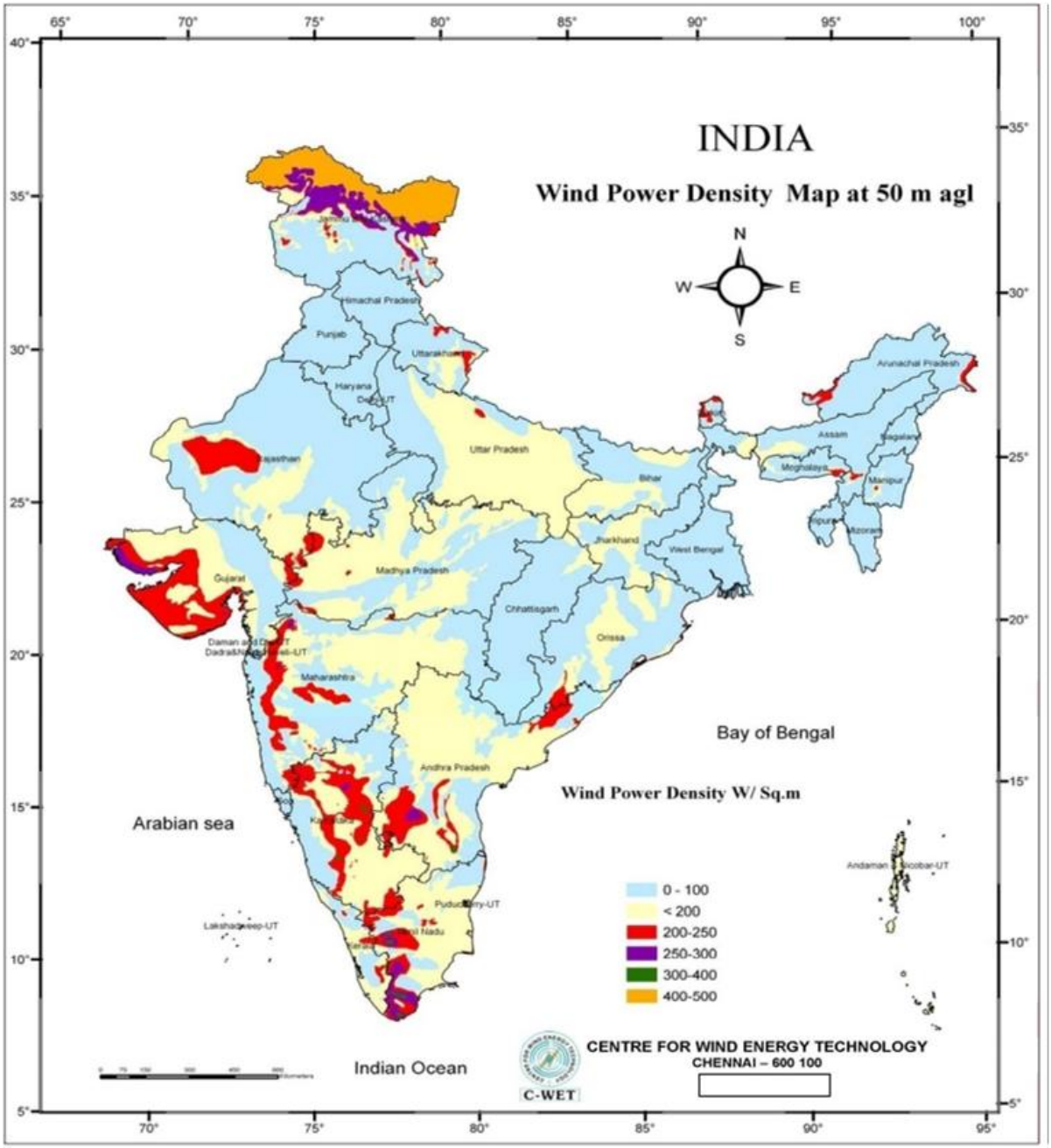
Officially, the country's wind energy potential is 103GW and even at this number, it is comparable to India's total installed generation capacity from all sources. Good quality sites, however, are concentrated in a few states, namely Tamil Nadu, Gujarat, Maharashtra, Rajasthan, Karnataka, Andhra Pradesh and Madhya Pradesh. Of these, by far the best quality sites exist in Tamil Nadu (see Figures 2.1 and 2.2). Moreover, wind power in India is fairly seasonal and windy days are typically limited to seven months per year. As of 2012, wind power contributed 0.6 per cent of the total energy produced, although it constitutes approximately 7 per cent of the total installed capacity and, of all renewables, wind power is also responsible for the greatest portion of installed capacity as well as energy production from renewable sources, apart from large hydropower plants (Planning Commission 2012).

India's solar power potential is even greater. With approximately 300 sunny days per year, most land area receives an average insolation of 4–6kWh/m2, which one official study has translated to equal roughly 600TW per year – one thousand times more than the projected energy demand over the next three decades (Ministry of New and Renewable Energy 2014). Utility-scale solar power installations, however, require large swathes of land, making some states more suitable than others: some of the best sites for utility-scale systems are in Rajasthan in the Thar Desert, which alone could provide over 600GW; the Rann of Kutch Lake in Gujarat; followed by particular areas in Maharashtra and Madhya Pradesh and most parts of the southern states of Karnataka, Tamil Nadu and Andhra Pradesh, where solar irradiance is high throughout the year. Particular information about the direct normal irradiance and land use is compiled by the Centre for Wind Energy Technology.

Strategically, these two resources – wind and sun – hold significant importance through their potential role in helping India achieve energy sufficiency, energy security and to expand energy access because of the wide distribution of the resources and their suitability for decentralised systems.

To date, however, wind power technologies have been deployed primarily for utility-scale applications (off-grid, and small- and medium-scale installations account for less than 2MW), as is also the case for solar power applications. (Decentralised applications currently account for 500–600MW in heating systems, cookers, lighting systems and mini-grids). This report focuses on private investment in the wind and solar power sectors in utility-scale projects and capacity. Firstly, to analyse this investment a greater understanding of the overall power sector, principles of policymaking, the governance structure and overall institutional arrangement is necessary.

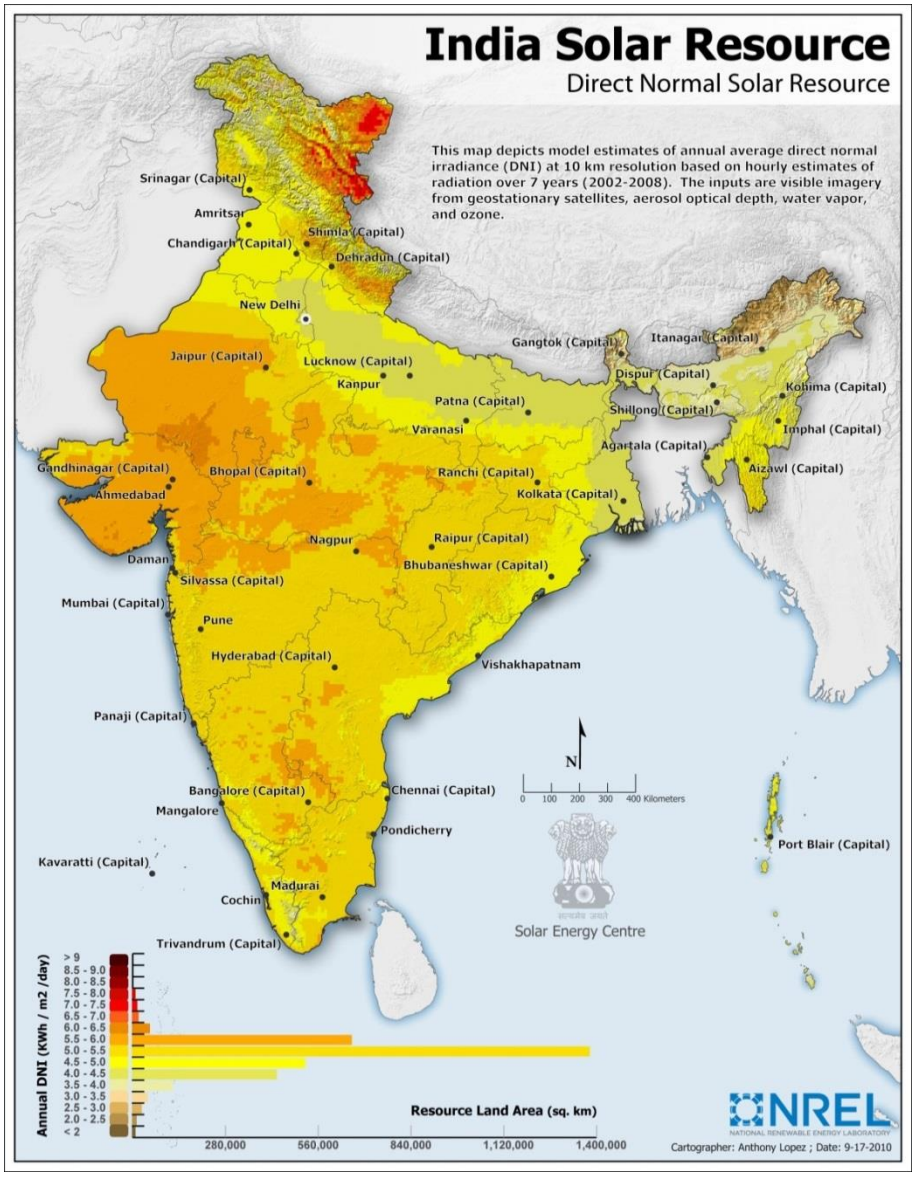
Figure 2.1 Map of India's wind resource showing concentration across states



Note: AGL: altitude above ground level.

Source: Centre for Wind Energy Technology (2010).

Figure 2.2 Map of India's solar resource showing concentration across states



Source: National Renewable Energy Laboratory (2013).

2.3 Institutions

India is a federated union of 28 states and seven union territories, with an executive, judiciary and legislature at each level. Legislative powers are split between the central and state government on a variety of subjects. Pertinent to the infrastructure sector, the governance of physical assets such as land and water bodies fall under the state government's jurisdiction, whereas the central government is in charge of national reserves, forests and sustaining ecosystems. There are, however, some subjects on which laws can be passed by both the state and federal (union/central) level executives specified in the Constitution under the 'concurrent list', of which electricity is a part. While taxation, sale and governance of power at the local level are the responsibilities of state governments, the central government is responsible for ensuring interstate integration and power markets. This activity is complemented by agencies such as the Planning Commission, which formulates policy recommendations and reviews various sectors from a macroeconomic standpoint, and may provide guidelines to various actors (including at the state level). In all

such sectors, the Ministry of Finance is a strong 'veto' player and its decision-making is constrained within the deliberations of the Cabinet, though individual ministries can and do appeal directly to the Ministry of Finance to allocate funds for their activities.

In addition, policymaking in India is highly fragmented, with the power sector and renewable energy sub-sectors also characterised by a number of governing bodies at various levels, and the level of coordination between various agencies varying greatly with the time and context. Although there is a strong bias toward the federal government in terms of taxes, provisions and laws, individual states have considerable freedom to implement policies on various subjects and may act quite contrary to plans or recommendations at the centre.

2.3.1 Policymaking institutions in the power sector

Legislation for the power sector (which is the sector arena for renewable energy) at the federal level falls largely under the purview of the Ministry of Power, which is the key nodal body responsible for thermal and (large) hydroelectric power generation, transmission and distribution, and maintains the national grid infrastructure. Following a central planning model it functions through several publicly-owned firms (public sector undertakings) to discharge its duties. Historically, all service provision in the power sector has been dominated by government bodies – a legacy of India's socialist, centralised planning principles. Prior to 1991, private sector participation in the power sector was at a minimum, and any investment was in captive generation (Dubash and Chella Rajan 2001).[4] Despite a move toward deregulation and private participation in the power sector since the late 1990s, the Ministry of Power-owned firms and state government-owned firms continue to enjoy market monopolies. In 2010, 82 per cent of the power generated was by state-owned (central and state-level) firms (D&B 2011). This monopolisation also extends to distribution and transmission. However, renewable energy generation capacity is mostly owned by private players (see Sections 2.6 and 2.7).

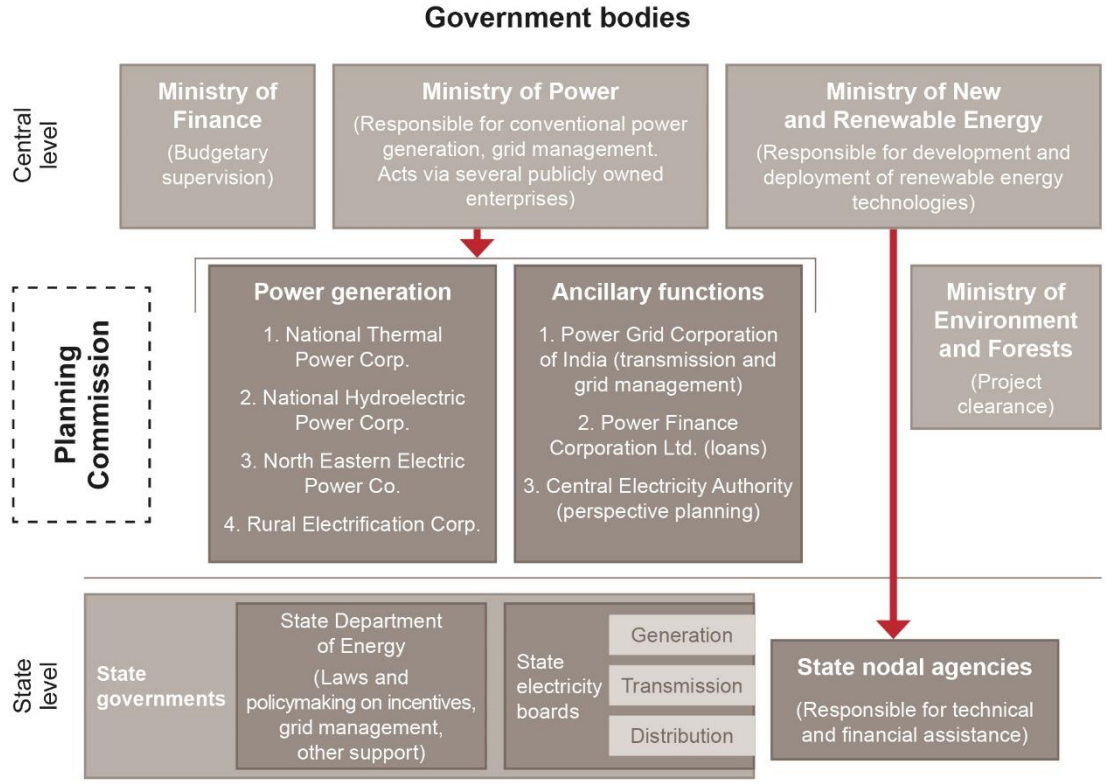
State-level markets match this structure closely. At the state level, legislative powers rest with the state department of energy, which carries out power generation, transmission and distribution through state electricity boards, in parallel to the Ministry of Power. Each state typically also has a local grid connected to the larger regional grid maintained by state-owned utilities, although these are of inferior quality to the national grid.

The Ministry of New and Renewable Energy (MNRE) was set up in 1996 (formed from the Committee on Alternative Sources of Energy, which had been in existence since the 1980s) and works as an independent ministry alongside the Ministry of Power. Its mandated role is to develop and deploy new and renewable energy for supplementing the energy requirements of the country. It also acts as a nodal agency coordinating with other ministerial bodies such as the Ministry of Finance and Department of Commerce to extend subsidies, tax breaks and other provisions for renewables. At the state level, the MNRE is helped by Energy Development Agencies which are responsible for technical assistance in developing renewable energy policies and disbursing federal funds in the form of the aforementioned incentives. Their decisions may be closely guided by the ministry.

Finally, it is important to note that the electricity markets in India are highly illiquid. Nearly 89 per cent of the power generated is sold under long-term procurement contracts of up to 25 years, i.e. power purchase agreements and power supply agreements. Intraday trading accounts for less than 3 per cent of total power while a remaining 6 to 8 per cent of the power is traded over a period of three months to three years. These practices have found relevance in renewable energy as well.

[4] Captive generation means a power plant set up primarily to generate power for one's own use.

Figure 2.3 Overview of government bodies involved in the power sector



Source: Authors' own.

For renewable energy this means that although the incentive structures may be extended by both federal and state-level governments, the state government entities have a significant level of interaction at the project level.

2.3.2 Regulation in the power sector (post-1998)

Apart from these bodies, a series of reforms in the power sector that began in the late 1990s set up a two-tiered regulatory system to oversee the functioning of state electricity boards, effect liberalisation of the sector, improve competition, draw investment and ensure greater transparency. Many of the recommended changes were still being implemented by the various states in the late 2000s.

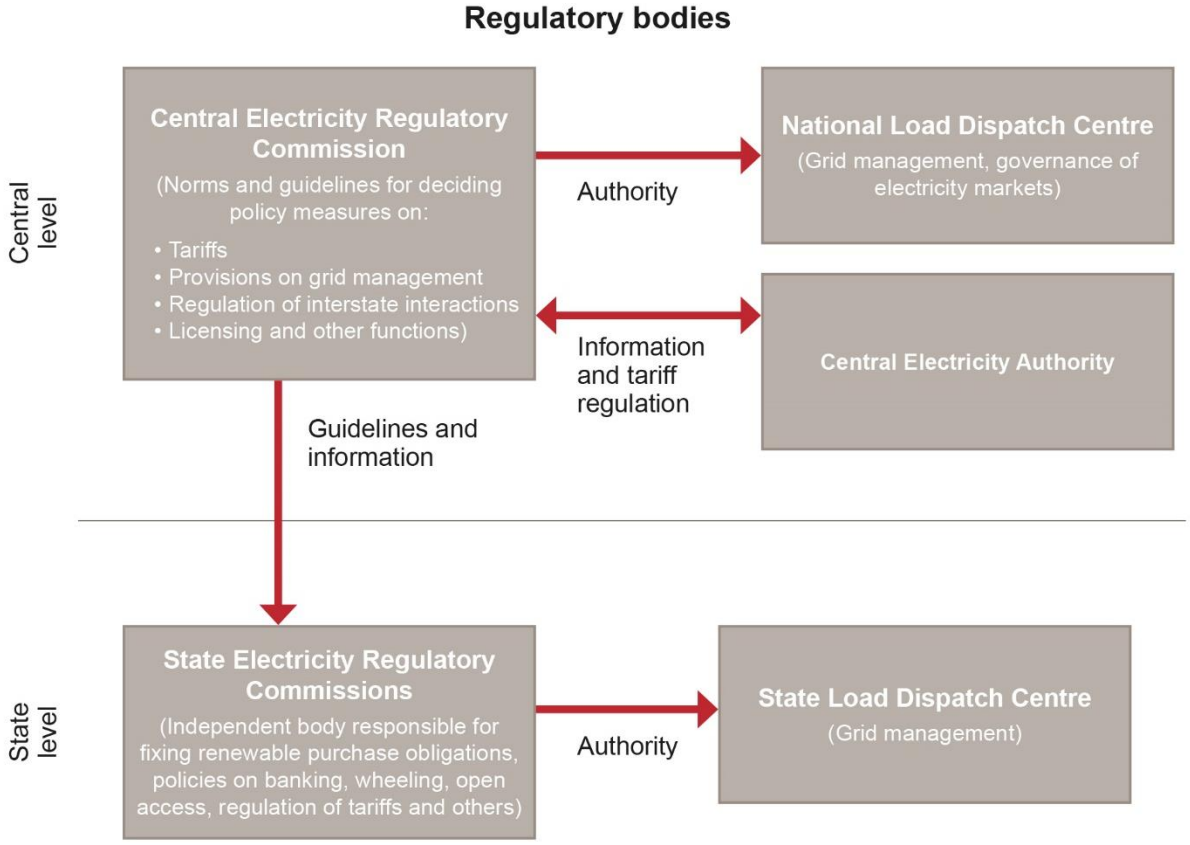
These bodies include the Central Electricity Regulatory Commission and one State Electricity Regulatory Commission per state, which is appointed by the respective state government on the advice of an independent selection committee. Together, these bodies are responsible for:

- tariff regulation (both at the consumers' end as well as the procurement end)
- policy management for grid infrastructure (in conjunction with the state electricity board) through grid codes, etc.
- promotion of environmentally-benign policies and alternative forms of energy[5]
- dispute resolution between stakeholders
- overseeing licensing and interstate operations
- advisory functions
    - national tariff policy and electricity policies
    - recommending measures for the development of the electricity markets.

[5] This was thanks to significant manoeuvring by the MNRE to ensure that renewable energy would be given an adequate platform under the new regime. An examination of this event is beyond the scope of this paper.

The role of the regulatory commissions has become nodal for the power sector and the renewable energy sector in particular.

Figure 2.4 Overview of electricity regulatory commissions



Source: Authors' own.

2.3.3 A brief overview of the actor dynamics in the power sector

Historically, the political economy of the power sector at the state level has been complicated. Until 1993, most state electricity boards were running year-on-year losses and even subsidies by the state government and soft loans from the federal government were not enough to cover them. There were multiple reasons for these losses: the state electricity boards were subsidising some sectors (notably agriculture) which accounted for a large part of the supply, but a minor share of the loss was due to cut-rate tariffs and poor metering practices. Industrial consumers, meanwhile, were charged extremely high rates and were subject to a cross-subsidy surcharge to make up for the losses, affecting operational costs (Tongia 2003). With mounting losses, the creditworthiness of these utilities dropped and their capacity to invest in additional infrastructure and generating capacity eroded.

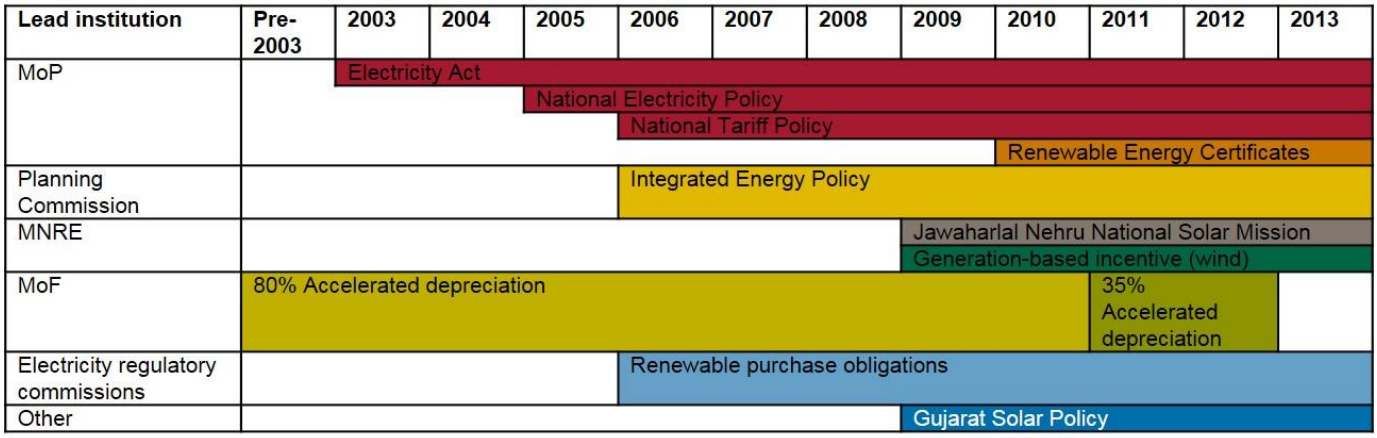
In addition, through various formal and informal channels, the decision-making capability of the state electricity boards was severely compromised by the state governments, affecting tariff determination, revenue realisation, internal management and other functions. The federal government did, however, with the aid of several agencies such as the World Bank and private sector consultants, commission a series of studies to assess the state of various state electricity boards and chart a pathway to improve their functioning. Some adopted 'unbundling' reforms early (such as Orissa (now called Odisha), Uttar Pradesh and Delhi), while many resisted (Tamil Nadu only began the process in the late 2000s and Maharashtra

did so in 2005).[6] Meanwhile, as industrial consumers increasingly resorted to captive generation and merchant contracts, a dual-track service economy was set up – one completely state-owned, and the other, through licensing and regulation, a market for capacity and power populated by private players.[7] Renewables featured in both segments.

However, even after unbundling, the structure of most state electricity boards is such that there is one holding company, with several subsidiaries along the value chain. Many utilities are still running deficits and/or continue to run unsustainable financial practices, and are still entirely state-owned companies rather than privatised independents. As such, policy frameworks within the power sector – including for renewables – have changed greatly over the period we are looking at, between 2003 and 2013, so it is important to keep a picture of these conditions in mind when exploring the policy formulation and implementation.

2.4 Policy frameworks

Figure 2.5 A timeline of key policies pertinent to the renewable energy sector



Source: Authors' own.

2.4.1 Major policy initiatives

a. Electricity Act (2003–present)

This was intended to consolidate relevant laws and create the regulatory structure governing generation, transmission, distribution, trading and use of electricity, and generally for taking measures conducive to promoting competition and development in the electricity sector. It mandates the creation of a Central Electricity Authority and State- and Central Electricity Regulatory Commissions to oversee electricity supply, with clear goals of promoting renewable energy. It also allows third-party investors to use state infrastructure and makes it the responsibility of state bodies to oversee the provision of this infrastructure.

The regulatory commissions are responsible for ensuring suitable measures of connectivity for developers and plant operators and sale of renewables to customers, mandating a minimum purchase of renewable energy (renewable energy obligations or renewable purchase obligations) each year. This minimum purchase fraction varies from state to state.

[6] Unbundling is the process whereby state electricity boards set up separate generation, transmission and distribution companies. In some cases these were then privatised.
[7] Interview with Bureau of Energy Efficiency, 4 November 2013.

b. National Electricity Policy (2005)

This is a consequence of the Electricity Act, and outlines compliance with Section 3 of the Act. The policy outlines the steps to be taken by all stakeholders in improving energy security and access. It outlines the need for specific purchase agreements and tariff mechanisms to promote renewable energy as well as particular measures to reduce the capital cost of technologies. The regulatory commissions are charged with the responsibility of ensuring suitable connectivity to the grid and the sale of electricity. Additionally, the commissions are free to specify a percentage of total electricity consumption in the area of a distribution licensee to be drawn from renewable energy sources, and each state can set its own renewable purchase obligations with guidelines from the regulatory commission. The *National Action Plan on Climate Change* (NAPCC) stipulates a minimum renewable purchase obligation of five per cent for each state and recommends an increase each successive year.

c. National Tariff Policy (2006)

This also follows the Electricity Act, outlining compliance with Section 3. For renewable energy it specifies that appropriate state commissions would have to fix a minimum percentage of purchase of energy, depending on the impact on retail tariffs, and it introduces the need for preferential tariffs or feed-in tariffs (FITs).[8]

d. Integrated Energy Policy (2006)

An expert committee report from the Planning Commission, this policy addresses all aspects of the energy sector and proposes solutions to issues of energy security, access, pricing, efficiency and environmental aspects. It proposes the phasing out of those capital subsidies linked to creation of renewable grid capacity by the end of the 10th Five-Year Plan (although this did not happen by 2007). As outlined in the Electricity Act (2003), it also requires the various State Electricity Regulatory Commissions to determine and specify FITs with the Central Electricity Regulatory Commission acting as a coordinating and guiding agency. Finally, it also requires power regulators to create incentive structures for integrating renewable energy and co-generated power into their systems and link these incentives to performance (i.e. the amount of power generated).

e. National Solar Mission (2010)

This aims to reduce the cost of generating solar power through long-term policy and regulatory measures that create an enabling ecosystem. The goal is to rapidly diffuse both solar photovoltaic and solar thermal generation for off-grid and grid-connected applications, create research and development (R&D) capacity and promote domestic production of critical materials and products. The mission has clear objectives and a roadmap for implementation. The Ministry of New and Renewable Energy is the lead ministry, setting strategies, timelines and evaluation criteria. The obligations in this mission are tied closely to India's obligations under the United Nations Framework Convention on Climate Change. The salient features of the policy provisions include:

[8] A feed-in tariff is a mechanism designed to offer cost-based compensation for each unit of power generated from renewable energy technologies, which includes some pre-determined profit margin. It is usually fixed and associated with a long-term project contract, and is typically decreased for newer projects to reflect technology improvements.

i. a three-phase roadmap with targets for adding to capacity in various segments (utility-scale, decentralised, heating applications, etc.)
ii. a reverse auction-determined rent mechanism to allocate projects[9]
iii. a payment guarantee routed through the Reserve Bank of India
iv. from phase 2 onwards, a viability gap funding instrument using central government funds[10]
v. risk mitigation instruments for off-takers[11]
vi. the creation of infrastructure in the form of solar parks.

f. Foreign direct investment (as of the Foreign Exchange Management Regulations 2000)

The government allows up to 100 per cent foreign direct investment in the renewable energy sector through the automatic route, i.e. without the need for prior approval from the Government of India and/or the Reserve Bank of India.

2.4.2 Key incentives for renewable energy

a. Accelerated depreciation[12]

i. 1990–2002: 100 per cent
ii. 2002–11: 80 per cent
iii. 2011–12: 35 per cent (15 per cent normal and 20 per cent additional depreciation).

This mechanism, under the Income Tax Act (now replaced by the Direct Taxes Code), played a large role in the early development of the wind energy sector (see Rajsekhar, Van Hulle and Jansen 1999; IRENA 2012). Accelerated depreciation allows an investor to divert taxable income into a wind power project which then acts as a tax shield. With accelerated depreciation, investors can show the allowed depreciation value as deductible from income in the first year of the investment, thus avoiding the tax that would be levied on that amount (in India this is approximately 30–40 per cent for corporates). In addition, the government provides an income tax holiday for the first ten years (see below), thus allowing this investment to recoup its equity, typically in the first five to seven years. The project internal rate of return is approximately ten per cent.[13]

In the case of solar, the policy varies from state to state. Gujarat allows 80 per cent accelerated depreciation on solar projects with power purchase agreements (see Section 2.3.1) that specifically mention this clause. Grid-connected plants that have signed power purchase agreements with NVVN (National Thermal Power Corporation (NTPC) Vidyut

[9] A reverse auction is a process by which one entity (in the case of rent allocation, the government) announces that it wants to purchase a certain amount of product or service (in this case, power), and solicits competitive bids from individuals (in this case, firms) so as to acquire the product or service at the lowest cost or rent.
[10] Under viability gap funding, the government can provide capital grants for a share of project costs, where the project would otherwise not be viable due to the constraints on user fees that can be charged.
[11] Off-taker: the party that directly purchases the power generated from the power producer.
[12] Accelerated depreciation is a method of depreciating the cost of a fixed asset such that the depreciation value is greater in the earlier years than the later years. This effectively reduces the taxable income for the investor in the first few years and thus reduces overall taxes in exchange for higher value of taxable income later. This essentially means that, due to the time value of money, the depreciated asset frees up cash flow and provides a return.
[13] The internal rate of return (IRR) of a project is the calculated interest rate at which the net present value of all costs (negative cash flows) of the investment equals the net present value of the benefits. In theory, the higher the IRR of an investment, the more attractive it becomes (if one does not account for risks and other opportunities). Net present value, in turn, is a measure of the excess or shortfall of all cash flows from an investment, taking into account the time value of money. Along with IRR, it is a widely used metric to compare investment opportunities.

Vyapar Nigam Ltd, the only power trading body in the country)[14] can avail themselves of this benefit, given a corresponding drop in their preferential FIT. This measure has not been as popular as sale of power to the grid, in the case of solar power (see the sector overviews in Sections 2.6 and 2.7).

With the introduction of the Direct Taxes Code, the 35 per cent accelerated depreciation means that the tax savings for core business are much lower, barely clearing the minimum tax a corporate entity has to pay by law.

b. Tax holidays (initiated in the 7th National Five-Year Plan, 1985–90)

The government allows income from the sale of renewable power to be tax-free for ten years under Section 80(1)(A) of the Income Tax Act.

c. Preferential tariffs (introduced by the Electricity Act 2003)

State Electricity Regulatory Commissions must fix a preferential tariff for renewable energy to incentivise investors. The seminal tariff order in the country was passed by the Maharashtra Electricity Regulatory Commission whose practices were adopted by other regulatory commissions later (see Section 3.2). Essentially, states have a multi-year levelised tariff offering a fixed return for investors based on assumptions of variable costs, plant performance and returns from comparable investments in other sectors.

d. Renewable purchase obligations (introduced in the 7th National Five-Year Plan and enacted by the Electricity Act 2003)

The first renewable purchase obligation was introduced in 2006, obliging distribution utilities and captive generation/open access (see below) consumers to procure a portion of their power from renewable sources. This portion is fixed by the State Electricity Regulatory Commission, depending on availability and demand for energy, and may be revised every year (some states continue to revise it regularly). The regulatory commission has the responsibility to oversee and facilitate this purchase. Renewable purchase obligations have been implemented by 24 states; however, long-term renewable purchase obligations have not been announced by many. This lack of long-term commitment has also led to some confusion for investors.

e. Generation-based incentives (GBIs) (2009)

These are disbursed half-yearly through the Indian Renewable Energy Development Agency (IREDA). The central government provides an incentive of 0.5 rupees/kWh for projects that offer the benefits of accelerated depreciation. This incentive is over and above the tariff fixed with the respective State Electricity Regulatory Commission.

f. Renewable energy certificates (RECs) (2010)[15]

Introduced by the Ministry of New and Renewable Energy to help those states with poor renewable energy generation capacities meet their renewable purchase obligation targets. Additionally, renewable energy certificates are intended to support the independent power

[14] NTPC Vidyut Vyapar Nigam Limited (NVVN) was formed by the National Thermal Power Corporation (NTPC) Limited, as a wholly-owned subsidiary with a vision to be a catalyst in the development of the wholesale power market in India, enabling the trading of surplus power – see www.indiaenvironmentportal.org.in/files/NVVN.pdf (accessed 8 September 2014).

[15] A renewable energy certificate is an instrument that decouples the electricity from renewable sources and its other benefits such as zero-climate forcing and zero-pollution. It is a certificate that provides proof that a certain amount of renewable power has been produced. This certificate can then be sold or traded separately from the electricity itself. The buyers are typically entities that buy commodity power from the grid, but then also buy renewable energy certificates to simulate 'sourcing' part of their power from renewable energy sources. This is typically done under regulatory obligations.

producer (IPP) business model, facilitate interstate transactions and reduce the transaction costs and risks associated with generation. Since the announcement of the NSM many states have a separate solar renewable energy certificate market.

g. Wheeling, banking and third-party sale (introduced in the 7th National Five-Year Plan 1985–90)[16]

These measures were particularly useful for the development of the wind industry because they facilitated captive consumption and were all measures that came about from the deregulation of the power sector.

Wheeling refers to the transfer of power from a generation site to a consumption site by using state-owned transmission infrastructure for a captive generation project. In effect, this means drawing power from one location and supplying an equivalent amount at another, with the utility charging a service fee in cash or in kind.

Banking refers to the storage of power with the state-owned utility. This, in effect, allows power to be transferred to the utility from a generation site and an equivalent amount drawn later within the allowed banking period. The utility charges a service fee in cash or in kind.

Open access/third-party sale: this allows a power provider and power user to enter into a contract and use the state infrastructure to transfer power or buy power from open markets/third-party supply contracts.

2.5 Wind and solar power in India

Renewable energy in India traces its history to the 1980s, when the global oil crisis led to the creation of a Committee on Alternative Sources of Energy for developing and deploying new technologies to harness non-conventional sources (becoming the MNRE in 1996). It began its work by exploiting wind power. In 1989, with the involvement of the Tamil Nadu and Gujarat Electricity Boards (the two states with the best wind resources) and the Danish International Development Agency, it launched its first wind turbine demonstration project in Gujarat. Following this, the World Bank seed-funded the newly created IREDA to finance renewable energy projects.

Early projects in renewable energy were targeted at industrial investors, who required the power from wind turbines as a hedge against erratic and costly power from the state electricity boards (see Rajsekhar *et al.* 1999 for more details). Since then, the wind industry has gone through periods of change (see Figure 2.6 for a short overview).

In the first phase (1990s–2000) the industry underwent a period of learning how to adapt foreign technology to Indian conditions, and there was some consolidation both in the manufacturing industry as well as the particular policy instruments required to spur a domestic industry (Mizuno 2011). In the next phase (2000–07), which is examined through the case studies in this paper, policies for wind power began to change, embedded in the context of the wider power sector, when the institutional and policy regime of the Electricity Act was taking shape. In the phase following that (2007–09) investments took place under a stable regime promoting renewables (see Figure 2.7). These two phases (2000–07 and 2007–09) also mark the growth of prominent wind turbine manufacturers and large-scale wind farms (over 25MW) in India. The last phase (2009–present) marks a shift to more mature business models and policy instruments with a focus on encouraging power generation and tying together production from resource-rich states to those states without significant potential (see Section 2.4).

[16] These measures allowed the captive generation and merchant power supplier models to emerge. Prior to these measures, all electricity was mandatorily bought from the state utility.

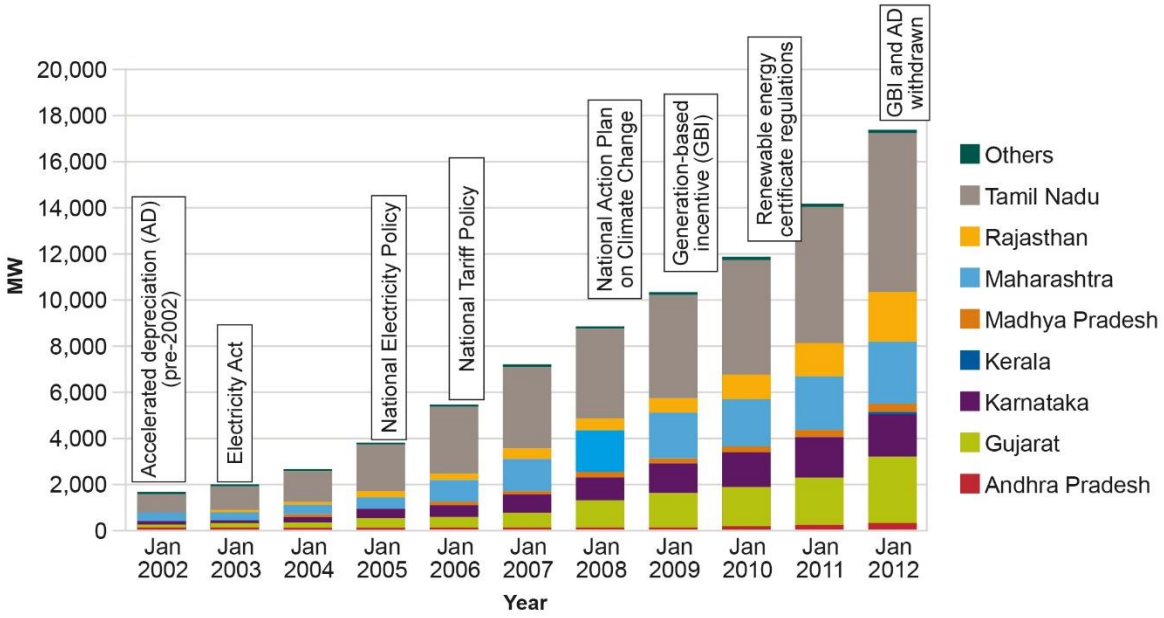
Throughout this transition the MNRE has remained a coordinating agency and a body of technical personnel with a marginal role in the power sector. However, in the case of solar power, it has taken a more direct role.

The scope of solar power in India prior to 2005–08 was minimal, relegated to off-grid applications totalling a few hundred MW. Domestic manufacturing capacity, too, was less than 200MW. However, thanks to the launch of the NSM (2010) with the *National Action Plan on Climate Change* in 2008 and the launch of Gujarat's and other states' solar policies, total installed capacity in solar power reached 2.18GW by the end of 2013. Approximately two-thirds of this installed capacity is in Gujarat. The MNRE has had a crucial role to play in the NSM, as implementing body and coordinating agent, which is explored later in Section 4.1. The next two sections provide an overview of investments in the two sectors under examination.

2.6 Wind power sector overview

The wind power market in India is highly concentrated across a few states with significant wind resources, namely: Karnataka, Tamil Nadu (which has the best quality resource), Maharashtra, Gujarat, Rajasthan and Andhra Pradesh (which has had hardly any installations). These states are followed by Madhya Pradesh and Kerala, which again, have had few installations in the past.

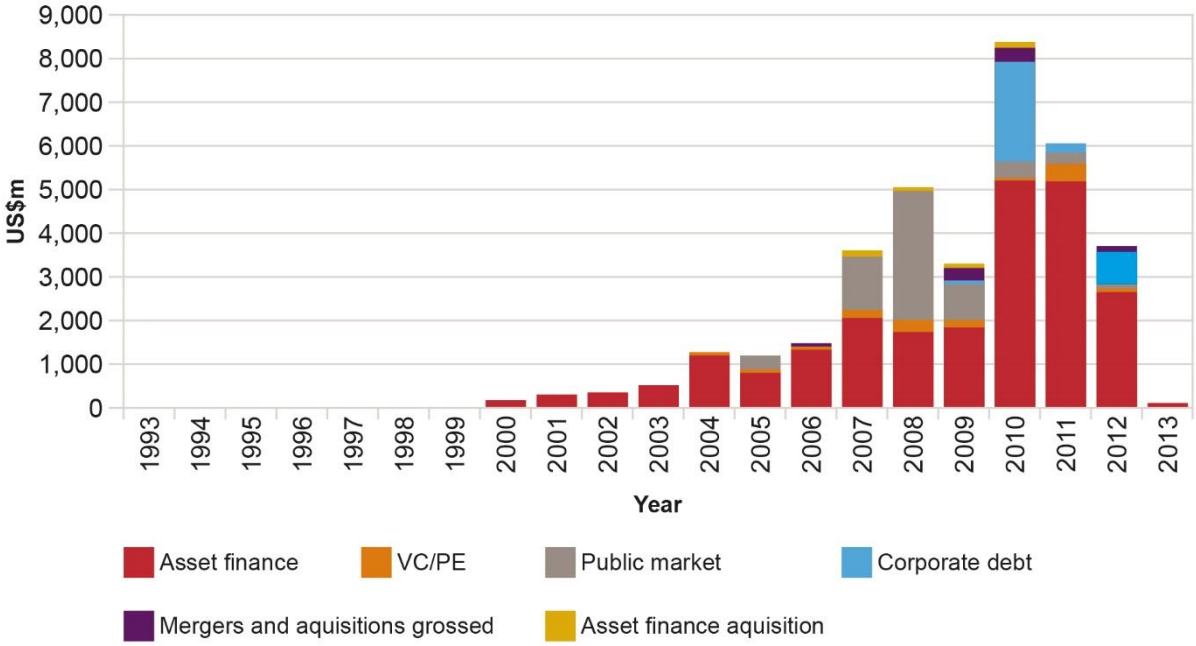
Figure 2.6 Installed wind power capacity by state, 2002–12



Source: Authors' own, based on data from Global Wind Energy Council (2012b).

Figure 2.7 shows the annual investment pattern in wind power in India:

Figure 2.7 Annual investment in wind power in India, 1993–2013



Notes: Asset finance: money borrowed by firms by using balance sheet assets such as accounts receivable, short-term investments or inventory; VC/PE: venture capital/private equity; public market: stock exchanges where firms raise money by selling equity shares to any willing investor; corporate debt: i.e. bonds sold to investors, with the debt repaid over time; mergers and acquisitions grossed: mergers (when two companies merge their operations and assets) and acquisitions (when one firm buys out all or almost all of the stakes of another); asset finance acquisition: when one firm buys out the assets of another.

Source: Authors' own, based on data from BNEF (Bloomberg New Energy Finance) (2014).

Note the growth in asset finance year-on-year. Public markets accounted for a large tranche of the investments in wind energy firms in 2008 as both developers/engineering, procurement and construction (EPC) players and turbine manufacturers who doubled as EPCs raised money to sustain their business (see manufacturers' business models below in Figures 2.9b and 2.9c).[17] In 2010, many firms entered the Indian market looking for a long-term opportunity as IPPs and, along with Suzlon Energy Ltd, were responsible for the peak in corporate debt issues and external commercial borrowings.

2.6.1 Buy side: projects

The wind power market has undergone stages of change on the buyer and supplier sides, which was discussed briefly in Section 2.5. The figures below show the evolution of the market in terms of project size.

[17] EPC is a common form of contracting arrangement within the construction industry.

Figure 2.8a Number of wind power projects by facility size, 2003–06

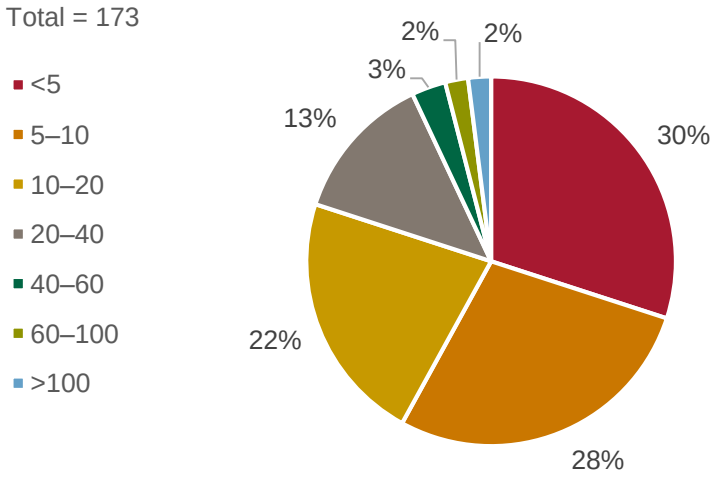


Figure 2.8b Number of wind power projects by facility size, 2007–09

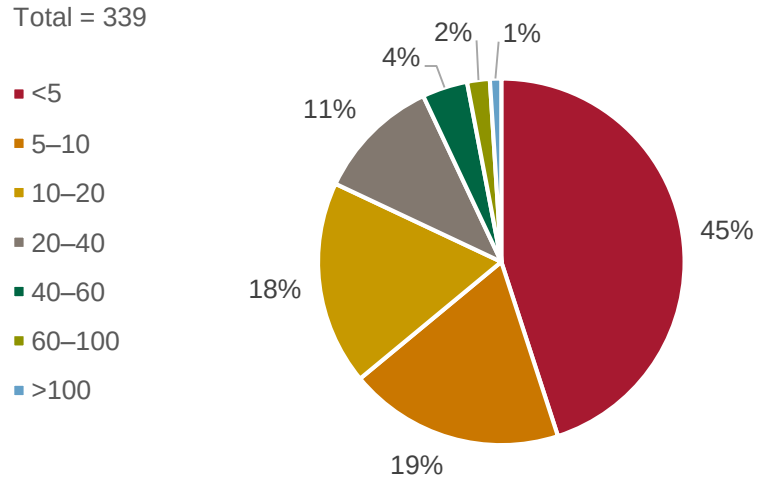
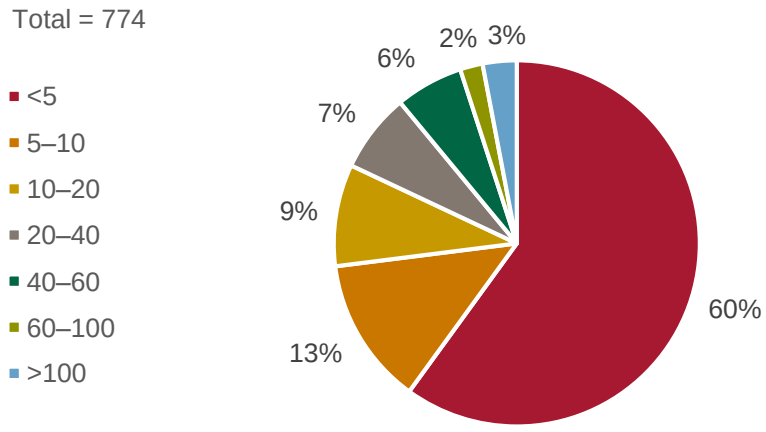


Figure 2.8c Number of wind power projects by facility size, 2010–13



Source for Figures 2.8a–c: Authors' own, based on data from BNEF (2014).

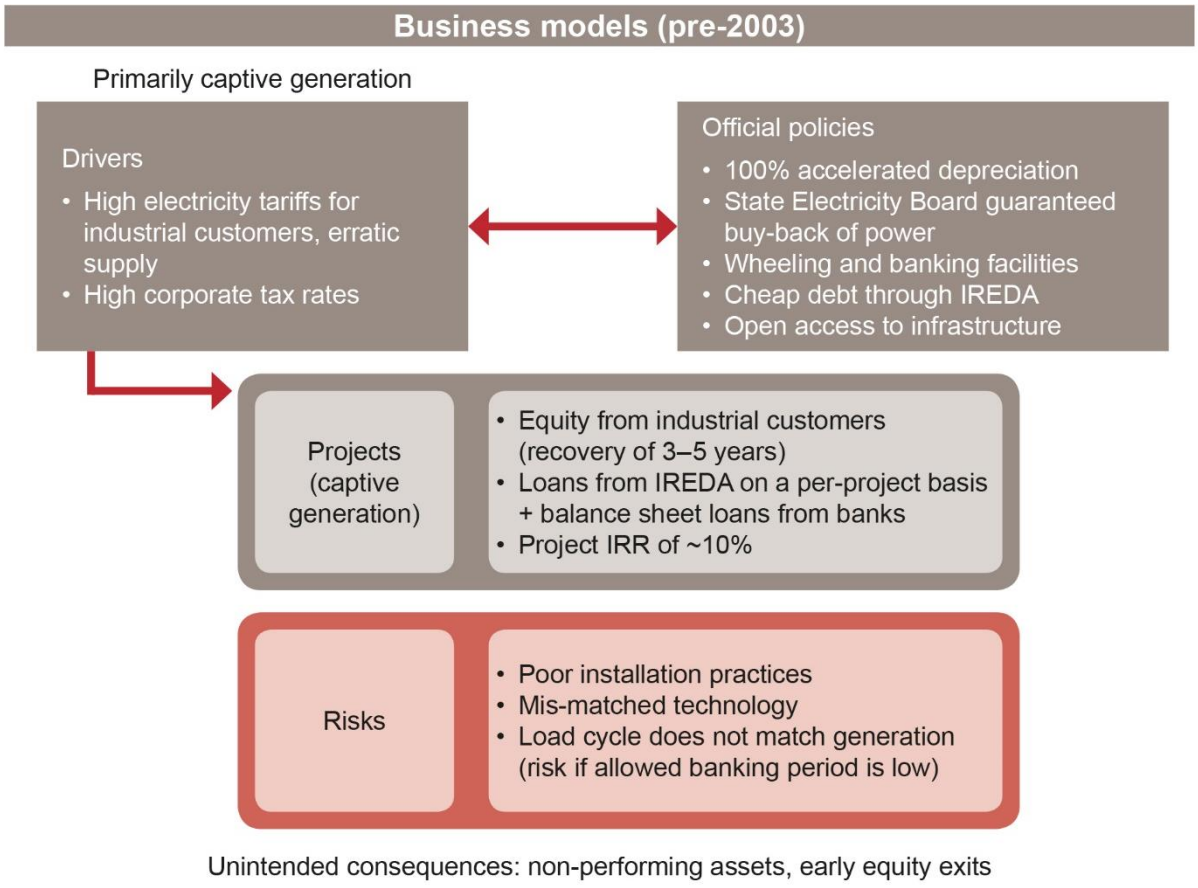
- An examination of the Bloomberg New Energy Finance data shows that most investors have consistently preferred small-scale investments (<5MW). These constitute a large 'retail' market
- Projects in the 5–20MW range are typically by private sector firms with other core businesses, investing in wind
- Projects between the sizes of 20 and 40MW show a wide variety of investors. These include larger power companies, diversified firms, IPPs, as well as publicly-owned utilities
- Projects in the 40–60MW segment are mainly owned by large diversified conglomerates, IPPs or publicly-owned firms only
- Large-scale facilities (>100MW) are becoming increasingly popular. An examination of the data showed that investments in large-scale wind farms were by IPP firms. This trend began in the period 2006/07 when the first facilities under the IPP mode of business emerged.

Over this period the revenue models of the projects themselves had undergone considerable evolution as the policy framework itself had changed. The figures below provide an overview of the evolution over time.

2.6.2 Revenue models and projects

The data for this section comes from both documentary analysis and interviews with key industry experts.[18]

Figure 2.9a Wind power revenue models prior to 2003



[18] Interviews with Bloomberg New Energy Finance, India (17 October 2013), and Idam Infrastructure (1 November 2013), and other documentary analysis.

Figure 2.9b Wind power revenue models 2003–09 under the Electricity Act regime

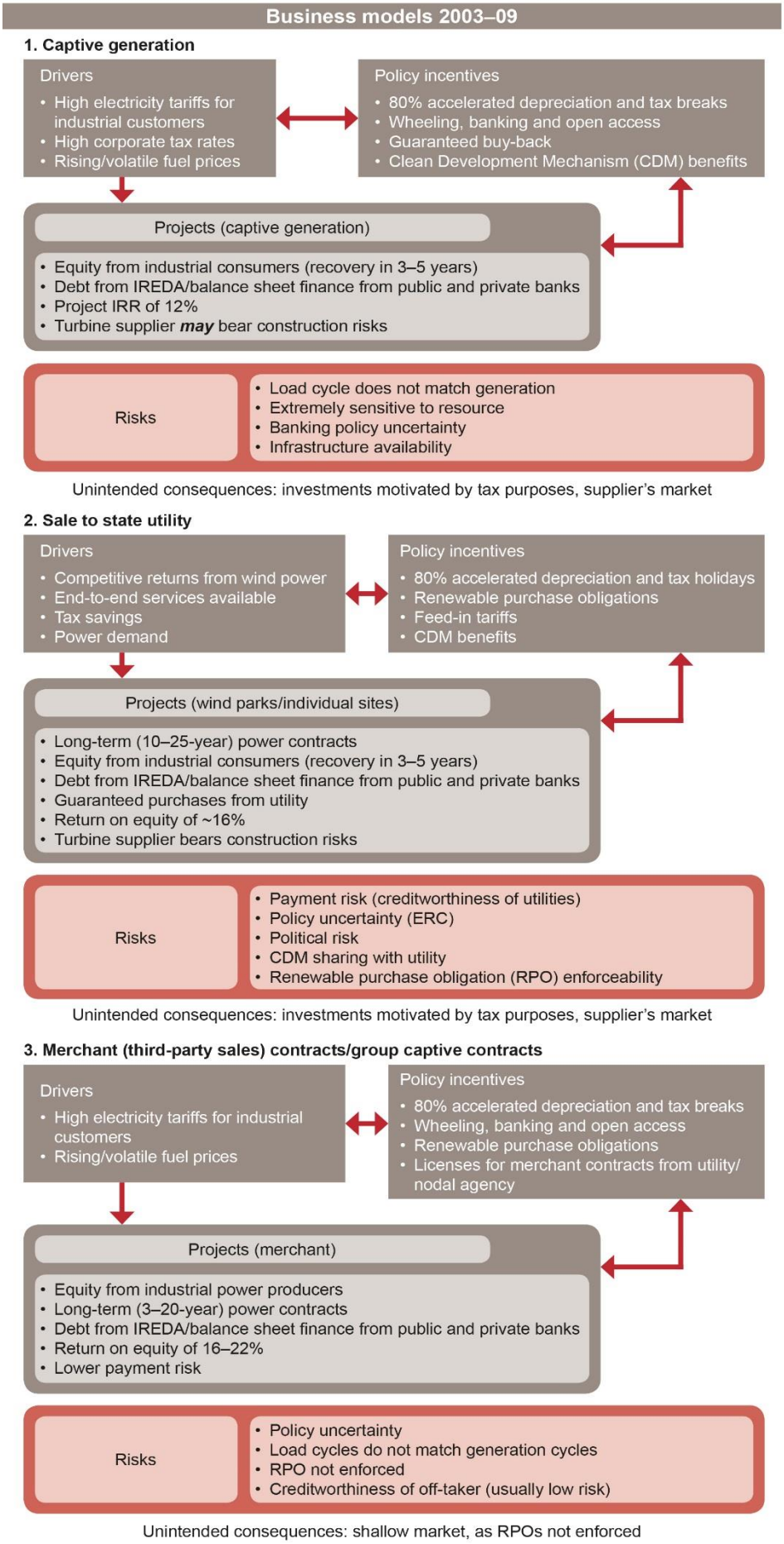
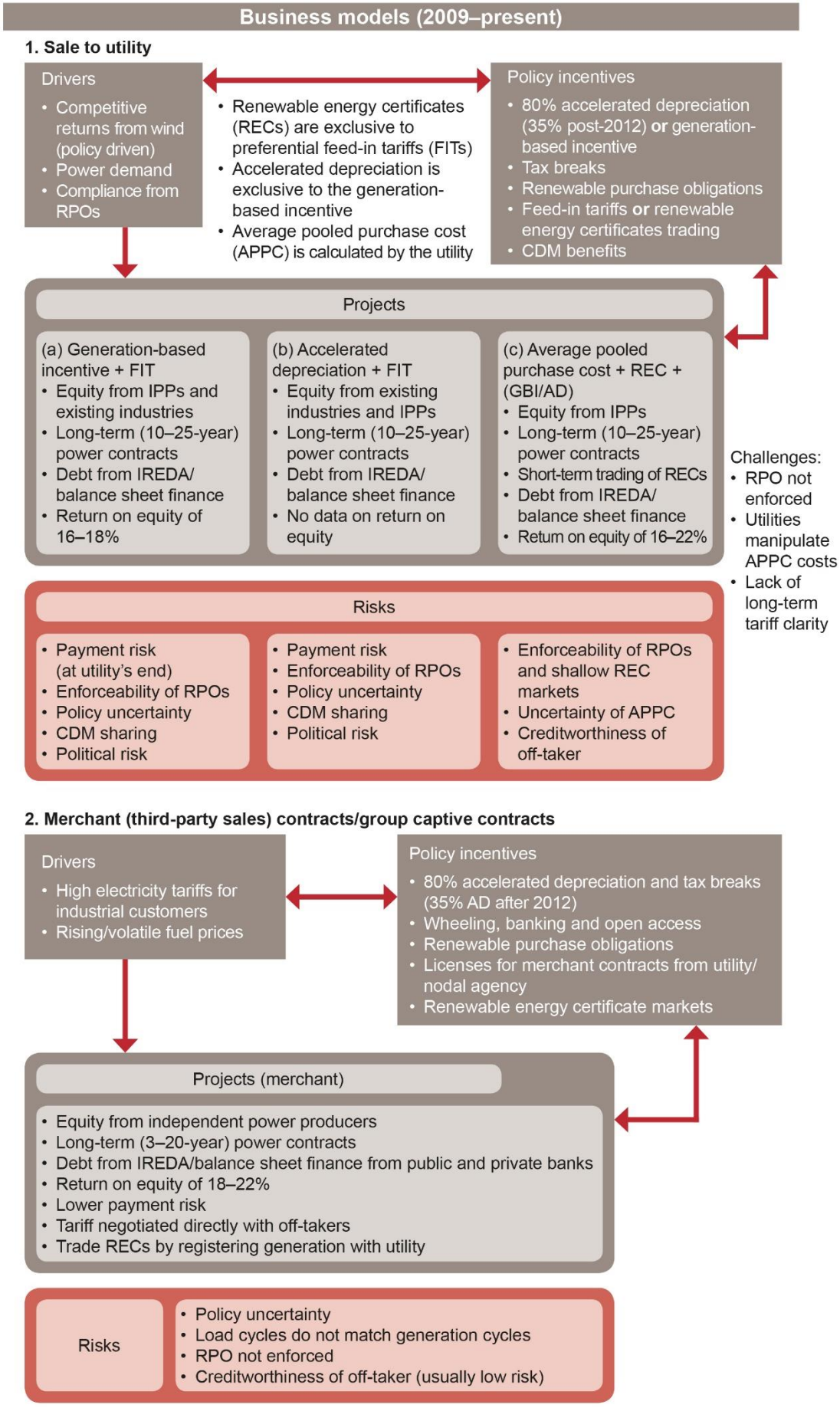


Figure 2.9c Wind power revenue models 2009–present under the Electricity Act and more recent performance-based instruments



Source for Figures 2.9a-c: Authors' own, based on interviews cited in footnote 21.

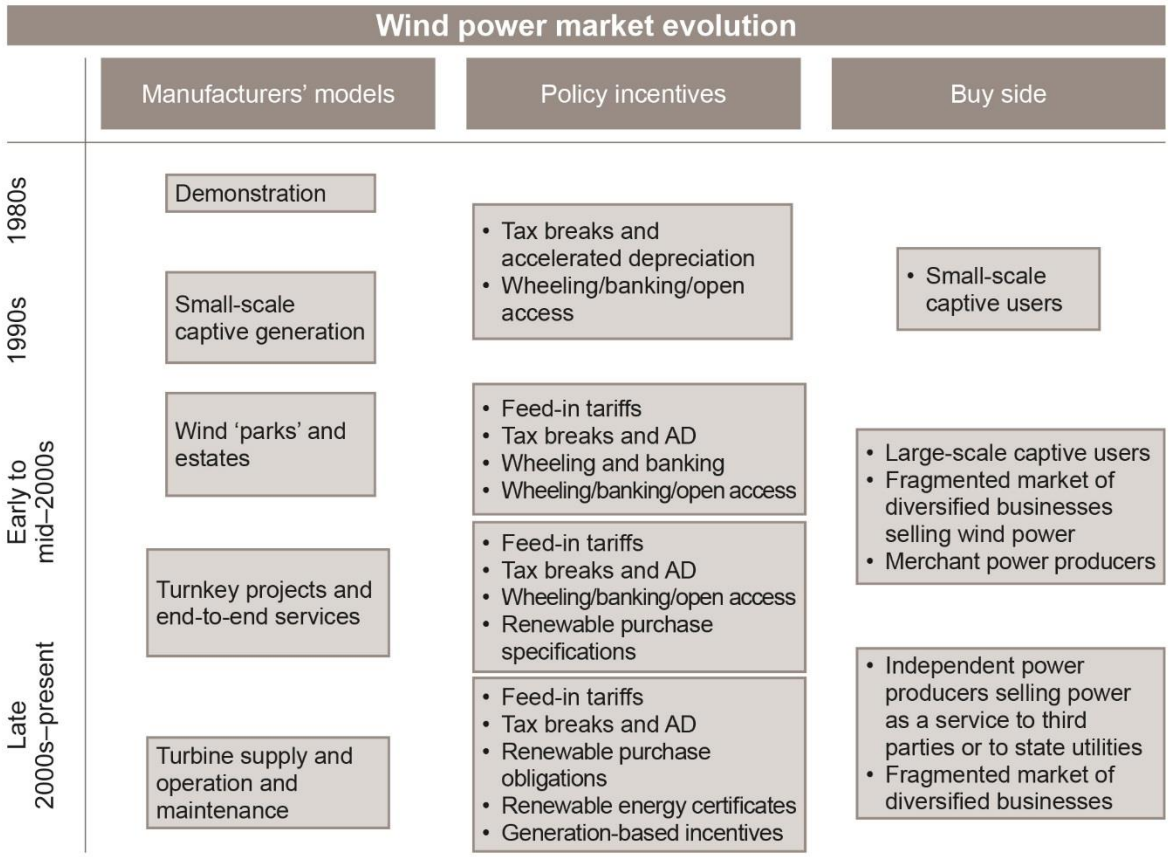
The models show a gradual move away from captive generation projects or tariff-driven projects with considerable tax benefits to instruments that rely on creating a guaranteed market and managing the demand side. As such, instruments such as the generation-based incentive and renewable energy certificates have been more attractive for foreign investors and firms with significant foreign equity stakes and have facilitated the deployment of larger amounts of capital, as accelerated depreciation is much more valuable for firms with an existing core business locally (interviews with SunBorne Energy, 8 November 2013, and a prominent wind IPP firm, 30 September 2013).

2.6.3 Supply side: manufacturing sector

The turbine manufacturing industry itself has undergone considerable evolution. It began with a business model of turbine erection and commissioning in the 1990s but moved to an end-to-end services model in the early 2000s, which ranged from project development to commissioning, operation and maintenance (interview with Ajit Gupta, former advisor, MNRE). This model, followed closely by Suzlon Energy Ltd in particular, also allowed manufacturers to play a larger role in the value chain and cater to the fragmented buy side of the market (Vietor and Semineiro 2008; Tendulkar 2012). By the late 2000s, there was considerable maturity in the way that wind parks or estates were being developed early on key sites, and then individual wind turbine generators sold to investors packaged as turnkey projects.

However, some newer firms following the IPP model are discarding the older pattern of turnkey solutions by taking on project development and EPC activities themselves. This allows greater customisability and presence across a larger part of the value chain, and thus, increased profits (Pearson 2013).

Figure 2.10 Wind power market evolution



Source: Authors' own, based on interviews cited in footnote 21.

Over the years the supply side has also evolved in its composition and, under the latest policy regime, firms guaranteeing better turbine performance and generation have rapidly gained market share.

Figure 2.11a Wind power market share, 2005

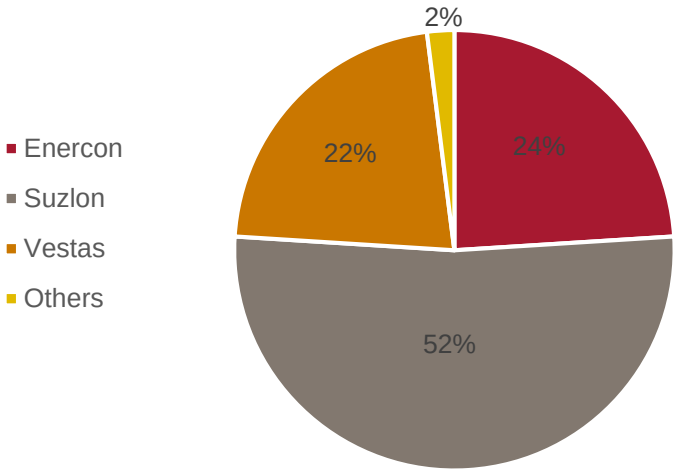


Figure 2.11b Wind power market share, 2009

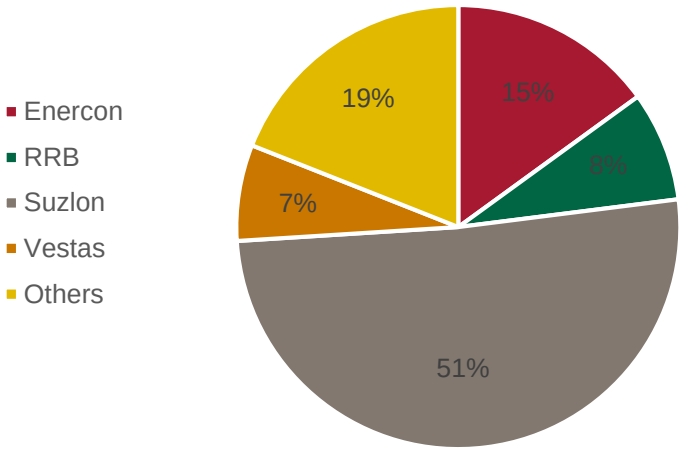
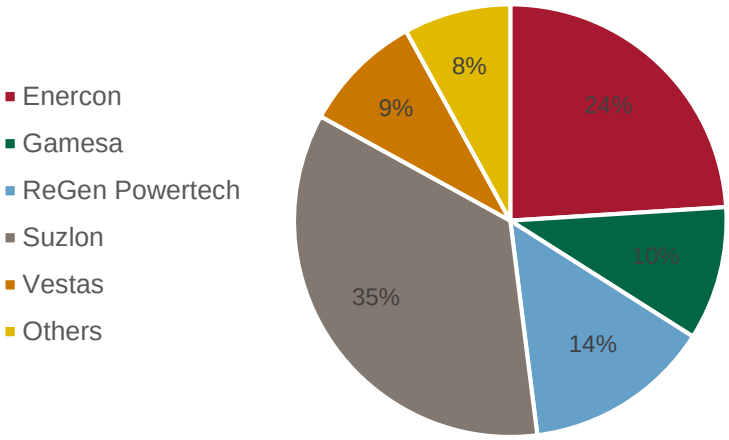


Figure 2.11c Wind power market share, 2012

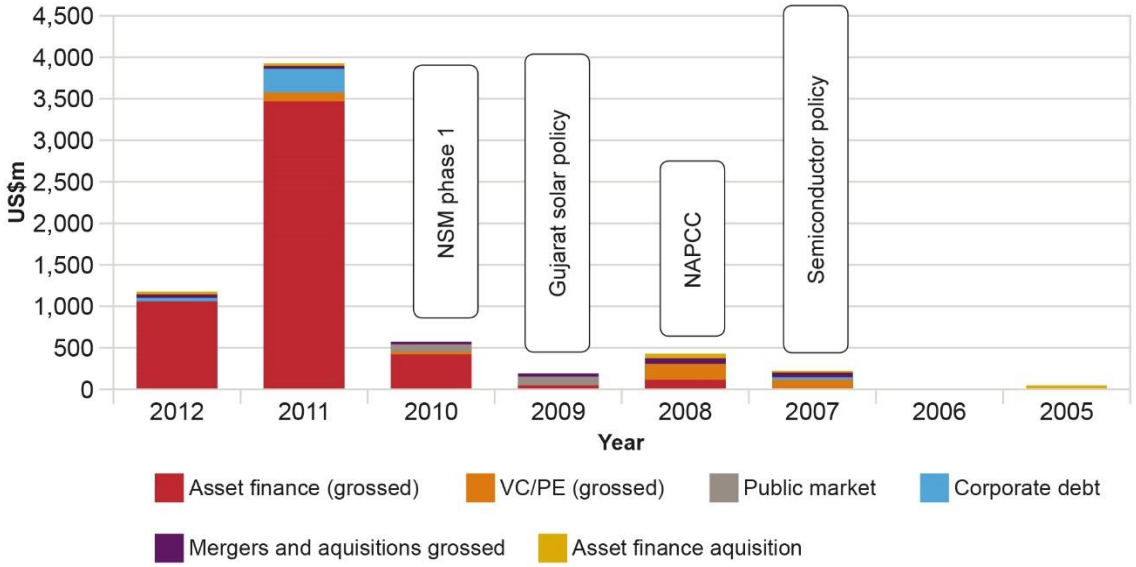


Source for Figures 2.11a–c:
Adapted from Narain (2013).

In our five wind-rich states, wind power remains highly regulated. The segment supplying to state-owned entities relies highly on policy changes. Inversely, the segment selling power in the open market or via merchant contracts depends on policy for the wider power sector and the governance of infrastructure, etc.

2.7 Solar power sector overview

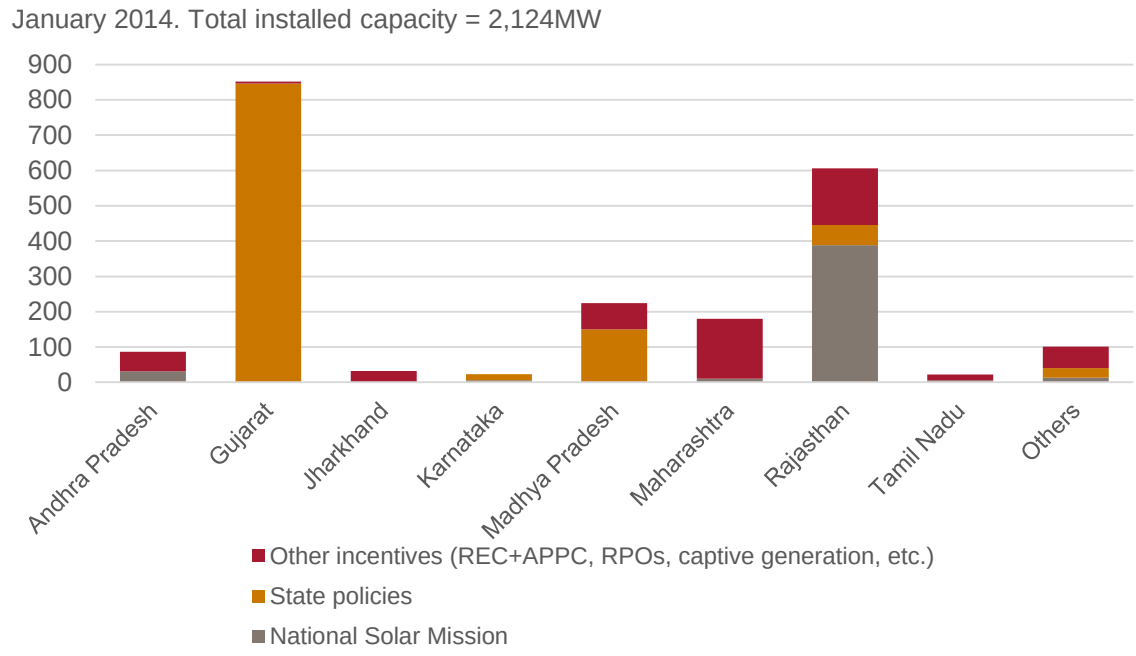
Figure 2.12 Investment in solar energy, 2005–12



Notes: Asset finance: money borrowed by firms by using balance sheet assets such as accounts receivable, short-term investments or inventory; VC/PE: venture capital/private equity; public market: stock exchanges where firms raise money by selling equity shares to any willing investor; corporate debt: i.e. bonds sold to investors, with the debt repaid over time; merger and acquisition grossed: mergers (when two companies merge their operations and assets) and acquisitions (when one firm buys out all or almost all of the stakes of another); asset finance acquisition: when one firm buys out the assets of another.

Source: Authors' own, based on data from BNEF (2014).

Figure 2.13 Installed solar PV capacity by state, 2014



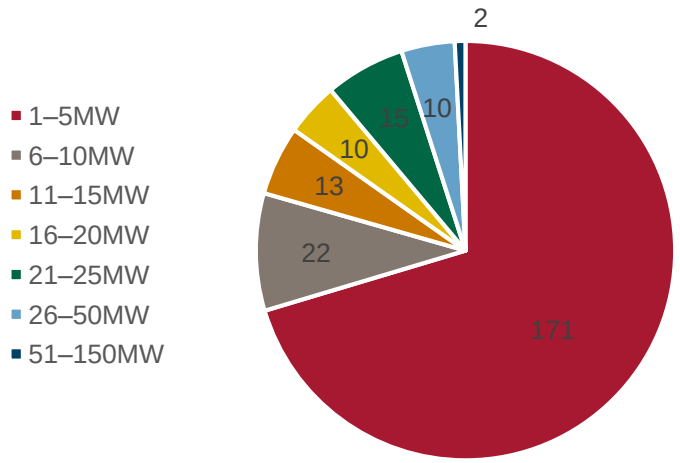
Source: Adapted from Bridge to India (2014).

Grid-connected solar power in India is still a nascent sector that has only taken off since 2008–09 with the announcement of the NSM and the Gujarat Solar Policy. The policy frameworks section provides an overview of the provisions of the NSM and Gujarat's domestic policy provisions (see Section 2.4).

2.7.1 Projects

Facilities in the solar power market in India are typically smaller than large-scale solar parks in China and Europe. There are many reasons for this: due to the perceived inherent riskiness of the technology and bankability of the projects, many investors prefer smaller projects; and secondly, large swathes of contiguous land plots are difficult to acquire quickly in India, where land acquisition is a risky and difficult proposition (see Section 4).

Figure 2.14 Breakdown of solar power investments by project size, 2003–13 (cumulative)



Source: Authors' own, based on data from BNEF (2014).

Solar power in India is characterised by a mix of firms but does not share the 'suppliers' market' characteristics of wind power, which was driven to a large extent by manufacturing firms. Developers in solar power are the primary link in the value chain and equity has flown from a variety of sectors.

Debt, however, comes from a few select sources. Many commercial and public sector banks have not participated in solar sector projects (unlike wind, which is now considered 'mature'), which rely instead on donor agencies/bilateral and multilateral institutions/development institutions and a few risk-bearing non-banking financial companies.

2.7.2 Supply side: manufacturing sector

The manufacturing sector in solar power in India consists of both photovoltaic technologies (crystalline silicon (c-Si) and thin films) and solar thermal technologies. The latter are still in the early stage of development and there are currently no dedicated manufacturing companies for solar thermal systems in the country.

In PV technologies, India is mainly present downstream in the value chain: of the four major links in upstream technology – polysilicon, ingots and wafers, cells, and module assembly – India only has a presence in the last two stages. As of 2013, around 1,000MW of cell manufacturing capability existed in India and around 2,000MW of domestic module manufacturing capability existed as compared to only 15MW of ingots and wafers manufacturing. In the next set of stages, inverters and the balance of systems, India has

approximately 2,000MW of installed capacity.[19] The vast majority of installed capacity is focused on thin films. A few Indian firms account for nearly 80–90 per cent of the installed capacity, and this includes Moser Baer, Titan Solar, Indosolar, Tata BP Solar (now Tata Power Solar) and the state-owned Bharat Heavy Electricals Ltd.

[19] Balance of systems refers to the physical structures, wiring and electrical control components of a solar system other than the photovoltaic module.

3 Case studies – wind power sector

The selection of case studies for both the wind and solar sectors was made by following two steps:

Firstly, two models – with the Ernst & Young country attractiveness index for wind and solar as the independent variable and the investments in each quarter as the dependent variable – were used to identify the effects of policy on investment. This, however, is national data and is not disaggregated for state level.

The relationship between the variables in the two models was studied using standard regression techniques (OLS (ordinary least squares) Univariate and Granger causality) and we found that the independent variable closely predicted variations in the dependent variable. In addition, since these were national-level events, it was a poor reflection of state-level variations in policy and investment.

The data were disaggregated to state level as far as possible:

- For wind power, this meant looking at the five leading states which house over 95 per cent of India's wind generation capacity and examining, qualitatively, the variation in investments *vis-à-vis* policy changes in:
    - Tariffs
    - Wheeling/banking changes
    - RPO requirements
- Investments in manufacturing are not specifically addressed, but experts and the desk literature point to the important role of individual firms from the manufacturing sector. The case study in Section 3.4 on Suzlon Energy Ltd has been chosen to reflect this
- For solar power, which is quite nascent in India, the major policy initiative that has so far utilised new instruments and methods is the NSM. This forms the basis of one major case study in Section 4.1
- India's solar power manufacturing sector is small compared to its counterparts in China or the US. However, its development pre-dates significant project-level activity. This is investigated through a case study on the manufacturing sector in Section 4.2.

The interviews for this study were conducted over a 12-month period in 2013. For key events and series of events, both third-party observers and the decision-makers involved were interviewed (the latter, as many as possible). The list of completed interviews can be found in the Annex.

To explore the drivers of investment in wind and solar energy in India, we then examined the material thrown up by each of our studies with the following framework:

- To what extent can formal targets and financial incentives explain changes in the level and pattern of wind and solar investment in India?
- For periods of major change that cannot be fully explained in each sector, which public and civic actors were most important in driving the growth/slowdown in investment?

We then proceed to analyse these sets of actors:

- To what extent can this group of actors be described as a coalition or alliance?
- What are the key characteristics of these coalitions? (e.g. active/passive cooperation, shared/differing interests, formal/informal, local/national/international focus)
- For identified investors, what were the key determinants of their investment decisions? (And what role did other actors play?)
- Which factors were most important in the coalescing of the identified coalitions? (e.g. shared interests, personal linkages, pre-existing institutional relationships; deliberate state actions to encourage coalition formation, such as 'policy-bundling')
- Which factors were most important in the success (or failure) of the identified coalitions? (e.g. fit with other aspects of development policy; observable co-benefits, such as employment; favourable external environments.)

3.1 Wind power case study 1: Tamil Nadu – acceleration between 2003 and 2005; deceleration between 2005 and 2007

With the best quality wind sites in the country, Tamil Nadu has historically been the most favoured investment destination in wind on a year-on-year basis. For our purpose of looking for investment events that do not seem entirely explained by policy and/or can potentially yield the greatest lessons about the political economy determinants of investment, the growth of wind power capacity in Tamil Nadu between 2003 and 2007 contains plenty of interesting material, as the desk research indicates:

- **Increase in capacity surpassing official targets.** During the 10th National Five-Year Plan period (2002–07), the MNRE's official national target for additional wind capacity was 2,200MW. However, the capacity installed during this period reached 5,426MW, and Tamil Nadu was the largest contributor with 3,100MW. This was also surprising given that, at the time, its calculated wind energy potential was 1,750MW
- **Incentives for investment – or the lack thereof.** The state was self-sufficient in terms of its electricity needs at the time, thanks to its existing thermal power generation (thus ruling out the usual argument in favour of renewables – the requirement to establish energy security). FITs were quite low (the lowest among the major wind states), although other measures such as wheeling, banking of power and open access were available (see Section 2.4.2). A key question is whether these three measures were enough to attract investors. If they were, who were these investors and what was their motivation? What role, if any, did the state government play apart from policymaking?
- **Investment pattern not entirely explained.** Investment grew steadily between 2003 and 2005, followed by a period of decline between 2005 and 2007, with no major changes in the tariffs, wheeling, banking and open access policies over the entire period
- **Large variety of actors.** The state has a large spread of actors across the public and private sectors. Bearing in mind the need to examine the actions of as many classes of actors for our study as possible, this case may yield lessons about drivers of or brakes on investment in renewable energy capacity that arose out of the interactions between these actors:
    - The Bloomberg New Energy Finance database (BNEF 2014) shows that investments in wind came from industrial investors across multiple sectors – textiles, automobiles, manufacturing, cement, petrochemicals, financial services and agribusiness – as well as from large conglomerates (also see Figure 3.3)

- Both the academic and business literature point to close and mutually favourable state-business relationships in Tamil Nadu (e.g. Benecke 2011; Calì, Mitra and Purohit 2009)
- A significant number of manufacturing firms are based in Tamil Nadu, which have been active in manufacturers' associations and other fora there since the 1990s – their role in lobbying, marketing and shaping attitudes toward wind power may have been important.

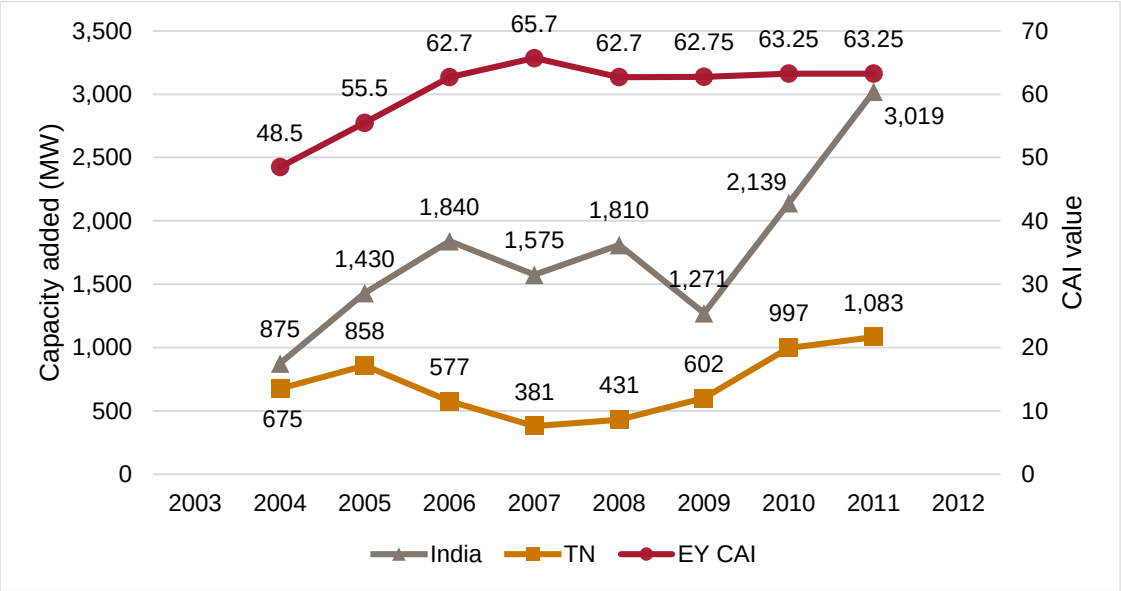
The information and supporting facts for this case study have been drawn from interviews with the Bureau of Energy Efficiency (November 2013), Idam Infrastructure (November 2013), IREDA (September 2013), Suzlon Energy Ltd. (August 2013), Indian Wind Energy Association (July 2013) and a former official at the Tamil Nadu Electricity Board (June 2013).

Table 3.1 Tamil Nadu – chronology of key events

Date	Event
2002	The Tamil Nadu Electricity Regulatory Commission fixes a wind tariff of 2.70 rupees/unit. This is much lower than other states looking to promote wind power (such as Maharashtra and Gujarat). The Tamil Nadu Electricity Board, Tamil Nadu Energy Development Agency and the regulatory commission announce intent to promote wind power. The development agency carries out resource assessments over 15 districts in the state. The Indian Wind Energy Association and the Indian Wind Power Association aggressively market wind power to textile firms as a potential avenue for energy self-sufficiency and long-term cost savings.
2003	Continuing a historic trend, the state's electricity board runs a deficit of 20bn rupees. This increases over the following years. Rising furnace oil prices and competition from low-cost manufacturers in Bangladesh raise concerns in the textile industry over competitiveness. The Ministry of Textiles states that wind energy generation projects are eligible 'in principle' for an interest rate subsidy under the Technology Upgradation Fund Scheme.
2003–06	Investors from various sectors including textiles, automobiles, financial services and wind turbine suppliers continue to invest. Prominent firms and groups include Vishal Exports Overseas Ltd, NEG Micon, Tamil Nadu Spinning Mills Association, Lanco Infratech, Indowind Energy Ltd and the Shriram Group.
2004	Revised orders for wheeling, banking and open access. Investment under captive generation business model increases.
2005	Lack of infrastructure connecting the wind-rich sites in southern parts of the state to the load centres in northern parts. No investment forthcoming from the Tamil Nadu Electricity Board in transmission corridors although No Objection Certificates (authorisations for wind farms) continue to be issued.[20] Wind plants are declared ineligible under the Technology Upgradation Fund Scheme.
2006	Revised tariffs of 2.95 rupees/unit are announced, which are much lower than the band for thermal power producers (which in turn, are lower than those of other states).
2006–07	Grid infrastructure issues lead to the setting up of a 'task force' between the state government and Indian Wind Turbine Manufacturers Association which encourages private investment in infrastructure, especially at substation level.
2007	10th National Five-Year Plan period ends. Record increase in capacity in Tamil Nadu over the 10th Plan period, beating official targets set by the Planning Commission.

[20] A transmission corridor mainly consists of overhead transmission lines and accompanying electronic controls, and may include pooling stations to aggregate generated electricity and at the end, substations through which power is distributed.

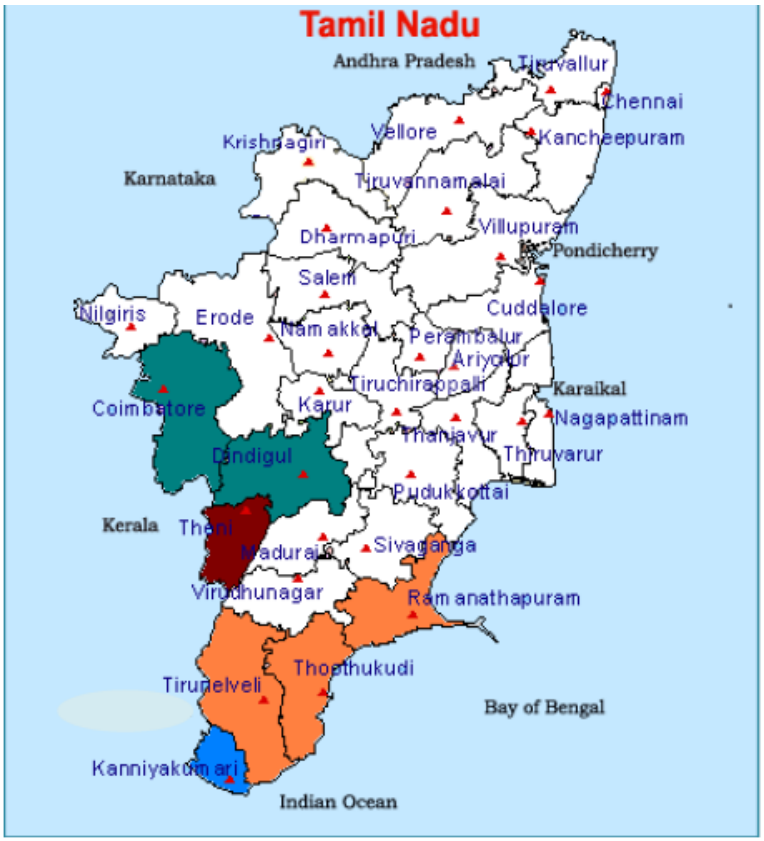
Figure 3.1 Increase in wind power capacity, 2003–12



Notes: EY CAI: Ernst & Young country attractiveness indices – a guide to the investment attractiveness of various renewable energy markets based on aspects of policy support, the business environment and other institutions; TN: Tamil Nadu. The data for this figure have been taken from CAI issues 1–32.

Source: Authors' own, based on data from Ernst & Young (2014).

Figure 3.2 Wind-rich sites in Tamil Nadu



Source: Ranjan (2012).

3.1.1 Key actors, roles, priorities and constraints

The key actors include central government (Ministry of Textiles – a non-active player extending incentives, Ministry of Finance, MNRE); state institutions (Tamil Nadu Electricity Board, Tamil Nadu Electricity Regulatory Commission, and state government); other public sector institutions (IREDA, Small Industries Development Bank of India, the Industrial Development Bank of India, Tamil Nadu Industrial Development Corporation – all financiers, except for the energy development agency); private companies (wind turbine manufacturers (NEG Micon, Vestas-RRB, Suzlon and Enercon) and other user and manufacturer associations (Indian Wind Power Association, Indian Wind Turbine Manufacturers Association, Indian Wind Energy Association)); and private investors (textile firms, the Tamil Nadu Spinning Mills Association, automotive firms and others).

We will firstly look at the various actors' roles during the period of growth.

Tamil Nadu Energy Development Agency – technical assistance

As stated earlier, wind resource assessments in India are critical. Despite considerable potential, there are few locations where the yields are very high and class I and II sites in the country are extremely valuable. Tamil Nadu has some of the highest yields and the Tamil Nadu Energy Development Agency (as per its mandate) conducted a study in 2002 identifying a number of potential sites (found mostly in the southern part of the state) and made this information available. These sites then went on to house many of the wind farms developed during the 10th Plan period.

Ministry of Textiles – extension of incentives for one class of investor

In 1999, the Ministry of Textiles launched the Technology Upgradation Fund Scheme for small and medium-sized industries operating in the textile sector. Under this scheme, an interest rate subsidy of up to five per cent of the loan amount per year was provided for expenditure on the expansion, replacement or setting up of new operating machinery. In essence, the subsidy allowed Indian textile firms to borrow at rates comparable to debt markets in developed countries. Power equipment for mills, looms and factories also fell under the purview of this scheme. In 2002, after much discussion with representatives from the textile sector and the wind power sector, the Ministry of Textiles commissioned a technical study. Following its recommendations the ministry allowed the inclusion of wind turbines in the technological upgrade schemes. In an optimistic scenario (with a capacity utilisation factor of 30 per cent, which was not uncommon in many of the better sites) the generation costs of wind power were ~1.2 rupees/kWh–1.5 rupees/kWh, compared to utility-supplied power at 4.5 rupees/kWh. The motivation of the Ministry of Textiles was to help a struggling textile industry (see Table 3.1).

Priorities

The Ministry of Textiles' priority was to develop a competitive textile industry based on modern technology.

Private investors

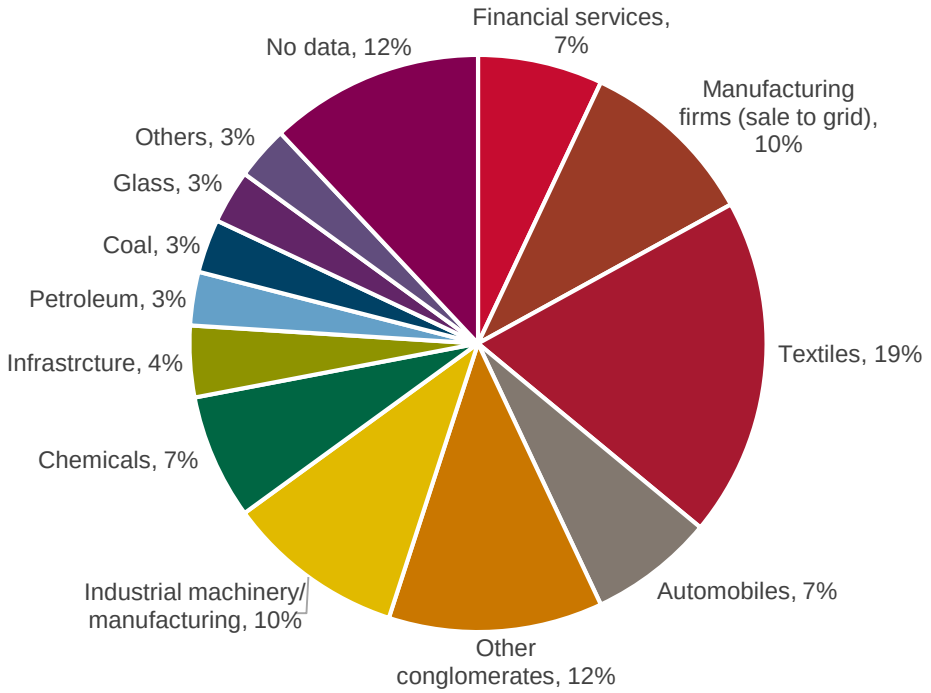
There were primarily three categories of investors in the state: firms looking to hedge against electricity supply risk for their operations, those seeking tax credits (many of the former were also tax credit seekers), and those looking to diversify their sources of income through power sale agreements with the state electricity board (these included both turbine manufacturers and small IPPs). Together these entities also formed their own sub-sector associations as well as prominent wind farm owners' associations. These firms covered a variety of sectors: automotive manufacturers (such as Ashok Leyland), chemicals and cement, and – somewhat uniquely for Tamil Nadu – a large contingent of spinning mills and textile manufacturing entities (see Figure 3.3). The Tamil Nadu Spinning Mills Association, for example, became one of the largest investors in wind energy during this period. In particular, these firms benefited highly from the Technology Upgradation Fund Scheme explained

above. All of these investors were ‘retail customers’, i.e. they relied on the wind turbine manufacturers for project development, execution and operation.

Thanks to increasing competition from low-cost manufacturing in Bangladesh, Indian textile manufacturers found that major brands had begun to move their operations offshore, prompting a widespread response from mill owners (Tamil Nadu remains home to most of the cotton production and export machinery in India).[21] Operationally, reducing costs was not simple – labour unions in Tamil Nadu have historically been extremely strong and wages in the state have always remained high – leaving power consumption as the most attractive means to cut costs in the short term. Given that industrial consumers (which included medium and small textile mills) were charged higher rates, wind power from captive systems or open access contracts became an excellent option.

The location of these assets is important to the slowdown in later years. Most of the wind-rich sites were in southern Tamil Nadu (see Figure 3.2), whereas the industrial clusters (including textile clusters) were mostly located in the northern part of the state. Between the northern and southern parts of the state there remained only a narrow transmission corridor to transfer power and this became crucial.

Figure 3.3 Tamil Nadu wind projects – investors by sector, 2003–07



Note:

Percentages calculated on number of projects, not installed capacity.

Source: Authors’ own, based on data from BNEF (2014).

Tamil Nadu Electricity Board – facilitator, financial interests in promoting wind

The state electricity board’s priorities during the time of growth were: financial sustainability, rapid clearances for wind projects, and development of wind power. Its main constraints were financial, though equally it could not make autonomous decisions; it was held in check by, among others, the regulatory commission. Continuing its historical role as a one-stop nodal agency for issuing clearances for wind projects, infrastructure provision, offtake clearances and grievance redress, the state electricity board remained extremely supportive of wind power between 2002 and 2005.

[21] See www.tn.gov.in/hhtk/dht/dht-textile.htm (accessed 11 September 2014).

The senior management of the electricity board had also maintained close relationships with the state government, together facilitating much of the investment in wind projects in the previous decade (1992–2002). This past role had also led to a number of mutual trusting relationships between the project developers (who were manufacturing firms), and between 2002 and 2006 a number of ratings agencies afforded Tamil Nadu the highest ranks and marks in terms of 'attitude' and 'procedural issues'. Another point mentioned in the interviews is the pre-existing relationship between mid-level managers in the electricity board and the wind industry.

The Tamil Nadu Electricity Board had two goals: firstly, under the instructions of the state government, to promote wind power for industrial consumers; secondly, to keep tariffs low and manageable for residential consumers, particularly in poorer areas. Operationally, the former was possible firstly because, between the late 1990s and 2007, much of the state's increase in wind power capacity was captive generation at sites already connected to the main grid. So, for the electricity board, allowing captive generation and charging for wheeling and banking facilities allowed them to earn revenues, with minimal outlay. In addition, there was enough firm (i.e. guaranteed, uninterrupted) power in the state to carry and manage the variable generation by wind power, enabling the banking and wheeling facilities to come into play (see the policy frameworks outlined in Section 2.4.1).

Another factor, however, reduced the capacity of the Tamil Nadu Electricity Board to provide critical elements such as infrastructure and investment in firm power. The board followed a government mandate (like all other state electricity boards) to provide cheaper power for residential consumers and the large number of political constituents in the agricultural sector, and consumer segments in economically backward areas – this meant that the overall costs of supply were higher than the recovery (Singh 2006; Tongia 2003; Dubash and Chella Rajan 2001). Increasingly dependent on borrowing and government subsidies, the board, despite its reputation for efficient collection and operation, followed a financial model that was unsustainable in the long run. In essence, the Tamil Nadu Electricity Board would borrow either from public banks or receive loans from federal government, in turn sanctioned by multilateral development agencies under a sovereign guarantee. Unable to repay these loans, this created a problem in later years when government 'dole-outs' ran out and the state government resisted changes in the governance of the state electricity board (namely, unbundling – see below).

State government – supporter of wind power through project authorisations

Politically, in Tamil Nadu, two parties have alternated control since 1969. In 2002, the party that had overseen some of the record increase in capacity between 1995 and 1998 returned to government. It remained supportive of wind power and continued to encourage an increase in capacity under the captive scheme, authorising a large number of projects and setting official targets for expansion. These targets were modest, however, apparently based on outdated information and lacking rigour, with only minimal participation from both the Centre for Wind Energy Technology and the Tamil Nadu Energy Development Agency (interview with former bureaucrat, Tamil Nadu).

The government also aimed to keep tariffs low under the sale-to-utility business model to manage procurement costs. The government meanwhile continued with two important provisions that had begun in the 1990s that were conducive to wind power. The first was making the state electricity board a nodal agency for project authorisation and land acquisition issues. Thanks to a close relationship with the management of the board, not only were No Objection Certificates for wind farms issued rapidly, but private land acquisition was encouraged, with the electricity board even stepping in as a facilitator. Under their schemes, private land was accorded a price by the government depending on the potential

yield from the site on a graded scale. Thus, many private landowners stood to gain a large profit from selling high yielding sites, as revealed by recent studies.

In the light of Tamil Nadu's Energy Development Agency's assessments of resources, with an emerging sympathetic policy regime and rapid project clearances, securing first-mover advantage became exceedingly important to firms' strategies. With resources still being assessed, firms with access to the best sites could offer better products and assets to prospective customers, resulting in a flurry of activity. When a new site was discovered, the land was acquired and 'hoarded' until customers were found.

Priorities
During the period of growth the state government's priorities were: industrial development, energy sufficiency, and low tariffs for residential consumers.

Wind turbine manufacturers – risk mitigation through supply models, information dissemination
It was in this period that individual manufacturers developed and honed the turnkey project business model that was to become a staple of the wind power industry (see Section 3.3). Under this model, the entire risk of prospecting, site development, construction, operation and maintenance was to be the responsibility of the wind turbine-supplying firm. Suzlon, Vestas-RRB, NEG Micon and Enercon were some of the prominent players, with strong supply chain bases within the state. With these firms bearing the brunt of short-term risks and project management, the risk exposure of investors went down drastically. In particular, once projects were cleared under particular schemes, both federal government schemes such as tax breaks and state government schemes such as tariff payments were included in the respective disbursing agency's budgets. Thus, in theory, policy fickleness or payment risk would not affect the contracts and power purchase agreements. For the captive model, as the Tamil Nadu Electricity Board earned money with no additional investment, there was no conflict of interest.

One more point is worth mentioning here: a majority of the investments in wind energy projects made each year were made in the third financial quarter, prompting some experts to question whether these investments were made for tax benefits under accelerated depreciation. Those manufacturing firms who were able to deliver projects before the year's close gained a competitive advantage.

With respect to connections, interviewees mentioned that in the wind industry, thanks to a history of working closely together in the 1990s to develop and execute wind projects, there was a high degree of trust between the officials of the state electricity board and the wind industry. While individual firms and officials were not named, on the whole, the interviews revealed that issues around land acquisition, project commissioning and other problems common to projects in other parts of India were, in Tamil Nadu, rare. Another important role played by the manufacturers (mostly through the platform of associations, discussed below) was in creating and disseminating information on wind power as an investment; their advocacy and lobbying skills proved invaluable.

Priorities
The wind turbine manufacturers' priorities were: profit and growth of the wind industry.

Wind industry associations – advocacy/lobbying
The industry associations had a general priority of sectoral development. Apart from shaping investor perceptions through educational events, conferences and workshops, the Indian Wind Power Association, Indian Wind Turbine Manufacturers Association and the Indian Wind Energy Association worked collectively to diffuse an 'ideology of wind' to both the government as well as the industry. Out of these, the wind power and wind energy

associations consisted of both wind turbine manufacturers as well as prominent investors in projects (the latter was founded by Suzlon and was mainly active in Maharashtra). The Indian Wind Turbine Manufacturers Association, on the other hand, consisted solely of manufacturing firms. The wind energy and the wind turbine manufacturers' associations, in particular, were instrumental in creating the business case for wind as a captive generation option to save on operational costs; they lobbied actively for wind projects under the Technology Upgradation Fund Scheme for textile firms. The buy-in from textile firms depended much on this instrument.

Tamil Nadu Electricity Regulatory Commission – policy clarity

The Tamil Nadu Electricity Regulatory Commission was initially formed in 1999 under the Electricity Regulatory Commissions Act of 1998. In 2003, its powers were expanded under the Electricity Act to its current form, where it consisted of former officials from the state electricity board who were experienced in both the technical and financial aspects of managing wind power. As such, when the reforms of the Electricity Act took place (see Section 2.4.1), the regulatory commission was responsible for rationalising the tariffs of wind power. However, the commission was also cognisant of the fact that the costs of wind power were to be kept low. Taking advantage of the state's higher yields from windy sites, it came up with some of the lowest tariffs in the country. The interviews and prior research hinted that the regulatory commission was sensitive to the fact that the state electricity board's model might be unsustainable and thus revised tariffs only three times in a ten-year period (2001–11), keeping them low. At the same time, by providing guidelines on banking and wheeling provisions, complementary to the state's policy, the regulatory commission provided much-needed clarity.

Priorities and constraints

The commission's priorities were: tariff rationalisation, policy clarity, and smooth operation of the state electricity board. It was constrained by the lack of legal powers to enforce its decisions and the overall power/political scenario within the state.

Public financiers – low-cost debt

Providing loans on a project-to-project basis, the Indian Renewable Energy Development Agency was a key provider of below-market rate credit in these early periods. The other important lenders were the Small Industries Development Bank of India, the Industrial Development Bank of India and the Tamil Nadu Industrial Development Corporation, who disbursed the interest rate subsidy to the textile factory owners who were eligible for the Technology Upgradation Fund Scheme. These bodies were, however, operated under a government mandate to lend. Their priorities were: market returns, the development of the wind industry, sound projects and financial models and, for the Small Industries- and Industrial Development banks, the development of the textile industry.

To what extent did the role of these actors change during the period of deceleration experienced by Tamil Nadu's wind sector?

Tamil Nadu Electricity Board – no incentive to extend support to infrastructure

By 2005, the carrying capacity of the narrow corridor used to transfer power reached its limit. New wind farms added in the southern part of the state could not 'wheel' power to the despatch centres in the north. It was proposed that the narrow transmission corridor be augmented. However, the capacity factor of turbines in Tamil Nadu was, at maximum, 35 per cent, and these transmission corridors were meant to carry power from wind only.[22] This effectively meant that for 65 per cent of the time, the proposed transmission corridors would lie unused, making it an expensive investment with low returns. In light of the constrained

[22] The capacity factor of a turbine is the power produced per year as a fraction of total power that would be produced if the turbine were to operate at full rated capacity through the year.

capacity to spend on infrastructure, and with little support from the state government, no support for this transmission corridor was forthcoming.

However, the state electricity board continued to issue certificates for wind farms despite this lack of investment in infrastructure as there was no directive from senior management or the state government to stop. In this case, while there was no action in favour of wind, there was no action opposing it either, but the lack of government support dented growth.

By 2006/07, another set of debates had opened the functioning of the state's electricity board to further scrutiny. In this period, a number of vertically-integrated state utility boards had already 'unbundled' (see Section 2.3.3) or had begun the process. The Tamil Nadu Electricity Board, on the grounds of its previous collection efficiency and functioning, resisted these procedures for two years. The state government, in turn, supported the status quo (with vested interests in the electricity board's borrow-and-subsidise paradigm), which resulted in a deadlock for two years with the board's capacity to make decisions severely constrained. The increase in thermal power capacity also slowed down.

State government – policy paralysis

The sitting state government, who could have issued directives to invest in the transmission corridor, did not take a decision one way or the other. In 2006, it was defeated by the main opposition who did not view the investment in this infrastructure as crucial and so the increase in wind power capacity stalled.

In addition, the newly elected state government resisted the unbundling of the state utilities and the subsequent proposed privatisation (some experts pointed to the fact that this would take away the government's influence on the state electricity board's decision-making). A deadlock on this issue between 2006 and 2008 was the focus of debate and deliberation between the union and state governments. In 2008, the decision was finally made to unbundle the board without privatisation.

Priorities

During the period of deceleration, the state government's priority was low electricity tariffs for residential consumers.

Ministry of Textiles – policy fails to achieve intended objective

In 2005, after three years of investment in wind projects under the Technology Upgradation Fund Scheme, the textiles ministry ruled that wind farms would no longer be eligible for the interest rate subsidy. The motivation for this decision lay in the consideration of the union Inter Ministerial Committee that firms investing in wind turbines were not making any upgrades to existing textile technology, which defeated the purpose of the initiative. This removal of financial support slowed down investments by textile firms into wind farms. Despite representations by wind energy associations and a few investors from the textile sector, the decision was not revoked. The Technology Upgradation Fund Scheme itself lapsed in 2007.

Turbine manufacturers and manufacturing associations – advocacy over infrastructure issues

In response to slowing investment, the Indian Wind Turbine Manufacturers Association and individual manufacturing firms petitioned the state government to permit private sector players to set up infrastructure. In addition, in 2006, the turbine manufacturers association and the state electricity board together formed a 'task force', allowing private investment into evacuation infrastructure at the substation level. This resulted in new substations being set up in southern parts of the state, although transmission infrastructure was still missing.

3.1.2 Assessment of relationships between actors

Tamil Nadu Electricity Board and state government
This relationship was both formal and informal. The senior management of the electricity board and the state government had worked together in the past to develop wind power in the state. In addition, the state government was responsible (through the energy department) for formal arrangements such as appointments and salaries in the directorial positions.

Tamil Nadu Electricity Regulatory Commission and Tamil Nadu Electricity Board
This relationship was formal. A number of previous officials at the electricity board were present as members in the regulatory commission. As such they were sensitive to the board's technical and financial constraints.

State government and Tamil Nadu Electricity Regulatory Commission
The state government and commission had maintained informal relationships from the past history of working together at the Tamil Nadu Electricity Board.

Manufacturers'/manufacturing associations and state government
Maintained a formal relationship through public fora, conferences, representations and annual meetings.

Manufacturers and Tamil Nadu Electricity Board
This relationship was both formal and informal. Thanks to the past history of working together in creating technical criteria for wind projects and executing them, a number of manufacturers and the mid- and senior management of the electricity board had maintained a network of mutually trusting relationships. One interviewee remarked that the bureaucracy in Tamil Nadu was always extremely helpful in acting as a nodal agency.

Lenders, project owners and manufacturers
Maintained both formal and informal business relationships.

3.1.3 Key observations

- Wind power in Tamil Nadu benefited highly from its 'co-benefits' to industrialised clusters, rather than purely as a business in itself
- The utility/state electricity board was a critical actor within the system and close relationships between the utility and state government and a common, positive view of wind power proved extremely conducive
- Historical relationships between the state electricity board, the government and experience with wind power projects formed the basis of trusting relationships between private actors and state electricity boards. Risks of delays and technical integration were reduced
- The captive generation model with the open access provisions at low penetration did not offer any direct incentives for utilities to oppose wind power at the time.

3.2 Wind power case study 2: Maharashtra – acceleration, 2005–07

With the second highest potential in the country (after Tamil Nadu, but with poorer quality sites – yielding capacity factors of 19–22 per cent in comparison to Tamil Nadu's 26–33 per cent) Maharashtra also ranks second in terms of installed capacity. However, Maharashtra was the initiator of two key policies for clean energy that have had a significant impact on the growth and development of wind power in India – namely the renewable purchase

specifications and the FITs. Furthermore, Maharashtra was also home to a number of high-profile wind energy projects across a variety of revenue models – the captive generation, sale-to-grid and open access contract. So, the following factors make Maharashtra an attractive case study:

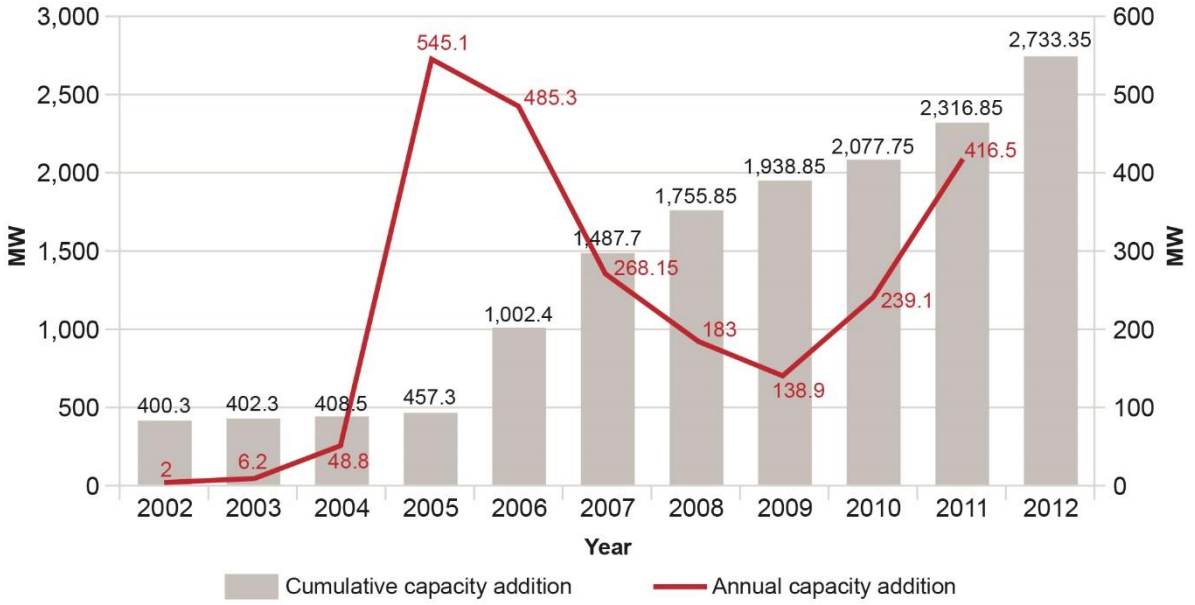
- There is a clear investment peak between 2004 and 2006 following policy changes at the state level. The details of implementation may yield lessons
- Maharashtra's wind energy policy environment has an array of elements: a number of incentives extended by the state government, the regulatory commissions and some by other agents such as the state energy development agency. As such, if policy has played a major role, Maharashtra may provide fertile ground in which to explore which policies make the most difference
- Maharashtra, as Suzlon's home state, hosts a number of high-profile projects that defined some of the early business models in the wind industry. The influence of such success stories on other actors' decisions can usefully be explored
- Maharashtra's regulators and its energy development agency have been extremely active – in contrast to other states, where the latter especially may play a muted role
- A number of policy and organisational innovations have come out of Maharashtra. The drivers and actors behind these may be better understood through this case study
- Maharashtra poses an interesting question: with a large and diverse investor base in wind turbines across many industries, what motivated these investors, as compared with those in Tamil Nadu?

The information and supporting facts for this case study have been drawn from interviews with a former official at the Maharashtra Electricity Regulatory Commission (November 2013); Idam Infrastructure (November 2013); Suzlon Energy (August 2013); a former official at the Maharashtra Energy Development Agency (October 2013); Indian Wind Energy Association (December 2013); and Bloomberg New Energy Finance (October 2013).

Table 3.2 Maharashtra: accelerated development – chronology of events

Date	Event
2003	Maharashtra Electricity Regulatory Commission raises tariffs from 2.25 rupees/unit to 3.5 rupees/unit with an annual escalation of five per cent over a contract period of 13 years – the tariff itself has a control period and is revisited regularly. First legally binding tariff order in the country. Also revised the wheeling and banking agreements, making them the lowest in India.
2004	Petition filed by director of the Maharashtra Energy Development Agency asking the commission to inculcate a statutory provision for a renewable portfolio standard, on the basis of provisions in the Electricity Act. Also introduced the Green Energy Fund.
2005	Suzlon signs memorandum of understanding with the government of Maharashtra to develop wind power in the state. National Electricity Policy comes into effect. Maharashtra Electricity Board unbundled.
2006	Regulatory commission fixes a renewable purchase obligation for Maharashtra; record year for capacity addition in the state.
2007	Investment slows drastically toward the end of the year, and tariff orders dry up. Upcoming elections stall clearances for wind projects as the land used for wind farms becomes the subject of scrutiny. A prominent non-governmental organisation (NGO) raises objections that the performance of wind farms in Maharashtra is lower than expected.

Figure 3.4 Increase in Maharashtra wind power capacity, 2002–12



Source: Authors' own, based on data from Centre for Wind Energy Technology (2012).

3.2.1 Key actors, roles, priorities and constraints

The key actors include central government (MNRE, Forum of Regulators, Central Electricity Regulatory Commission); at state level, the Maharashtra Electricity Regulatory Commission, Maharashtra Energy Development Agency, Maharashtra state government, Maharashtra State Electricity Board; and private companies (manufacturers – particularly Suzlon, investors, scheduled commercial banks, the Renewable Energy Developers Association of Maharashtra and the Indian Wind Energy Association). There were also notable civil society actors: Prayas, the World Institute of Sustainable Energy and the Centre for Science and Environment.

The roles they played during the period of growth and expansion of the wind power industry in their state were as follows:

Maharashtra State Electricity Board – facilitator

In terms of institutions and the power sector scenario, Maharashtra, like most other states, had a power deficit in 2003 (this is still the case). The supply-demand gap increased from 13.4 per cent in 2002/03 to 18.1 per cent in 2005/06 as the state utility resorted to load shedding to manage demand.[23] Major contributors to the state's thermal power generation capacity include private sector giants Tata and Reliance Power as well as state-owned enterprises such as the National Thermal Power Corporation, GAIL and others. Investment in generation capacity and infrastructure at the state level, however, remained capped because of the poor financial health of the state electricity board, despite a subsidy of over 5bn rupees each year from the state and central governments between 2003 and 2006. The board was finally unbundled in 2005, completing the transfer of assets and liabilities to the four daughter firms by 2007. The unbundling had a significant expansionary effect: with fresh funds issued from the central government for restructuring, the state electricity board (now the holding company for the three daughter firms responsible for power generation, transmission and distribution) announced fresh investment in transmission infrastructure, and notably, in the wind-rich districts of Dhule, Sangli and Satara (the latter was already

[23] Load shedding is a term used to describe planned and unplanned power supply cuts to certain consumer-geographic segments when the demand for power exceeds the utility's (in this case the distribution company's) supply.

home to what was then Asia's largest wind farm, the Vankusawade Wind Park owned by Suzlon).

The lack of infrastructure to transfer the energy generated from the project site to the substation and from the substation to the transmission corridors always remains a key consideration for wind projects. As utilities were responsible for this, wind projects had often faced a risk of delay and execution problems. The problems most often cited were the availability of funds and the capacity to invest in infrastructure (also see Tamil Nadu case in Section 3.1). In Maharashtra, the senior management of the state's electricity board and energy development agency had created an arrangement where the developer/promoter could pay for 50 per cent of the infrastructure through the development agency and the electricity board would bear the remaining cost. This was successful in reducing the burden on the utility for providing infrastructure for disaggregated wind projects.

Priorities and constraints

The electricity board's priorities were low tariffs for domestic consumers, agriculture and the rural areas. It also sought financial consolidation (with energy sufficiency). It was constrained in its decision-making, especially financial, and perceived itself as being under pressure from civil society groups to keep residential tariffs low.

Maharashtra Electricity Regulatory Commission – leading policy reform

Since 2003, when the Electricity Act came into effect, Maharashtra's Electricity Regulatory Commission had come up with a series of influential tariff orders. Firstly, unlike other state regulatory commissions it revised its tariff orders annually, and held consultations frequently. This regularity of decision-making allowed for lobbying groups to remain actively engaged in the process and highlight a number of issues that set the tone for renewable energy policies in the state (and were reflective of debates in others). In 2003, Maharashtra's regulatory commission decided that wind energy tariffs would be determined on a cost-plus methodology, allowing equity investors a return of 12–15 per cent. The motivation behind this was the energy shortage in the state (described above) and to make wind competitive with other investments in the market (which offered this sort of return). There was also a vision that, in the future, India would rely on renewables as they constituted a more secure source of energy and thus it was important to provide a platform for growth. In addition, to give a nudge to retail investors interested in setting up captive or open access plants, the wheeling and banking orders were strengthened, with a clear division of responsibilities for grid infrastructure. These orders, however, had a 'control period', capping the amount of capacity that could be added under a direct sales agreement with the utility to 750MW, in order to determine the industry response before proceeding. Thus, between 2004 and 2006, the policy environment for wind power in Maharashtra was considerably strengthened.

The regulatory commission also conducted a study to show that purchasing wind power at a higher cost would not drive up the consumer retail prices charged by the utilities significantly, because it constituted such a small percentage of the overall total. The study was a response to fears raised by both the utility and residential consumers (led and represented mainly by the NGO Prayas) who participated regularly in the regulatory hearings. The results of the study were then used to show that a renewable purchase specification could be implemented in other states as well, thus paving the way for this incentive's wider use and later, renewable purchase obligations, too (see Section 2.4).

Dr Pramod Deo, a key member of the state regulatory commission, had been responsible for setting up the Maharashtra Energy Development Agency in 1986 and played an important role in particular policy manoeuvres. Between 1999 and 2004, the development agency's director, who maintained connections with Dr Deo, helped to introduce the idea of a renewable portfolio standard. This was intended to boost numbers of co-generation projects in sugar mills, which were a major consumer of energy in the industrial segment, but wind

power also benefited as a result of the clarity this measure brought to the market. In 2006, Maharashtra's regulatory commission introduced a renewable purchase specification within the state, set at three per cent – the first anywhere in India.

Priorities and constraints

The commission's priorities were energy sufficiency and security, and the smooth and transparent operation of the state electricity board, plus adequate representation of its stakeholders. In common with other state regulatory commissions it felt constrained by its lack of legal powers to enforce the judgements it reached.

Maharashtra Energy Development Agency – policy and organisational innovation

The state energy development agency's director, Dr G.M. Pillai, who later founded the World Institute of Sustainable Energy, oversaw a period of great activity in Maharashtra's renewable energy industry. On the one hand, there was a movement to establish funds to provide the infrastructure necessary to transmit the electricity from the wind farm into the main grid that had become a bottleneck in Maharashtra, and to promote co-generation with a large sugar and textiles industry that was growing considerably each year. The plan, called the Green Energy Fund, was promoted by the energy development agency and the Minister for Non-Conventional Energy, and received support from the Maharashtra government. It essentially relied on a 'polluter pays' principle to create a fund for investing in transmission infrastructure from renewable resource-rich sites to existing state electricity board corridors. The fund was created by imposing a cess on commercial and industrial units to the tune of 0.04 rupees/unit, and resulted in an estimated collection of 1bn rupees per year, placed under the governance of the state energy development agency and the central government through the MNRE. Another 1–2bn rupees each year was collected from private investors, including commercial banks and the local infrastructure giant, Infrastructure Leasing & Financial Services. Over the next two years most of the funds (approximately two-thirds) were diverted to co-generation projects and related infrastructure, but they also contributed to the roadways constructed up to the wind sites and, to a smaller extent, to the transmission lines.

Priorities

The energy development agency's priorities were promotion of renewable energy and corresponding policy measures, but also political prestige.

Forum of Regulators and Central Electricity Regulatory Commission – policy brokering

The Forum of Regulators is a body consisting of the chairpersons of various state regulatory authorities and the Central Electricity Regulatory Commission. Dr Deo, who took over as chairman of the state's electricity regulatory commission in 2005, also helped broker the idea of national renewable portfolio standards ensconced within the provisions of the Electricity Act. The rationale was that some states, such as Tamil Nadu, already had enough power to meet the renewable purchase specification and that demand could be created with greater clarity in other states. It was felt that, nationally, the renewable energy market could not grow without such a provision across all states. The MNRE included the provision for a renewable purchase obligation within the National Electricity Policy and National Tariff Policy, setting up the regulatory bodies responsible for ensuring it happened.

Private manufacturers and Suzlon – process innovation to capture market

Prior to the passing of the Electricity Act in 2003, Maharashtra had added just 400MW of wind power capacity since the introduction of wind power in India in the 1980s and growth was stagnating. While 2003–04 did not see much improvement, 2005–06 saw a surge in the creation of wind power generation capacity. Of a total addition of 545MW Suzlon was responsible for 473MW, much of it in the districts of Sangli, Nandurbar, Ahmednagar and

Dhule (the wind-rich belt in western Maharashtra), and announced that the following year they would develop a wind farm with a capacity to generate 1,000MW.

Maharashtra was already home to some highly publicised projects; for example, Bajaj Auto, a leading automobile manufacturer situated in the Pune industrial cluster, was one of Suzlon's early customers. Suzlon commissioned a 62.5MW captive generation project for Bajaj Auto that allowed the company to write off a large portion of the electricity bill and get tax benefits, proving the success of a captive generation model similar to Tamil Nadu's (see Section 3.1).

Our interviewees made clear that securing first-mover advantage when the policies were about to be announced became critical. Since the tariff order was valid only for a certain amount of time and the power purchase agreements were for 13 years, speed became imperative. The critical link in the stage was acquiring land in the wind-rich belt in western Maharashtra, where gaining right of way and ensuring that wind farms could be prospected and developed required a certain amount of time. Negotiating with individual landholders and clearing the authorisation processes of the state was a long-drawn-out process. Maharashtra allowed these firms to negotiate directly with the third party, or in the case of agricultural land, go directly through the government. Suzlon Energy, based in Pune, which had already created a network of likely customers, managed to secure a vital first-mover advantage.

The firms who started early benefited. Enercon India set up two wind farms for sale to the newly created state utility, which bagged orders from China Light & Power in 2006 who became India's first large-scale wind IPP. Meanwhile, Suzlon received some high-profile offers for its wind farms in Dhule and Nandurbar, including BP Energy India, Tata Power (which both operated as IPPs), Essel Mining (a subsidiary of another giant conglomerate, the Aditya Birla Group), and also the Steel Authority of India and REI Agro who were diversifying into wind power. In 2006, Suzlon also opened its gearbox manufacturing unit in neighbouring Daman, a small union territory south of Maharashtra, created after it acquired Hansen Industrial Transmissions in Europe. The new induction gears produced in this facility also helped Suzlon create machines that were marketed as yielding higher capacity factor outputs, which were more profitable.

Priorities and constraints

The manufacturers' priorities were straightforward: profit and a stable policy environment in which to do business. They were constrained by risks and delays in accessing project-level resources, particularly land.

Box 3.1 Suzlon: end-to-end services in wind parks

Given the fragmented buy side of the wind turbine market, Suzlon had pioneered a business model of end-to-end service. With scarce wind sites, grid integration issues and the large number of customers interested in small installations, Suzlon (followed by other wind turbine suppliers) had initiated a model of *wind parks*. These estates or parks were, essentially, large swathes of land, over hundreds or thousands of hectares, owned entirely by the developer who in this case was also the turbine manufacturer. Turbine manufacturers, after initial resource evaluation, purchased the land, carried out detailed evaluation and micro-siting (which could be done well as the land ownership was not fragmented), and marketed the future turbines to investors. Simultaneously, the development of the wind park took place and construction activities began. The operation and maintenance of these parks were carried out by the developer for a fee, and the investor gained from the revenues and fiscal benefits with no additional input required. Beginning in the late 1990s, this model then became very prominent in the Indian market between 2003 and 2007, and all of the major turbine manufacturing firms – Vestas, NEPC Micon and Enercon – developed their own version.

Private investors – shift to newer models

The investors sought profit, too, but through tax benefits and returns on equity. A variety of investors invested in wind during this period: industrial consumers looking for captive/open access generation options as well as, uniquely in Maharashtra, firms from finance, chemicals and individual investors looking to diversify into wind power. Firstly, and most importantly, the state's renewable energy policies (stated above, and in effect from 2006) had created some excitement that Maharashtra would be an attractive destination for investment over the longer term. Secondly, there was confidence in the regulator (especially for the management of payment risk – between 2002 and 2006 it had issued orders against the non-payment of bills) and the local energy development agency. Thirdly, with the unbundling of the state utility in 2005, the cracks in the state's power sector were exposed and resulted in a slew of investments from the state government in infrastructure that increased the availability of good projects.

With attractive returns from FITs combined with the mitigation of risk offered by the manufacturers' turnkey project models, wind power in India was seen in terms of a new business model separate from the traditional attractions of depreciation/operational cost savings from captive generation. Agribusinesses, mining firms, independent power generating firms, banks, high net worth individuals, automotive firms, textile firms and chemical industries all invested for the profits that could be made.

One class of consumer that developed during 2007 was the IPP. With the high tariffs and power demand in the state, some prominent investors (such as China Light & Power and BP Energy) invested in big-ticket projects (40–50MW or more) purely as a means to sell power to the grid. This model was new in the Indian wind industry at the time and set the tone for tariff revisions and other instruments in the future (see Section 3.3).

Financiers – nascent period for long-term lending relationships

During this period wind power began to be seen as a stable business, with low risks and adequate returns. As the risk perception of the newly restructured market settled, lenders built up closer relationships with manufacturers. Suzlon, for example, syndicated loans with a consortium of lenders regularly, and the State Bank of India (SBI) chairman was a member of Suzlon's board of directors. Enercon, similarly, relied on existing networks with scheduled commercial banks and the Indian Renewable Energy Development Agency (although the latter would only lend on a project-to-project basis). Many networks based on business relationships were developed during this period and continue to this day.

But what happened when growth began to slow down, during the period of deceleration?

Maharashtra State Electricity Board – unbundled, financially constrained

By 2007, as the tariff orders began to lapse and the state electricity board was unbundled, the newly formed Maharashtra State Electricity Distribution Company found itself at the centre of a number of reimbursements and past payments that were pending. Given that dues were pending to external suppliers of thermal power and to private sector giants, wind power was given a much lower priority leading to payment delays – a significant risk for new investors.

Civil society – flagged concerns about improper policy implementation

The high wind tariffs in Maharashtra had become the subject of public scrutiny ever since the influential tariff order. Prominent civil society organisation the Centre for Science and Environment (CSE) investigated a number of installations in the state, bringing to light certain issues that brought wind farms some adverse attention. Finding that there were many locations where the capacity utilisation factor of the turbines was as low as 11 per cent and that, in certain areas, the wind farms had not even been developed but that the land was

being held for tax benefit purposes, the CSE published a series of studies highlighting these problems. They became the subject of much media attention and allegations that the accelerated depreciation was not incentivising production adequately.

Priorities
The NGOs' priorities were: low cost of renewables, efficient policies and project execution.

Maharashtra state government – policy paralysis, inability to manage local policy implementation
In 2007, with state elections looming, the government in Maharashtra, particularly the Ministry for Non-Conventional Energy, remained constrained in terms of new investments. On a separate note, wind farm developers unwittingly became the centre of populist protests in Maharashtra over land deals. Local politicians around the Pune area (near to Dhule and Nandurbar) harked back to the land deals covered in 2005/06, alleging that developers had not compensated local landowners adequately or had forcibly acquired the land. A popular petition by one member of the legislative assembly, a member of the opposition party, gained enough support to be taken up in the local legislative assembly by the opposition president. Maharashtra, which already had a reputation for a volatile political environment, now suffered blows to the reputation of its business environment. Ratings agencies still rank the state poorly when it comes to land-related and procedural issues. The combination of political risk and temporary regulatory standstill slowed wind power installations considerably.

Priorities
The state government's priorities were industrial growth and low tariffs. It was constrained by pressure from the electorate and an inability to monitor and regulate projects and local level processes.

3.2.2 Assessment of relationships between actors

State government and Maharashtra Energy Development Agency
This relationship was both formal and informal. The agency required support from the Minister for Non-Conventional Energy to launch the Green Energy Fund and required assistance in securing buy-in from the state's electricity board. In this, the government was very helpful.

Maharashtra Electricity Regulatory Commission and Maharashtra Energy Development Agency
Again, a relationship that was both formal and informal. The founder of the agency was a member of the regulatory commission. In addition, the leadership of the agency was in close contact with the commission through formal channels. The idea of a renewable portfolio standard required both sets of agents to formulate and then push through the idea at the state level.

Maharashtra Electricity Regulatory Commission and Forum of Regulators
This relationship was exclusively formal. The chairperson of the commission who was, by extension, a member of the Forum of Regulators, tried to sell the idea to the MNRE of a cost-plus methodology of tariffs, as well as the idea of a renewable energy portfolio standard.

State government and Maharashtra State Electricity Board
This relationship was both formal and informal. With the need to provide power cheaply for smaller industries, low-cost power for other electoral constituents, and overall, cut down operational costs and losses, the electricity board shared many goals with the state government.

3.2.3 Key observations

- The role of the regulator and leadership can be extremely important under the policy regime set out in the Electricity Act. Provisions for wheeling, banking, tariffs and other elements that determine the revenue model fall under the purview of the regulator, whose decisions are, in principle, independent of the state government
- The Forum of Regulators provides a seemingly important arena for brokering policy ideas and principles. It is also an important body for disseminating research
- The risk profile of wind projects and the lack of service providers in development, execution and operations allowed turbine manufacturers to develop an end-to-end service model that helped expand the investor base to a much larger, more fragmented market. This precipitated a suppliers' market.

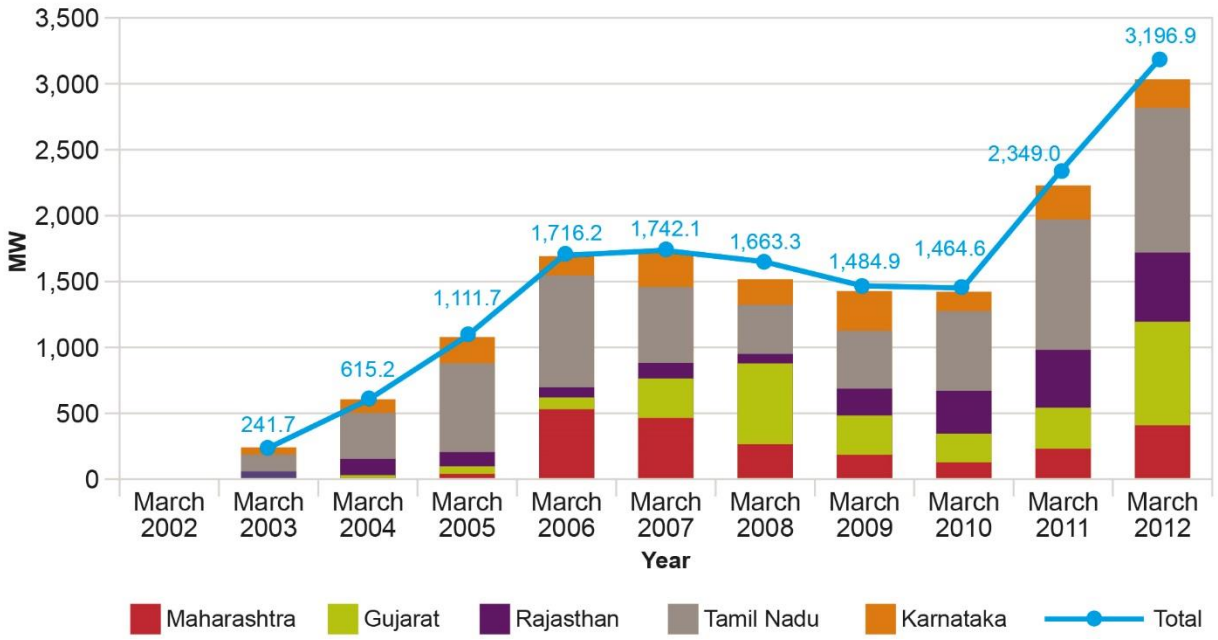
3.3 Wind power case study 3: the generation-based incentive and independent power providers, 2009–12

Given the events of the previous years and the experience with higher tariffs and multiple investors, many stakeholders in the wind industry pushed for a generation-based incentive (GBI). There was a view within policymaking circles that, as well as higher tariffs, performance-rewarding instruments and a push for greater efficiency were necessary, prompting interest from a class of firms looking to provide and sell power as a service. The launch of this GBI also coincided with other measures that incentivised better performance. Experiences in states such as Maharashtra showed that the renewable purchase specifications (later, renewable purchase obligations as defined by the Central Electricity Regulatory Commission – see Section 2.4.2(d)), implemented with strong regulatory support, were a valuable tool to provide market/policy clarity. However, nationally, the market was still shallow as a number of states with poor renewable energy resources were setting (understandably) low renewable purchase obligations. In order to tie together states' renewable purchase obligations a mechanism of tradable renewable energy certificates was established (see Section 2.4.2(f)), which essentially allowed obligated states (and entities) to purchase these certificates in lieu of generating power from renewable energy sources. Hence, the GBI and the renewable energy certificates represented a shift in the system of incentives toward performance.

Newer investors and entrepreneurs – including those from overseas – invested in the IPP model introduced in 2007 and, as the model matured, brought some expertise to India as well. To give some idea of their scale: the five largest IPP investors in India have a combined project pipeline of 16GW in the next five years, compared with India's cumulative installed capacity of 19GW in 2013. In 2010 and 2011, approximately 35 per cent of all projects were IPP projects, signalling the beginning of a possible shift, or at the very least a significant addition to the wind power market. This case study aims to illustrate, firstly, the launch of the GBI and its role in attracting investors; and secondly, the incentives and risks faced by this newer class of investor.

The information and supporting facts for this case study have been drawn from interviews with a prominent IPP firm (September 2013); Suzlon Energy, Regulatory Affairs department (September 2013); Bureau of Energy Efficiency (November 2013); Indian Wind Energy Association (December 2013); and Bloomberg New Energy Finance (October 2013).

Figure 3.5 Annual increase in wind energy capacity for all of India, 2002–12



Source: Authors' own, based on data from Centre for Wind Energy Technology (2012).

Table 3.3 GBI, IPPs and acceleration, 2009–12 – chronology of events

Date	Event
December 2009	MNRE announces GBIs of 0.5 rupees/kWh over and above power purchase agreements worth US$60m for projects totalling 4,000MW.
2010	The Central Electricity Regulatory Commission announces renewable energy certificate norms. Markets open but are extremely shallow. Mytrah Energy and ReNew Power incorporated. Outlook of foreign lenders toward Indian wind sector improves drastically after the events of the global financial crisis.
2011	ReNew Power, Green Infra, Mytrah Energy, China Light & Power all expand their project portfolios. Investment peak year for wind energy investments in India.
2012	GBI withdrawn, accelerated depreciation withdrawn, renewable energy certificate market failures appear, combined with macroeconomic instability, weak rupee and cautious lending – resulting in a dramatic fall in investments.
2013	Fall in stock prices and a strengthening rupee make wind an attractive investment. GBI reinstated, investments rise again.

Table 3.4 Key investment events

Date	Event
2008	Green Infra incorporated by IDFC Private Equity Ltd with a financial commitment of ~US$88m.
October 2010	Mytrah Energy listed on London's Alternative Investment Market (AIM) – raised US$79.24m in equity.
June 2011	Mytrah Energy secures a first tranche of mezzanine finance (a first for any Indian wind energy IPP) – raised US$78.5m from the India Infrastructure Fund (managed by IDFC Project Equity).
August 2011	Mytrah Energy secures a second tranche of mezzanine finance – raised US$33.3m from IDFC Ltd.
September 2011	ReNew Power receives US$250m equity investment from Goldman Sachs.
December 2011	Mytrah Energy secures a third tranche of mezzanine finance from PTC India – raised US$20m from PTC India Financial Services.[a]
June 2013	Goldman Sachs invests another US$135m. Constructed portfolio reaches 318MW.

Notes: [a] PTC India Financial Services is also a public–private partnership between the state-owned Power Trading Corporation India Ltd (60 per cent equity shareholder), Goldman Sachs, Macquarie Group, Capital Investment, Global Investment House and the domestic Life Insurance Corporation and SBI.

3.3.1 Key actors, roles, priorities and constraints

The key actors for central government are: the MNRE, Ministry of Finance, Prime Minister's Council on Climate Change and the Central Electricity Regulatory Commission.

The key institutions at the state level are: Rajasthan government, Maharashtra state, Maharashtra State Electricity Distribution Company Limited, Maharashtra State Power Generation Company – Mahagenco Ltd, Rajasthan Renewable Energy Corporation Ltd (the state nodal agency for Rajasthan) and each of the relevant State Electricity Regulatory Commissions.

The private companies and investors include IPP entrepreneurs, foreign equity investors (e.g. Morgan Stanley, BlackRock), wind turbine manufacturers, and industry associations (e.g. the Wind Independent Power Producers' Association, and India Wind Turbine Manufacturers Association).

But there are other lenders as well, both public (e.g. IREDA and SBI) and private (e.g. IDFC India and L&T Infrastructure).

MNRE – policy reform

Role

Up until 2007, the MNRE had, for many years, followed a regime of tax incentives (e.g. accelerated depreciation) to attract investments in wind power. With rising tariffs (led by Maharashtra), however, the wind park and wind estate models selling power to the grid had become quite profitable for large (>25MW) wind farms in India. The scale of the projects was also helpful for utility firms and end-use managers as the size of the facilities smoothed factors such as load variation and unpredictability of the resource. With enough tariff variation across the wind-rich states (high in the case of Maharashtra, moderate in the case of Rajasthan and low in Tamil Nadu and Gujarat) it was felt that a 'level playing field' or at least a longer-term incentive was needed for larger players. In addition, there were questions raised as to the efficacy of the depreciation-based tax incentive to actually produce power (raised mainly by civil society organisations, see below). The ghosts of 'gold-plated'

machines in the past had also been raised by an evaluation of underperforming farms and assets in newer installations (Rajsekhar *et al.* 1999). Indeed, as the accelerated depreciation-driven market was heavily geared toward installation, a large portion of the profits in the value chain were accrued by manufacturing firms, whose interests were not immediately aligned with generating electricity.

Following a number of closed-door discussions with stakeholders in the industry beginning in 2006, in 2009, the MNRE introduced the generation-based incentive, which could not be used with the depreciation benefits available to wind projects, with a cap of US$60m for projects totalling 4,000MW. This was done on an experimental basis with a control period of two years. This was a relatively low-risk layer of revenue, disbursed by the state nodal agency and which bypassed the state electricity board entirely. Although the incentive added a small part to the returns on equity, it was relatively risk-free and signalled the move to a focus on generation.

Priorities and constraints

The ministry wanted to make sure it got the right sort of investment to spur the wind power market, to promote the generation of electricity rather than simply the installation of turbines. It wanted to rid itself of the investors attracted by the depreciation incentives who were primarily interested in wind power assets as tax shields and exited once they had recovered their investments and taken the tax benefits. Its priorities therefore included the stronger renewable energy certificate market, incentives (such as the GBI) for all classes of investors, plus funding for infrastructure. The MNRE was constrained, however, by its limited ability to signal policymaking at the state level. It also had little spending power and marginal influence over areas such as infrastructure provision, land, and so on.

Planning Commission, Indian Renewable Energy Development Agency and other bureaucrats (policy reform)

Prominent bureaucrats within the MNRE (in particular, the ministry's former secretary and joint secretary), the Clean Development Mechanism of IREDA,[24] a few state regulatory commissions and prominent members in the wind energy industry (such as Dr Ajay Mathur: former president of Suzlon, former consultant and later, the director general of the Bureau of Energy Efficiency) had long pushed for a move to incentivise the generation of electricity, leading to a series of stakeholder meetings from 2006 onwards. This was outlined within the Planning Commission's (2006) Integrated Energy Policy report which also came to the same conclusions. The business case for a GBI was constructed (theoretically) and the MNRE brokered the idea to the Ministry of Finance.

A second prod in this direction came from the sheer numbers that wind power had achieved. In 2006, for the first time, electricity from wind exceeded power produced from nuclear power (a highly publicised and much debated sector at the time). This event, much discussed within policymaking circles, became an important talking point in preparations for the climate change talks taking place in Bali at COP 13.[25]

[24] The Clean Development Mechanism is an arrangement made under the Kyoto Protocol which creates emissions reduction 'credits' through emissions-reducing projects in developing countries. These credits can then be purchased by developed countries to meet their own emissions reduction targets. The revenues generated add to the revenues of the project generating these credits.

[25] Conference of the Parties, Thirteenth Session. The Conference of the Parties is the governing body of the United Nations Framework Convention on Climate Change.

Central Electricity Regulatory Commission and Prime Minister's Council on Climate Change – policy innovation

Role

In 2009, the Prime Minister's Council on Climate Change announced its *National Action Plan on Climate Change*. One of the key provisions was that each state must set a minimum renewable energy purchase obligation (at five per cent) and escalate it each year. The obligated entities included distribution utilities, group captive customers[26] and open access customers (third-party customers using the state's transmission network to buy power from merchant providers). The problem was the inclusion of states with minimal renewable energy resources.

Discussed internally within the Forum of Regulators and the Central Electricity Regulatory Commission, the idea of a renewable energy certificate market was deemed a suitable means to link generation at the state level to national demand. The physical transfer of power remained a problem, however – in particular, electricity transmission between the northern and southern parts of the country is extremely constrained as transmission corridors simply do not exist. The renewable energy certificates, in accordance with the Electricity Act, would introduce a compliance measure so that states could, in theory, set and meet renewable purchase obligation targets. Given the demand for power, however, the certificates do not directly address states' primary concern (i.e. the physical supply of electricity) (see Shrimali, Tirumalachetty and Nelson 2012 for further details on the renewable energy certificate market's performance).

Priorities

The commission's priority was to implement the stipulations of the *National Action Plan on Climate Change*.

State Electricity Regulatory Commissions – adopting renewable purchase obligations and other policies

Apart from federal-level policy, some states became early adopters of the renewable purchase obligations and renewable energy certificates – the Maharashtra and Rajasthan regulatory commissions were the first to announce an adoption of renewable purchase obligations after the National Electricity Policy and National Tariff Policy were passed in 2006. In Maharashtra, this only meant strengthening existing renewable portfolio standards. By 2009, this renewable purchase obligation was projected until 2014 and included open access customers. This was a significant signal for the market.

Independent power producers (IPPs) – changing the model[27]

With higher tariffs, Clean Development Mechanism benefits and, now, the introduction of the generation-based incentive and renewable energy certificate market, the returns on equity (on a per project basis) could range between 15 and 16 per cent, making wind more than competitive with other investments. Our interviews revealed that the higher tariffs, projected demand for power, and a positive reception of the renewable energy certificate market formed the final tipping point for a rush of development players in the wind power sector. With the central government itself endorsing and regulating the renewable energy certificate market, investors felt confident that there was sufficient policy stability.

This market model is already used in other countries, although it is a first for India. Gradually, the focus of manufacturers also began to adjust. Traditional turnkey models became cheaper and more cost-efficient. Turbine design improved so that they could function efficiently at lower wind speeds: Suzlon, ReGen Powertech and other

[26] A group of firms or facilities purchasing power from a single supplier.
[27] Please refer to the wind power sector overview in Section 2.6 for details of the business models.

manufacturers all launched models with better yields in International Electrotechnical Commission (IEC) class II and III sites which have low-medium wind speeds.[28] In fact, ReGen has been able to claim that their turbines are the most efficient in Indian conditions.

The initial turnkey model has also been challenged. Manufacturers providing turnkey project services typically carried with them information about attractive sites and would gain first-mover advantage by proceeding to secure the land in question for future sale. IPPs, with their large scale, have themselves sought out sites and many (e.g. Mytrah Energy, ReNew Powertech and Greenko Group) have built their own expert teams of experienced individuals to conduct resource assessments, secure the land, build the necessary infrastructure and carry out other pre-project activities. The strategy was to optimise on costs, allow for customisation (by not relying on the turbine models provided by the turnkey service provider), and so increase their profits. In the years that these firms have entered the market, the share of established giants such as Suzlon and RRB has fallen, and the share of firms such as GE Energy and ReGen Powertech who position themselves primarily as suppliers, has grown.[29]

Even in the IPP model, our interviews revealed that the state-level policies were more important than central-level policies. Tariffs, wheeling and banking provisions (all controlled by state regulators, utilities and governments) form the basis of the revenue models developed by IPPs, and thus, IPP projects still remain sensitive to 'policy fickleness' at the state level (see accounts of state-level actors below). These firms all have a diverse asset portfolio across multiple states – concentrated in Rajasthan, Maharashtra, Karnataka, Gujarat and Tamil Nadu – and their experience is illustrative of the risks and incentives present in the sector.

In addition, IPPs' interests in the sector are not entirely and immediately aligned with manufacturing firms, especially those vested in the older business models where the manufacturer controls a large part of the value chain. The Wind Independent Power Producers' Association formed a separate representation to governments at the state and national levels, making sure that their point of view was fully represented in the policy consultation processes.

Priorities and constraints

The IPPs' priorities were profit and building up scale rapidly. They could get higher returns by using the generation-based incentive and renewable energy certificate market than from the previous incentive of accelerated depreciation, although the risks were higher. They were constrained by their exposure to risks at state level, in terms of access to the infrastructure necessary to transmit the electricity generated and political uncertainty over instruments that enable merchant contracts (see Section 3.3.2).

Equity investors – new models attracting foreign investment

Since the launch of the *National Action Plan on Climate Change* and the global financial crisis, the outlook for the Indian market has changed considerably. Foreign investment firms, with a benchmark return on equity of 20 per cent, found that the IPP business could deliver the returns and also had sufficient scale to absorb the capital that they wanted to deploy. As a result, a number of deals have been struck in the Indian wind power sector (see Table 3.4). The role of these actors beyond investing and providing guidance on best practice to their ventures, however – particularly in policy formulation – was minimal. Indian equity

[28] International Electrotechnical Commission: the IEC categorises wind speeds according to classes ranging from I (the best quality, highest speeds with the greatest frequencies) to III (among the lowest wind speeds). A brief overview can be found online at: www.renewablesfirst.co.uk/wind-learning-centre/what-is-the-wind-class-of-a-wind-turbine/ (accessed 12 September 2014).

[29] There exist many other reasons for this, including the financial unsustainability of the business models followed by these firms both domestically and internationally. See wind case study 3.4.

investors have also been engaged. IDFC Private Equity, one of India's largest infrastructure funds with a mandate to invest in renewables, has committed the most funds. Most other Indian firms have limited themselves to providing debt capital.

Priorities
The foreign investors are interested in profit alone.

Table 3.5 Key foreign investments in IPPs, 2010–12

Firm	Foreign investor	Details
ReNew Power	Goldman Sachs	September 2011: US$250m June 2013: US$135m
Mytrah Energy (formerly Caparo)	Eton Park International, BlackRock Investment Managers, Capital Research Global Investors	Raised US$80m on London's AIM Raised US$111.8m from domestic investment firm IDFC Ltd
China Light & Power, India	China Light & Power (Hong Kong)	Undisclosed. Entirely owned by CLP
Bhilwara Green Energy	International Finance Corporation	US$15m in equity
Inox Renewables Ltd	International Finance Corporation	US$130m (US$40m equity, rest in debt)

3.3.2 Risks inherent in the GBI and IPP model

Reneging on contracts – Gujarat state government and Gujarat state utility
In Gujarat, IPPs came up against significant challenges in early 2013, when a developed wind farm was refused an offtake agreement. This was the result of a decision taken by the local electricity board that average pooled purchase cost-based purchases would not be allowed.[30] Although the underlying reasons for this decision were unclear, the broad explanation was that the electricity board was constrained in its budget and, as the purchase costs were too high, decided to suspend power purchase agreements. Following this decision, ReNew Power's team attempted a series of negotiations speaking with the officials of the state electricity board and its utility (GUVNL – Gujarat Urja Vikas Nigam Ltd), which proved unsuccessful. A parallel series of petitions was also made to the state chief minister, who had previously publicly supported renewable energy in his state. As petitions from other notable operators in the state also gained momentum, the electricity board and utility were forced to reverse their decision, but with a compromise – that half of the capacity installed would be commissioned under an average pooled costs scheme and half would be commissioned under a cheaper, fixed feed-in tariff. The outcome of this series of decisions severely affected the profitability of the project and delayed commissioning by six months.

Priorities
It is the stated view of the Gujarat government that the state should be a leader in attracting foreign investment as well as a leader in the energy sector (these are general stated objectives, unconfirmed as applying to the wind power sector in particular). One interviewee remarked that the state government possibly also aimed to become an energy exporter. The priority for GUVNL, the state utility, was to maintain its financial stability.

[30] Average pooled purchase cost is the weighted average cost of electricity at which the purchasing entity (in this case, the state utility or privately owned distribution company) buys power from various sources. As in India, tariffs for the power sector are determined by the electricity regulatory commissions; this is notified by the state electricity regulatory commissions.

Conflict over tariffs – Maharashtra state government and Maharashtra State Electricity Distribution Company vs Maharashtra Electricity Regulatory Commission

In August 2013, when the Maharashtra State Electricity Regulatory Commission raised the existing tariff of wind power by 40 paise/unit (~0.67 US cent) to 5.81 rupees/kWh, it faced stiff opposition from the state government, the Maharashtra State Electricity Distribution Company and Mahagenco (the state power generation utility). The stance taken by the government and the distribution company was that the commission, by fixing higher tariffs for wind power (particularly when selling to industrial consumers directly) was biased in favour of wind, particularly when the Maharashtra tariff was much higher than those of Gujarat and Tamil Nadu. Citing the performance of plants under the accelerated depreciation scheme, the parties pointed out that investors in the recent past (2011/12) had already recovered their capital costs. The result was that the distribution company refused to sign wind power purchase agreements; projects worth 500MW, in various stages of development and commissioning were suspended.

The motivation of Mahagenco for protesting was straightforward. Tasked with promoting solar power, Mahagenco owns all of the state solar generation plants. The regulatory commission has fixed some of the lowest rates in the country for solar and claims by Mahagenco reveal its perception that these tariffs for solar power are unviable. The final result of these clashes was that the commission did not lower its tariff rates and the distribution company refused to sign power purchase agreements, a practice that it had already adopted when the tariff hike was initially being considered, even before its approval. Thus, wind power projects totalling up to 500MW and already developed between March and September 2013, could not be commissioned.

Priorities

With successive cabinet changes between 2006 and 2008, the Maharashtra state government, previously extremely supportive of renewable energy, particularly wind power, has more recently adopted a less supportive stance. Its priority is energy efficiency, but relying more on stable thermal power (coal) rather than wind.

The Maharashtra State Electricity Distribution Company, since unbundling in 2005/06, has been rectifying the debts and loans that made it a loss-making entity. Low costs have been its main priority.

Elections and political unpredictability – Rajasthan state government and Rajasthan Renewable Energy Corporation Ltd

Uncoordinated activity has also caused problems in Rajasthan. The state is characterised by certain unique elements – namely, lower tariffs, different land acquisition policies (generally seen as better), and higher *force majeure* risks including theft and lockouts – and is perceived as requiring administrative support and coordination. While the administration was traditionally supportive of wind power producers (and now, increasingly, solar power), in what was perhaps an attempt to upstage Gujarat or other states and emulate the success of the NSM, the state nodal agency announced that a further 300MW of projects in the state would be allotted purely through competitive bidding. This was problematic on many counts: as investors' business models were geared toward conventional project allotments and offset the high costs and risks of setting up infrastructure by the stable returns of tariffs, their effectiveness in responding to the new proposal was severely compromised. Given the uncertainty surrounding the returns in competitive bidding, which only added to the riskiness of projects due to the lack of grid infrastructure, the Indian Wind Turbine Manufacturers Association and the Wind Independent Power Producers' Association approached the state chief minister to discuss this issue and ask for a phased introduction of competitive bidding. Despite sympathy and a promise of investigation from the political class, no action could be taken with the looming state elections. The state election commission, in an attempt to curb

any populist measures and hasty legislative action, suspended all decisions for a period of six months before the election. Unable to respond, the state government could not publicly announce a decision and the Rajasthan Renewable Energy Corporation was subsequently approached by the powerful wind turbine manufacturers association as well as the newly formed association of IPPs. In September 2013, the decision was reversed. However, in early 2014, a new state government was elected, which has so far shown less interest in promoting renewable energy than the previous one.

Failures in the certificate market, the grid – state energy regulatory commissions
Another significant source of risk includes the failure of the renewable energy certificate market and the related question of grid expansion. Interviewees cited significant reluctance shown by state utilities to purchase these certificates. Haryana, Uttar Pradesh and Delhi particularly would not meet their renewable power obligation targets and obligated bodies in these power-starved states argued that the physical transfer of power was a greater priority for them than obligations. In each of these states, the central government was loath to take punitive action by withdrawing grant money, as development was much higher on the agenda than renewable energy. The state regulatory commissions, sympathetic with the utilities on this matter, also did not take action.

A proposed solution to the renewable energy certificate market has been the creation of interstate infrastructure. The bottleneck preventing physical transfer of power between states lies in the poor condition of interstate corridors and state-level infrastructure constructed by state utilities and distribution companies. Private sector stakeholders have raised concern that the Power Grid Corporation of India's current approach to setting up grid infrastructure is highly influenced by its experience with the conventional power industry. Project approvals and processing times take six months and along with other activities and construction, up to three years in total. For wind projects, which have a turnaround time of six to 15 months, this is impractical. This bottleneck also compromised the firms' ability to sell surplus power from high-quality sites to third-party consumers in other states. A second factor affecting project profitability is also the high charge made by the Power Grid Corporation for its grid infrastructure. Charged on an installed capacity basis rather than per-unit transfer, wind power projects suffer from additional transaction costs due to their low capacity utilisation factors. This means that few agencies are willing to invest in upstream infrastructure, including government agencies. A major constraint for the regulators, as ever, is their lack of legal powers to ensure compliance from the utilities.

A remedy? Industry associations and the Planning Commission
In the light of the various coordination issues between states, regulatory stakeholders and private sector stakeholders, the prevalent view in the industry is that a forum for all stakeholders in the wind sector is necessary. To this end, representations from the associations of turbine manufacturers and IPPs approached the Planning Commission and the creation of a national 'task force' to bring stakeholders together is now underway.

3.3.3 Assessment of relationships between actors

Ministry of New and Renewable Energy and State Electricity Regulatory Commissions
Officials at the ministry have formal relationships with the state level regulatory commissions, but can only recommend and have no legislative powers. Officials do maintain informal relationships with regulators at the state level, but these have limited influence.

Central regulatory commission and state regulatory commissions
The central commission can determine the norms and broad structures of the policy mechanisms. However, the implementation of the policy at the state level is entirely dependent on the state regulatory commission and the central commission lacks any enforcing powers.

State regulatory commissions and state-owned utilities
The goals and priorities of the state regulatory commission may (as in the case of Tamil Nadu) or may not be (as in the case of Maharashtra) aligned with the state utility, although broadly power sufficiency is an important factor. Formally, the state commission can pass orders with which the utility must comply, but the utility can delay action through protests or appeals to the government, so in effect the state commission may have limited power to enforce its decisions in the short term.

3.3.4 Key observations

- At the state level the risks created by a lack of coordination between the various bodies concern investors the most. They rely on the legal status of the agreement as an important measure against short-term policy changes
- Merchant contracts are less risky than power supply agreements with utilities (in terms of payment risks). However, by controlling the banking, wheeling and open access policies, state level regulatory commissions and governments have considerable influence over the viability of the revenue models. For particularly cash-strapped utilities, for which industrial consumers form high-value segments, supporting open access (merchant) contracts is simply not a priority
- The overall trends in the industry point to a move toward a 'national framework' of policy, although the implementation has been challenging so far. However, the policy has favoured a more mature business model and a new investor class whose interests are more aligned with the desired output (i.e. the generation of more power)
- The industry is therefore at least beginning to show signs of a structural shift away from the older suppliers' market. The state of the manufacturing industry itself may become a medium-term risk in the future if supply fails to meet demand.

3.4 Wind power case study 4: Suzlon – the Indian 'champion' in the wind power manufacturing sector

The explosive growth of the Indian wind power market between 2000 and 2007, which put it among the leading wind power markets in the world, is marked by Suzlon's growth into a dominant force in the domestic market. During the same period, Suzlon not only became the dominant local player, but one of the world's leading wind turbine manufacturing firms – its growth avidly studied by scholars.

However, the foundations for this growth – the demand conditions in the Indian market, the strategies adopted by the firm, the unique factor conditions and wider technological interplay – offer intriguing lessons as to how investments in wind power were enabled. This case study, then, is a brief overview of Suzlon's domestic success and, through this firm, a historical view of the Indian wind turbine manufacturing sector itself. This case study, dealing with a single firm and its role in facilitating investments, does not follow the structure of the previous case studies directly, but is organised into a number of sub-sections: the early days of Suzlon, its global manoeuvres and strategic action, its domestic manoeuvres and strategic action and finally, its recent position and activity under the changing policy and investment regimes explored in the previous case studies.

The information and supporting facts for this case study have been drawn from interviews with the Suzlon Energy, Business Development department (March 2014) and Suzlon Energy, Regulatory Affairs department (September 2013).

Table 3.6 Suzlon Energy – chronology of key events

Date	Event
1995	Suzlon Energy Limited founded in Maharashtra by Tulsi Tanti and the Tanti family.
1997	Suzlon acquires former licensing partner Südwind Energy in Germany.
2001	The Tanti family closes textile business to focus solely on Suzlon Energy. Suzlon executes captive generation projects for big-ticket investor Bajaj Auto. Suzlon executes wind park projects to demonstrate the financial viability of wind energy investments.
2004	Suzlon Energy A/S founded in Denmark. Per Pedersen from NEG Micon joins Suzlon, develops global strategy. Joint venture with ELIN Motoren GmbH. Citigroup Inc and ChrysCapital invest US$24m for a collective stake of 15 per cent.
2005	Acquires Hansen Transmissions International NV for US$520m. Funded by ICICI Bank, SBI, Deutsche Bank AG and Barclays Bank PLC. Listed on the Bombay Stock Exchange and National Stock Exchange of India; raises ~US$348m. Invests US$14m in Minnesota, US, in a manufacturing facility. Takes over Sarjan Engitech (engineering components firm). Arrangement with Winergy for gearbox supply (within India).
2006	Enters Italian, Australian and South Korean markets. Gains 53 per cent market share in India. Gains a seven per cent market share globally. Establishes rotor manufacturing facilities in Gujarat and Maharashtra.
2007	Acquires 33 per cent stake in REpower for €453m. Raises US$500m in debt through the sale of zero-coupon convertible bonds in the US.[31] Raises US$552m through a follow-on offer of equity to qualified institutional buyers.[32] Hansen listed on the London Stock Exchange for ~US$400m.
2008	Strong focus on cost-efficiencies and reducing sourcing distances. Acquires a further 37 per cent stake in REpower. SE Forge issues equity shares to IDFC Private Equity, raises 4,000m rupees (~US$80m). Sells ten per cent stake in Hansen. Completes a blade retrofit programme, adding significantly to the company's debt. Completes a US$383m rights issue.
2009	May: Sells two per cent stake to raise 230 crore rupees (US$50m). July: Raises US$175m through an offer of global depository receipts.[33]

[31] Zero coupon convertible bonds: bonds bought at less than their face value, with the face value repaid at maturity by the issuing entity; zero coupon means that there are no periodic interest payments; 'convertible' means that they can be converted to shares of common stock of the issuing company at a certain price.
[32] Qualified institutional buyers: entities satisfying a certain net-worth criteria and who own and invest, on a discretionary basis, a minimum amount of money as determined by stock-exchange regulating bodies (for example, the Securities and Exchange Commission in the US).
[33] Global deposit receipts: bank-issued certificates in more than one country for shares in a foreign company. The bank, in this case, is typically an international bank and the shares are traded domestically in the issuing country, but are offered for sale globally through the various branches of the bank. Thus, these receipts allow companies to raise capital through international channels.

(Table 3.6 cont'd.)

2010	Celebrates 5,000MW of installations in India – cumulatively, nearly one-third of the Indian market. Enters into a long book-order with leading IPPs.
2011	Exits Hansen by selling its remaining stake. Launches 9x wind turbine platform in India. Defaults on its foreign currency convertible bonds accumulated in the previous years.[34]
2012	Enters into a corporate debt restructuring programme with a consortium of 19 banks/lenders, raising working capital limits.
2013	Sells 75 per cent of its Chinese subsidiaries.

Founded in 1995, with an initial investment of US$600,000 as a diversification from Tulsi Tanti's core textiles business, Suzlon Energy was one of India's first wholly indigenous wind turbine manufacturers. Like other Indian firms, Suzlon began by gaining access to European technology via licensing agreements, in Suzlon's case with Südwind in Germany, but saw an opportunity to absorb these capabilities when the latter went bankrupt in 1996, enabling Suzlon to take it over. This acquisition, allowing the development of capabilities upstream, was the first of many for Suzlon Energy.

Suzlon's management board, consisting largely of Mr Tanti and his family, saw wind power generation as a ready market in India. Their own experiences with erratic power supply and the high costs of power for industrial consumers convinced them that wind power, which was supported by accelerated depreciation and various other tax incentives and excise duty breaks, was a viable alternative and provided a ready growth market. All that was needed was a proper business model. In Mr Tanti's experience, Indian firms had very little expertise in installing and maintaining wind farms, and did not always have the capacity to bring the necessary skills together for one-off projects. Thus, he saw an opportunity for an engineering, procurement and construction (EPC) service provider, who could develop, execute, operate and maintain a project on behalf of the power plant owner, thus creating and capturing value. This formed the core of Suzlon's business model – selling turnkey projects along with supply and maintenance contracts for businesses of all sizes. This model would soon spill over to other countries.

In the early 2000s, a number of flagship projects helped Suzlon Energy cement their position as one of the leading firms in the wind turbine industry and popularised their end-to-end service model, which became a staple for the Indian market (and later, for other markets), creating pressure on other manufacturing firms to develop their own variants of the same service.

Many major projects executed by Suzlon in the late 1990s/early 2000s set the standard for the captive generation/buy-back projects that became the standard model in the Indian market. One of these was a 62.5MW captive generation project for Bajaj Auto, one of India's leading automobile firms, in Pune, Maharashtra. This project allowed Bajaj Auto to significantly reduce their power bill through the wheeling and banking arrangements with the state utility (see Sections 2.3 and 2.4) and, along with the major tax incentives, significantly cut operating costs. Bajaj would be a repeat customer for Suzlon for other significant projects. Suzlon's own presence in Maharashtra, Mr Tanti's home state, expanded rapidly by leveraging the Tanti family's existing business network in the textiles business. By 2004, Suzlon had become a dominant player in the state, and established manufacturing facilities in other wind-rich states, namely, Tamil Nadu and Gujarat. The company's existing

[34] Foreign currency convertible bonds are 'convertible' bonds that allow companies to sell bonds in a currency other than their domestic currency, thus allowing customers from other countries to buy these bonds. As they are 'convertible' they can be converted into a share of common stock of the issuing company for a certain price.

connections and its understanding of the textiles business also helped Suzlon bring the captive generation model as a means to cut costs to other textile industry clusters in these states (see Section 3.1), where the speed of executing such projects became critical.

Another critical offering that Suzlon brought to its customers was access to credit. Banks in India, at the time, perceived wind power to be a fairly risky business, so they lent at rates with a high premium, and took a long time to conduct the due diligence. Suzlon and other turbine manufacturers aimed to speed up the process. Relying on individual relationships developed with a few key banks (e.g. SBI and Punjab National Bank) during earlier wind power projects, Suzlon helped project investors secure credit for their projects, putting the entire risk of the project on its own balance sheet. For the partnering banks, a strong balance sheet-based loan provided an instrument to distance themselves from the risks of individual projects as it shifted the risk onto the individual investor and EPC firm. The balance sheet of the third party (in this case, Suzlon) became the key metric for lending. Fuelled by strong growth, Suzlon's year-on-year cash flows helped create confidence in both lenders and investors, and this model was particularly prevalent between 1995 and the early 2000s when the Electricity Act was taking shape (see Figure 2.5 for a timeline).

Another key project by Suzlon, the Vankusawade Wind Park in Maharashtra, was set up to demonstrate the viability of the IPP/buy-back scheme. In 2001, Suzlon acquired thousands of hectares in the Satara district of Maharashtra, setting up grid infrastructure and developing a wind park based solely on its S33 350kW turbines. By 2004, this was Asia's largest wind park and in 2014, with a total capacity of 184MW, it remains one of the largest. Suzlon developed the site from scratch, conducting resource surveys (previously the purview of the state nodal agency) to assess the road and grid infrastructure. Suzlon also commissioned and erected the turbines on its own, and then ran the wind farm. While the Vankusawade Wind Park is wholly owned by Suzlon, the pattern of ownership of other such farms in Jaisalmer in Rajasthan, or Sankaneri in Tamil Nadu, is different. What is interesting is the ownership of the individual turbines: a number of firms from Maharashtra's rich industrial belts and from Tamil Nadu and Rajasthan own projects ranging from less than 5MW to 50MW within the wind farms, constituting a large 'retail' consumer segment. Suzlon developed and refined this wind park model – acquiring and setting up assets which entailed a risk of delays and construction early on, then offering customers projects of various sizes with a short turnaround time (approximately four to seven months) and providing a 'guaranteed' stable return for 20 years by virtue of the locked power purchase contracts with the state-level utilities. In fact, Suzlon took on the role of representative in negotiations with the utilities and in appealing to regulators and other machinery against payment risks, etc. (see case studies 3.1, 3.2 and 3.3, which show that the state utilities are important stakeholders whose cooperation is critical for a project's success).

Suzlon also competed on the basis of an extremely short turnaround time between an investment decision and the erection and commissioning. The company's head of Regulatory Affairs, Chintan Shah, explains that:

> *Suzlon always had a ready pipeline of land available. We would begin the project activity early on, acquiring or leasing the land, putting up our wind masts and setting up roads and sometimes even setting up electric substations. Once you have these things in place, the actual turbine manufacturing takes only two months. The installation and commissioning [have] a similar timeline. Therefore, what is apparently a short turnaround time really is not, and people don't often see this background homework.*

This ability to rapidly meet consumer demand constituted a key competitive advantage for Suzlon. The diversity of the project sizes allowed investors with different requirements, ranging from investments of a few hundred thousand rupees to many millions, to participate

in wind projects. With Maharashtra's tariff regime, wind power became attractive both as a business and as a tax-saving scheme. While in Maharashtra, Rajasthan and Gujarat, investors looked for both business models – captive generation and selling power to the grid – with roughly 40 per cent of investments going into the former, Tamil Nadu had a greater number of investors in captive generation (see case study 3.1).

This model, of course, met with great scrutiny. NGOs and industry experts alleged that the capital subsidy-intensive regime in India, with its focus on accelerated depreciation, encouraged sub-optimal behaviour, citing investment decisions made in Suzlon's wind parks. The criticism was based on the fact that many of Suzlon's orders came in the third quarter of the year, when most firms carried out tax-planning activities. If investing in wind power was primarily a way to save on taxes, then the parent firm would decide to invest and expect a rapid turnaround time – and Suzlon, thanks to their willingness to take on projects of all sizes and deliver them fast, was the reliable provider. This led to a burst of last-minute investments in wind power, with little regard to the execution of the project itself or to the power generated.

However, these allegations were denied by both the wind turbine manufacturers and the investors. The Renewable Energy Developers Association of Maharashtra, a consortium of investors, many of whom had sunk equity into wind park-based projects by Suzlon, Enercon and other developers, actively lobbied for good returns on investments through preferential tariffs (or FITs) instituted under the Electricity Act. Nonetheless, wind power developers in India did not immediately focus on better generation, and indeed, turbine costs, rates of return and project execution speed were more important than turbine generating capacity and performance. Despite a wealth of detailed data on this issue, NGOs such as the Centre for Science and Environment, the World Institute of Sustainable Energy and Prayas conducted their own studies, finding that turbine performance in India was indeed lower than in other countries, but without reaching consensus on the exact reasons.

3.4.1 Global aspirations

By the early 2000s, Suzlon had become a manufacturer of choice for many Indian firms, actively creating the business case for wind and conducting market development activities at industry fora and conclaves. Partnering with industry associations such as the Indian Wind Energy Association, Indian Wind Turbine Manufacturers Association and the Indian Wind Power Association, Suzlon was an active participant in educating a number of industries and industrial clusters who were either new or first-time investors in wind. Its rapid growth attracted major private equity investments from the US-based Citigroup Inc and ChrysCapital, who together invested nearly US$25m in the firm. However, Suzlon's growth-aggressive model needed further diversification and Mr Tanti believed that the only direction to expand would now be global.

In 2003, Suzlon's expertise in Indian low-wind environments helped it secure project orders in the American Midwest. With this, the firm decided to establish its presence in other countries. Its core strategy consisted of three elements: vertical integration, establishing manufacturing centres within learning networks and close to the demand sites, and finally, leveraging its international footprint and its knowledge of diverse environments. With growing markets in Europe, China and the US, becoming an international player presented a lucrative opportunity.

Vertical integration, both forward (into distribution) and backward (into core component manufacturing), allowed Suzlon to gain two important advantages: firstly, in the existing business climate the supply for critical turbine components such as gearboxes was controlled by a few manufacturers, whose production capacity was the determining factor in the global supply of wind turbines. By acquiring these capabilities, Suzlon provided itself with

a firm platform for sustained future growth. This was doubly advantageous in terms of cost and value: because of the limited supply, a large portion of the profits in the wind turbine value chain was captured upstream in component manufacturing. Suzlon, by virtue of vertical integration, could internalise these profits within its supply chain.

The second advantage was that Suzlon could, in essence, control every aspect of its product, replicating its end-to-end services model or develop new models according to the domestic business environment of whichever market it chose to explore. This flexibility was crucial for the company as a differentiator. In a flurry of acquisitions and expansion, Suzlon bought AE Rotor Holding BV in the Netherlands, set up manufacturing facilities in Minnesota, set up joint ventures with ELIN Motoren GmbH in Germany, founded a global headquarters in Denmark and brought in expertise in the form of Per Pedersen, the chief operating officer of European giant NEG Micon. This significant knowledge and asset base, combined with investment in upstream R&D in India, helped Suzlon begin the indigenisation of multiple components of the turbine – effectively allowing specialised design suitable for the local markets in which it operated. This also allowed the firm to diversify its product offerings from smaller turbines to mid-size turbines (and for the Indian market, which lagged behind Europe in terms of technology, 'larger' turbines of over 1MW). Suzlon, without the expertise and access to funds that other global firms possessed (e.g. GE Energy and Siemens), had managed to build up capabilities to rival the existing giants in the global wind turbine manufacturing industry.

To fund this aggressive inorganic growth Suzlon listed itself on the Bombay Stock Exchange in 2005, raising approximately US$350m, with its shares being oversubscribed nearly 40 times. Breaking off its license agreements in rotors with Aerpac BV and blades with Enron Wind, Suzlon then attempted two major acquisitions that were critical links in the global supply chain.

In 2006, Suzlon bought Belgium-based Hansen Transmissions, a key supplier of cutting-edge gearboxes to Vestas, Siemens and Gamesa, so gaining access to R&D and manufacturing capabilities in gearbox technology. Essentially, this made Suzlon a supplier to some of its competitors. Hansen would provide Suzlon with the manufacturing, innovation and financial capabilities (through stake sales) that sustained its strategy for years to come. Fresh off the back of this success, Suzlon proceeded to diversify its product offering even further, moving into large-scale on-shore and offshore turbines, by purchasing REpower, a German company with capabilities of manufacturing 3.5–6MW turbines – at the time, the world's largest. Strategically, Suzlon gained early entry into what it anticipated would become a booming offshore wind industry in Europe as well as critical know-how on handling and integrating such large machines.

3.4.2 Manoeuvres within a stable regime

The Indian market was characterised by rapid changes in the policy regime at the state level, in terms of tariffs, utility offtake agreement windows, government policies and tax incentives, etc. For a turbine manufacturing firm to succeed, the ability to secure early-mover advantage within a favourable policy window and lock in project investments was critical.

To try to achieve some policy stability and predictability, a number of turbine manufacturing firms actively lobbied at state-level electricity regulatory commission meetings and advocated the need for longer-term security. In different periods, this materialised as investment peaks in different states. Suzlon secured bids for a large proportion of the capacity added during a favourable policy period in Maharashtra between 2003 and 2007. The firm's management teams and board were made up of people from different backgrounds – policy analysts at leading NGOs, ex-government officials, top management

from banks, and so on – which helped the company develop a strong network that gave it flexibility and the ability to react quickly to external changes.

3.4.3 Domestic activity under a changing policy regime

While Suzlon was diversifying its operations across the world,[35] its share of projects within India still made up a significant chunk of its revenues (~60 per cent in 2011). India now had the fourth largest wind market in the world, supported by FITs and renewable purchase obligations under the Electricity Act. At state level, however, there was frequent policy change and constant uncertainty. Acting with speed, and capturing the resources for good wind projects – sites, land, infrastructure, government approval – to gain early-mover advantage was more important than ever. By 2007, Suzlon held the top spot in the domestic market, but its long-running model of end-to-end services was facing increased competition. To compound the difficulties, its debt-heavy model and aggressive acquisition-based growth had created a large deficit, which was increasingly difficult to fund.

Between 2007 and 2008, Suzlon raised funds from multiple sources, including selling a 10 per cent stake in Hansen and listing it on the London Stock Exchange. In the same year, doubts about the reliability of Suzlon's products were raised in the US, where a number of turbines, installed in major projects across the south and Midwest, developed cracks in the rotor blades. The firm had to spend massive amounts in a blade-retrofitting programme, further denting its cash flow.

Then came policy changes in the domestic market. The Indian government was unhappy that the current policy regime encouraged investment in renewable energy sources but not the actual generation of power. So, in 2009, it increased FITs and introduced the generation-based incentive, market-based tradable renewable energy certificates and renewable purchase obligations. As a result, the nature of the investor in wind power began to change, as did the basis of competition. Projects became larger, foreign direct investment in wind power generation increased and interest in achieving and driving grid parity surged. Firms still relied heavily on the 'retail' market for wind power, but in addition new turbine technologies emerged which claimed better overall efficiency and productivity – the gearless turbine, for example, introduced by newcomers to the market, cost less to maintain and had greater generation capacity. In addition, as IPPs emerged, some de-linked project development and operation, separating turbine supply from other services. Suzlon, while still a key turbine supplier to many IPPs, lost market share. Between 2007 and 2012, it dropped to 34 per cent in the face of competition from turbine suppliers such as Gamesa, Enercon (now known as WinWinD), GE and ReGen Powertech, which focused on R&D and developing turbines tailored to local low-wind speed regimes. Indeed, GE and ReGen are leading suppliers to IPPs, earning almost all of their income from this segment.[36] Thus, the policy regime and changing investor characteristics combined to change the nature of the demand itself, which was no longer met by the end-to-end services business model.

Suzlon found itself struggling to sustain its growth-led, debt-based business model. After 2009, the debt it took on exposed the firm and its subsidiaries to a high degree of risk, and Suzlon had to resort to further equity dilution in the core business and subsidiary firms both domestically and internationally. By 2011, the debt had grown to approximately US$200m, putting the board under enormous pressure. At the same time, to compete technologically, Suzlon began the development of its first wholly indigenous turbine designed specifically for IEC class II and III regimes in India, the 9x platform, which incorporated multiple features from the global best-selling 8x platform. Reliability and grid-integration, along with lifecycle costs are now the design characteristics on which Suzlon is attempting to compete with

[35] During this period handsome policy incentives in the US, China and other economies were giving wind power a fillip across the world. Suzlon, by 2008, had commenced operations in 16 major economies.
[36] Interview with ReGen Powertech, 3 March 2014.

other turbine manufacturers. Since 2010, however, Suzlon's share in the Indian market has further decreased, prompting questions about its strategy of global acquisitions.

3.4.4 The current scenario

With a global downturn affecting the wind power industry along with the global economic crisis and slowdown in the European wind power markets, Suzlon failed to grow at the pace required to sustain its debt. Between 2010 and 2012, the firm defaulted on a number of loans and underwent a massive corporate debt restructuring programme, diluting its equity further. By 2013, its market capitalisation, once nearly US$1,500m, had fallen to US$450m. While maintaining its presence globally, Suzlon's domestic revenues fell further as the Indian government's withdrawal of the accelerated depreciation incentive severely dented growth in the 'retail' segment of the Indian wind market – the key segment for Suzlon (see UNEP/BNEF 2012, 2013). This policy uncertainty led to further risks and a tough business environment for Suzlon, exacerbating its existing debt-related problems.

The CEO and owner, Mr Tanti, recently announced the intent to slow the company's growth-centred approach and to focus on consolidation within its core markets and initiate cost-cutting measures. In light of these events, there has even been talk of moving its core manufacturing and research facilities to the US, in anticipation of an improving economy and policy environment abroad. The firm believes that the wind industry is about to pick up globally as the economy rebounds, and expects that its technology bets and services model is also likely to pick up, and Suzlon, durable, is likely to thrive.

4 Case studies – solar power sector

4.1 Solar power case study 1: investments under the National Solar Mission, 2009–11

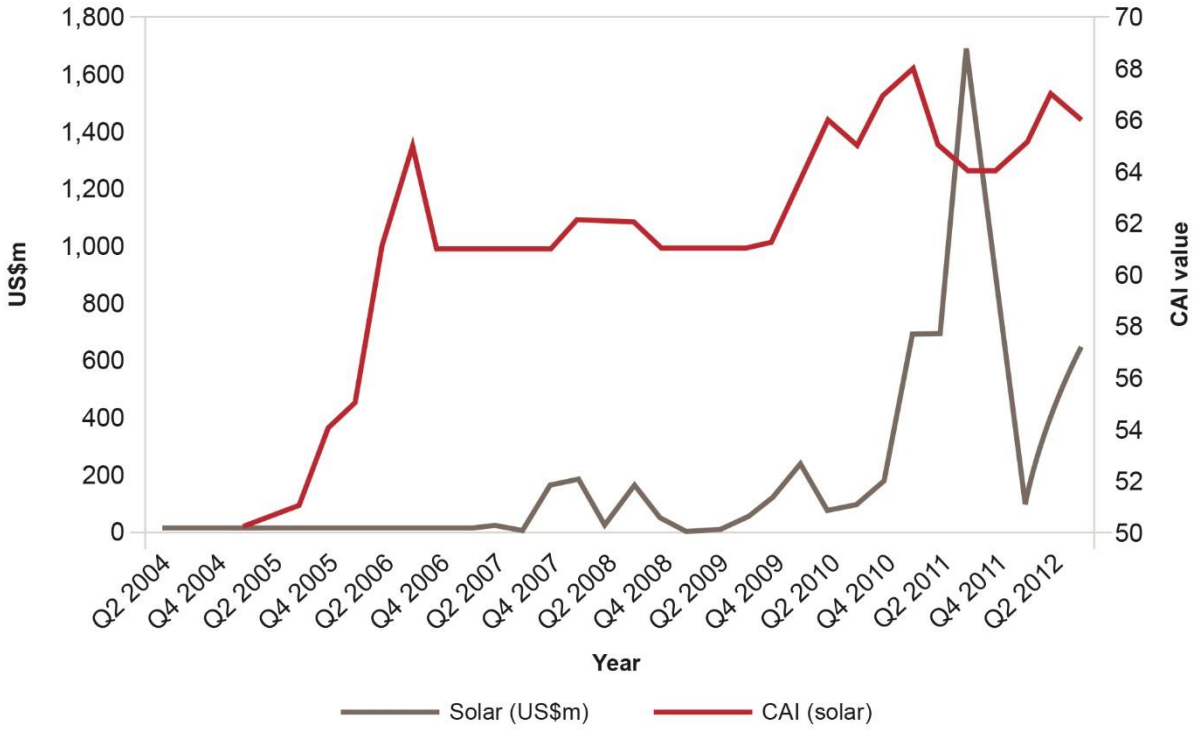
Prior to the NSM India had no definitive policy package to support renewable energy generation and to bring together the various institutions involved in its implementation. The mission represents a transformation of the whole system – the policymaking process, the engagement of public and private stakeholders, and the implementation – and involves both the MNRE and the Ministry of Power, under the aegis of the Prime Minister's Council on Climate Change and the *National Action Plan on Climate Change*. Studying the NSM is useful for understanding the conditions and coordination that are required for an intervention of this nature, as well as the roles of actors and investment involved in creating a high-profile industry such as solar power is perceived to be.

Points to note:

- Implementing the mission required the government to signal the creation of a market within the regulatory structure of the power sector. This also required state-level bodies to coordinate and this case study explores how they did this
- The mission created a framework for both integrated industrial development policy and deployment. The political economy interests of different private actors affected the policymaking elements as well as the investments themselves
- Solar photovoltaic technologies can be broadly classified into two types: crystalline silicon (c-Si) and thin films. Of these, the former has had a longer track record of deployment and a relatively proven history. Crystalline silicon can also yield higher conversion efficiencies as compared to thin films, but is relatively expensive to produce. Thin films, by comparison, are cheaper to produce and are relatively more durable. It is also believed that thin film technologies can still be improved to yield higher efficiencies, although, due to a global oversupply of c-Si, thin films are attracting few investors, even at the R&D phase
- The first phase of the NSM imposed a domestic content requirement on all projects allocated. In batch 1, this was limited to the modules used in projects, and in batch 2 this was expanded to include crystalline silicon solar cells as well. Thin film technologies were exempted from this requirement.

This case study aims to shed some light on the following questions: What motivated actors to act and come together? Which aspects of policy were important for investors? What mechanisms emerged from these interactions?

Figure 4.1 Investment in solar power, 2004–12



Source: Authors' own, based on data from Ernst & Young (2014) and BNEF (2014).

The information and supporting facts for this case study have been drawn from interviews with a former official at the MNRE (November 2013); the World Bank (October 2013); Bridge to India (July 2013); a prominent solar power developer (April 2013); a prominent solar power system manufacturing firm (June 2013); and the authors' observations of NSM stakeholders' meetings in phase 1 (February 2013) and phase 2 (September 2013).

Table 4.1 National Solar Mission – chronology of events

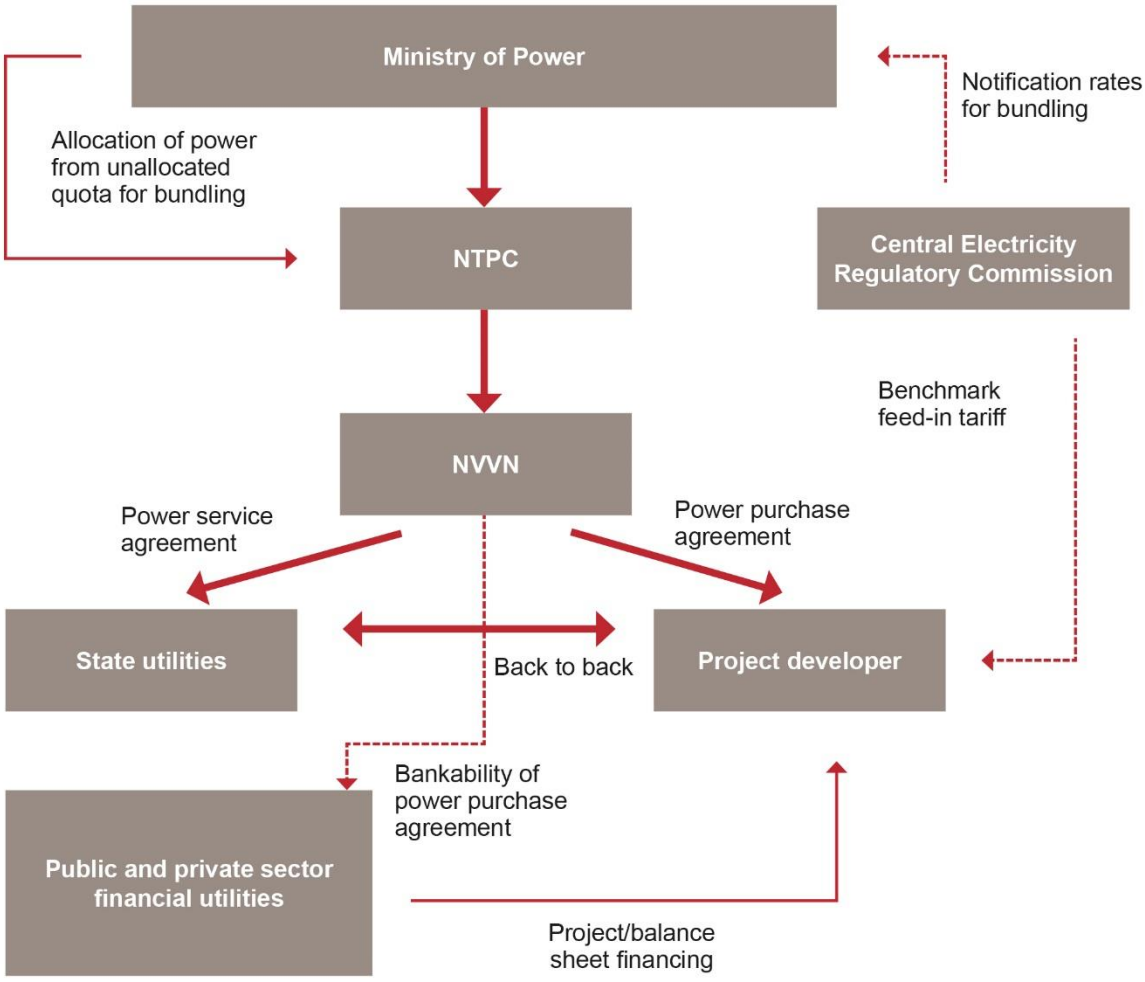
Date	Event
2006–07	Internally, the MNRE begins to formulate a national action plan or 'mission' for solar power.
2008	*National Action Plan on Climate Change* announced and 'missions' brought under the aegis of the Prime Minister's Office. NSM (previously an MNRE initiative) launched. An initial budget allocation of 385 crore rupees (US$85m) made. Closed-door meetings initiated between various ministries.
2009	NVVN becomes nodal stakeholder in power purchase agreements through NTPC, a registered public sector company, which is brought in as an institutional actor.
September 2010	Asian Development Bank announces US$400m commitment. Four hundred and eighteen project bids submitted for a cumulative target of 1,000–2,000MW for phase 1, batch 1. Project sizes are small (5MW cap) with a domestic content requirement. Developers prefer sourcing alternative equipment from foreign suppliers.
October 2010	Thirty solar projects allocated and the transparency of the process is lauded. Authorisation of 172.3m rupees to 37 'solar cities'.
July 2011	Projects constituting 610MW achieve financial closure.

(Table 4.1 cont'd.)

November 2011	Solar Energy Industry Advisory Council constituted by the MNRE to help attract investments, encourage R&D and make the Indian solar industry competitive.
December 2011	Allocated 350MW in utility-scale solar projects under batch 2 (20 projects). Ninety per cent of these projects are in Rajasthan. Cap on project sizes relaxed (up to 20MW), and players looking for scale invest.
2012	NVVN replaced by the Solar Energy Corporation of India under the supervision of the MNRE. Power purchase agreements directly signed with the Solar Energy Corporation of India.

Notes: NTPC: National Thermal Power Corporation Ltd; NVVN: NTPC Vidyut Vyapar Nigam Ltd.

Figure 4.2 Institutional framework of the National Solar Mission



Notes: PPA: power purchase agreements.

Source: Adapted from PwC (2012).

Table 4.2 A short overview of the salient features of the National Solar Mission

Instrument/provision	Purpose
Reverse auctions	Price discovery/push down costs
Long-term power purchase agreements	Reduce payment/policy risk
Tripartite payment agreement with NVVN and Reserve Bank of India	Provide stronger offtake agreements; ensure that payments from utilities will be routed through the Reserve Bank of India
Domestic content requirements	Market provision for domestic manufacturers
Payment guarantee schemes	Mitigate payment risk arising from utilities' poor financial health
Caps on project sizes and allocations to one firm	Encourage competition
Non-compliance penalties on timelines for execution, generation and operation for plant owners	Dissuade non-serious candidates
Legal norms mandating local vehicles for investment	Regulation and inflow of capital
Restrictions on equity dilution for stipulated time periods	Ensure long-term participation

The provision of long-term power purchase agreements, the tripartite agreement and payment guarantee schemes were the most important de-risking measures for investors who looked for stable returns and some protection from the risks in the renewable energy power sector at large.

4.1.1 Key actors, roles, priorities and constraints

The key actors in this case were numerous. For the central government they included: the MNRE, Ministry of Power, Prime Minister's Office, former Special Envoy for Climate Change, National Manufacturing Competitiveness Council, NTPC (National Thermal Power Corporation Ltd) and NVVN (NTPC Vidyut Vyapar Nigam Ltd), and the Central Electricity Regulatory Commission.

At the state level it was Rajasthan that played a major role: its state government, the Rajasthan Renewable Energy Corporation Ltd and the Rajasthan Electricity Regulatory Commission.

In terms of private companies, these were pure play solar power developers,[37] conglomerates, equity investors (foreign and local) and manufacturing firms.

The domestic debt financiers were the scheduled commercial banks, e.g. Axis, ICICI and SBI. Finally, the international debt financiers included: the International Finance Corporation, Asian Development Bank, US Exim Bank and China Exim Bank.

[37] Pure play developers are firms with no business other than developing solar power projects (as opposed to conglomerates and diversified businesses).

Ministry of New and Renewable Energy

Role
Prior to the launch of the *National Action Plan on Climate Change*, the MNRE had already internally discussed a plan for some sort of national 'mission' on solar power. Interviewees pointed to a number of factors that contributed to this internal initiative: firstly, India's own large resource endowments; secondly, the fact that Indian firms had already begun forays into solar power (both manufacturing of solar power systems and deployment at the utility and sub-utility scale); and thirdly, the MNRE had already had experience with solar power in the distributed and off-grid segments.

However, before a plan was launched a national climate agenda had begun to take shape, prompted by both the Prime Minister's Office and actions at fora such as the G20, and also by the actions of the vocal Minister of Environments and Forests at other international fora. When the *National Action Plan on Climate Change* was launched, the Prime Minister's Office moved the nascent solar mission under the aegis of the plan. Not only did this broaden the scope and provide a strong mandate, but it was also an ambitious plan to make India a globally significant market for solar power. Driving the mission, however, firmly remains the prerogative of the MNRE.

Priorities
The MNRE's main priorities were national: to achieve energy sufficiency and political prestige for India. The mission, in its initial form, was discussed to expand MNRE's initiatives in renewable energy deployment. Once the *National Action Plan on Climate Change* was launched and the nascent mission included, the MNRE saw an opportunity to increase the scale and scope with a strong mandate.

Constraints
It lacked the capacity to manage larger issues in the power sector, such as the behaviour of state utilities and infrastructure development. Through the Solar Energy Corporation of India, the MNRE gained a greater role within the implementation of the mission. It also lacked the capacity to influence debt financiers.

Ministry of Power

Role
Once initial inertia had been overcome, the implementation of the mission passed to the bureaucracy. The secretary of the Ministry of Power shared a common connection with the former Special Envoy for Climate Change and the secretariat in the MNRE. All three became involved in a series of closed-door roundtable discussions with the MNRE and, later, included the secretary of the National Manufacturing Competitiveness Commission. When the NSM was included within the *National Action Plan on Climate Change* the Ministry of Power also became involved, and its subsidiary bodies and public sector arms, the National Thermal Power Corporation and the Power Grid Corporation of India, were then able to closely engage with the solar mission's implementation.

Priorities
The Ministry of Power wanted above all to ensure the smooth roll-out of the mission, acting under the prime minister's mandate. The secretary of the Ministry of Power was concerned to coordinate well with the MNRE to implement the mission.

Constraints
The ministry's main constraint was its limited jurisdiction over state-level issues and governance.

NTPC (formerly known as National Thermal Power Corporation) and NVVN (NTPC Vidyut Vyapar Nigam Ltd)

Role

In the next stage of planning NTPC presented itself as a partner in implementation. This was fortuitous in the way that NVVN, a player in a shallow and marginal power trading market, was actively scouting for business and received a nodal position as an intermediate off-taker and counterpart to power purchasing agreements for firms in the NSM. This allowed for the design of important de-risking measures and instruments for inspiring investor confidence and added another element of agency to the willingness to act on the plan for a solar mission (see Table 4.2). One important, even critical, resource made available due to this was an arrangement allowing the *unallocated* power supplied by the NTPC,[38] often a strategic tool in the hands of the central government used to incentivise power-starved state governments into adopting better management practices, to be diverted for the cause of the solar mission.

These early discussions had brought up a number of concerns about attracting investors that policymakers tried to meet. Firstly and foremostly, was the need to provide some idea of market size and long-term growth potential (for both developers and manufacturers). Prior experience from the stop-and-go growth and policy reform in the wind power sector (and the overall experience in other sectors of the economy) fuelled the view that, for solar power, it would require a much smoother transition between the stages of development.

The interviews pointed to a common view that the NTPC's role in standardising technical aspects of the mission had been crucial for carrying the mission. Most importantly, the bundled power scheme for utilities (thus reducing costs), the technical screenings required for the auction mechanism and the assistance in grid management issues which had hitherto plagued the wind power sector, enabled the smooth governance witnessed in the first phase. The tripartite offtake agreement between NVVN, the state utilities and the Reserve Bank of India allowed for the mitigation of payment risks by utilities (which is a significant risk in India as seen in the wind case studies). According to this policy measure, in case a state utility which is a signatory to the tripartite agreement fails to pay its dues to the solar power developer on time, the NVVN has a right to invoke the relevant clauses in the agreement and allow for a payment to be routed through the Reserve Bank of India to the developer.

A strong message was also sent out to the state governments as significant stakeholders and their involvement in the mission's execution prior to day one was counted as an accomplishment of coordination. One interviewee remarked that the uptake was particularly strong in Rajasthan as, apart from offering excellent resources, the state had hoped to become a 'power exporter' (some experts said that Gujarat might also be aiming to export solar power).

Priorities

As a 'public sector undertaking' the NTPC was concerned to implement the Ministry of Power's mandate smoothly. NVVN's priority, as a marginal player in India's relatively shallow power trading market, was to secure new business opportunities.

[38] Power generated by central government-owned public service enterprises is 'allocated' or diverted to states based on norms and guidelines decided by the Central Electricity Regulatory Commission, taking into account factors such as the state's power deficit. This is revised annually, and takes the form of a contractual supply to the state in question. However, 15 per cent of the power generated is not immediately allocated to any particular state, and the central government makes a decision as to where the need is greatest and accordingly diverts this power. The official use of this power is to meet exigencies such as droughts or seasonality in hydropower.

Central Electricity Regulatory Commission

The central regulator was also key to the NSM's success. Along with the NVVN, the central commission provided technical support in rolling out the mission and was responsible for determining aspects of the bidding process, selection process and other guidelines. Its priorities aligned with the MNRE and Ministry of Power in rolling out the mission smoothly.

Private firms – manufacturers and developers

For a more detailed overview, see Altenburg and Engelmeier (2012).

Role

Even prior to the launch of the solar mission, the learning mechanisms in place (open-door discussions, stakeholder consultations) were inclusive and, at least procedurally, the views of the private sector were taken into account in each successive iteration (the interviews with private sector representatives, the stakeholders' meeting and with third parties confirmed this). However, the influence of individual actors was unclear although some researchers have suggested that certain measures, such as the introduction of a domestic content requirement, may have favoured incumbents, particularly manufacturers (also see Chaudhary *et al.* 2014 for more detail). Within both policy and industry circles there was an aspiration to make India a low-cost manufacturing base for the world and promote opportunities for employment locally.

Investors in projects in the first phase of the solar mission came from a variety of backgrounds and can be divided into: (1) Indian pure play solar EPCs/developers (Kiran Energy, SunBorne Energy); (2) IPPs (both Indian and foreign); (3) large power companies, both private (such as Tata Power and Reliance Power, and although they did not bid for projects under the solar mission, Mahindra) and public (such as GAIL); (4) foreign developers (such as Solairedirect and SunEdison); and (5) Indian firms with other core businesses diversifying into solar power (these can be subcategorised as public sector undertakings looking to diversify or fulfil their investment mandate and avail themselves of tax benefits, and privately owned firms from a variety of sectors – see EAI 2011 and NVVN 2010).

Equity investments into these parties also came from a variety of channels, including foreign firms (notably US-based firms such as Bessemer Venture Partners and Khosla Ventures), Indian private equity and financial services firms with a mandate of investing in renewables (such as IDFC Ltd) and a number of existing large conglomerates mentioned above. Equity internal rates of return varied from 17 to 20 per cent, with foreign firms looking for higher returns, but surprisingly, were found to be as low as 15 per cent and in some extremely rare cases, below that (also see Nelson *et al.* 2012). Some of these firms were betting on making exits through capital markets or looking to be acquired a few years down the line as other firms gained confidence in the sector.

Opinions offered by interviewees and direct observations of stakeholder meetings pointed at a variety of motives for investors: many were seeking first-mover advantage (many firms in the first batch of bidding also returned to the second batch of bidding, signalling their long-term interests), some simply looked to gain experience early on and become pure play service providers later on (such as SunBorne), some looked to integrate backwards (or forwards, such as major local manufacturers squeezed by Chinese and Taiwanese competition upstream), and many wished to diversify from core businesses to manage risk or jump to what they perceived were attractive returns from the benchmark 15 rupees/kWh tariff (also see Altenburg and Engelmeier 2012). It is notable that many bidders in the first batch were firms with hardly any prior experience, who miscalculated the costs, risks and returns involved.

A number of experienced firms also showed a significant risk appetite and, surprisingly, managed to achieve extremely low bid prices even in states where the perceived risks were high (such as Solairedirect in Rajasthan). The interviews indicated that these firms wanted a 'foot in the door' and first-mover advantage and were willing to bear the risk-return trade-off to participate early in the solar sector. Many have returned for the second round of bidding and thus seem to be serious players. Others pointed at possible co-benefits from the investment in solar – some firms, for example, already owned the land on which they were building solar farms, and this, for them, was a way to earn revenues while boosting the values of existing assets.

The interviews and documentary analysis (see PwC 2012; World Bank 2010; CEEW-NRDC 2012) revealed that at the end of the first batch of allocations, four major forms of risk emerged, in the following order:

1. State-specific risks (including infrastructure availability, land acquisition, *force majeure*, resource availability, etc.)
2. Finance-related risk
3. Policy and political risk (in particular, whether the NVVN would remain engaged and whether the state-specific contracts with utilities would remain bankable)
4. Technology-related risks.

The first of these was a crucial determinant to the investment decision. From the developers' perspective, securing good quality sites with approval from the respective authorities has always remained a long-drawn-out process with some uncertainty involved, and was the cause of a great deal of variation in the expected returns of a project between firms engaged in buying land/acquiring land from the government and those firms who had already owned the land. Bankers proved even more sensitive. One interviewee and many representatives in stakeholders' discussions remarked that, despite their wariness, banks genuinely wanted to lend but could not find enough 'good' projects where the state-specific risk was deemed manageable. This was more so in the solar thermal segment, where high-quality data on solar irradiance was lacking and hence added significantly to the project risk.

Infrastructure and land availability, common concerns across the Indian power and infrastructure sector, still rank highest for most investors. Investment tended to flow to those states which undertook measures to de-risk solar projects (Karnataka, Gujarat and Rajasthan all initiated a policy of 'solar parks' to provide access to crucial resources).

Priorities

The first priority for manufacturers and developers was profit.

- Incumbent private firms in other sectors: in the first batch of projects allocated under the mission, the technical criteria for screening bids were relaxed in order to ensure wider participation. A number of local firms with no prior experience in solar power development entered the fray, and analysts reported that the apparent high returns from an initial benchmark cost set by the central regulatory commission of 15 rupees/kWh attracted these investors. These firms form the largest class of investor
- Foreign entrants/foreign equity investors in Indian firms: experienced foreign developers (such as Solairedirect and SunEdison) also entered the market, although most of them partnered with a local firm with expertise in engineering, procurement and construction areas. Again, drawing from analyst reports and interviews, these firms were interested in the business of solar power and opportunities for a large market because of the power deficit in the country, as well as the returns offered by the policies on solar. Note that all of these entrants also have projects under state policies in Gujarat and other states, separate from the solar mission. Some firms

were also developers who were looking to provide services, but ventured into operation to gain experience

- Publicly-owned firms: state-owned firms have ventured out into solar power projects, though their combined market share is less than 10 per cent. Interviews suggested that these investment decisions were made for three reasons: firstly, the relatively attractive returns; secondly, these firms already possessed the capabilities required to execute projects from their core businesses. Finally, Indian public sector undertakings typically have investment norms spelled out by the government for profits made and diversifying is a common practice when investments in related areas are feasible. As many of these firms already own critical assets in land and have access to infrastructure, the project execution risks are lower.

Constraints
The main constraint on developers was that they had a smaller share of the industry and relatively low policy influence in the first phase.

For the manufacturers, the price of supply and financing models were mainly uncompetitive with the modules and equipment-linked finance available from foreign suppliers.

Rajasthan Renewable Energy Corporation and the Rajasthan Electricity Regulatory Commission

Role
We note that most solar projects under the NSM are based in the state of Rajasthan (Bridge to India 2013). A number of reasons exist for this: this state, with large swathes of barren and desert land (60 per cent of total land area), receives the highest amount of insolation in India (5.78 kWh/metre2/day) with good quality investment-grade resource data available. The state had a handful of solar projects already running (owned by Moser Baer and Reliance Power) as early as 2008, and Rajasthan's attractiveness preceded the solar mission. The state's electricity regulatory commission had announced its commitment to develop solar power in 2008 by imposing a solar renewable purchase obligation, in some sense, pre-empting the mission. In terms of the overall power sector, Rajasthan's state utility, the RVPN, is one of the more creditworthy institutions in the country. Although payment issues had crept up in the past, renewables overall have had some support from Rajasthan's electricity regulatory commission, including a payment guarantee mechanism, which lowered risks.

The mission's provisions also stipulate the development of solar parks for clustered development of projects. State governments would receive financial assistance from the MNRE, subject to financial and technical criteria, which is also an attractive incentive. The Rajasthan Renewable Energy Corporation had already been taking a leadership role in wind power, coming up with a wind renewable purchase obligation (which was not highly enforced, but existed nonetheless) and in 2010, signing a memorandum of understanding with the Clinton Foundation and the Asian Development Bank to float the Rajasthan Solar Park Private Ltd to oversee the development of such parks. Additionally, the state utility, with a comparatively strong balance sheet as far as state utilities go, set up dedicated infrastructure lines for wind along the sun-and-wind-rich districts of Jaisalmer, Barmer and Marwar-Jodhpur. With this initiative in place, the state representatives have made contact with the MNRE repeatedly, with a view to make Rajasthan a solar state.

Rajasthan state government

Role
Politically, the ruling Congress government (in power since 2008) has been supportive of renewables as a means to draw investment into the state. In 2011, as solar power continued

to grab headlines, Rajasthan's chief minister inaugurated the Rajasthan Solar Energy Policy 2011, and has since been vocal in support for solar power. Previously, he had also been supportive of wind power projects. Strategically, as some experts pointed out, solar power offers a valuable opportunity for the state to draw investment, and has thus remained part of the state's industrial development agenda. Committing financial resources, however, particularly for infrastructure, remains a crucial area for support and the state recently received a massive fillip when it received a US$500m loan from the Asian Development Bank to expand grid infrastructure in the state.

Priorities

The state government's main priority was development: to gain comparative advantage by developing a solar power sector, and to attract the investment to do so.

Debt financiers

Role

Debt finance for the NSM (and solar in general) has been a cause of concern. In the first phase of the mission, borrowings from scheduled commercial banks had a combined share of less than 30 per cent of the debt market (and typically went to larger firms and conglomerates with excellent balance sheets, who had pre-existing relationships with these banks), on a balance sheet basis. The International Finance Corporation, which provided up to 30 per cent of the debt, was the other major lender, albeit with a mandate to promote the fledgling solar sector in India. Non-banking finance companies such as the Indian Renewable Energy Development Agency and the Infrastructure Development Finance Corporation invested on a project-to-project basis, typically providing loans to more experienced players. The most voluminous channel, however, was equipment-linked debt provided by the US Exim and China Exim banks for projects using panels from these countries. These lenders provided up to 30–40 per cent of the debt in the first phase to both domestic firms as well as foreign entrants, at low interest rates and generous loan tenures. Additionally, once Exim funding had been secured, it was also easier to get additional loans from local lenders, a fact reflecting that lenders did not have much confidence in locally manufactured modules. To put this in context with the overall condition of the financial industry in the economy, infrastructure as a whole slowed considerably between 2010 and 2012, and banks reached their priority sector caps,[39] so their lending for renewables has been somewhat restricted. However, all stakeholders agree that there needs to be more done for projects to be considered more creditworthy. The MNRE cites this as one of the major reasons for introducing a viability gap funding mechanism in the second phase of the mission and for using public funds to provide opportunities for leveraging.

Priorities and constraints

Development finance institutions such as the International Finance Corporation and the Asian Development Bank prioritised providing support to a sector that was still very risky in order to set their own lending norms for future engagement. These norms could also then inform the private sector. For corporate lenders, too, solar power is still a risky sector with many unknown hazards, but it is a sector with potentially high returns. However, the major lenders typically have a history of lending to renewable energy projects, and this sector is part of their portfolio as standard.

For private financiers the main constraint is risk. Although obliged to lend to infrastructure projects, there are no guidelines that specify lending to the solar power sector whose projects compete against lower risk-profile infrastructure projects. Two banks (Axis Bank and

[39] Lending in India is highly regulated, and each bank must comply with lending norms set by the Reserve Bank of India, which specifies certain sectors, such as 'high-priority' and fixes a range for assets within the banks' portfolios. Infrastructure is also a priority sector, though lower in priority, and there is little differentiation between various types of infrastructure lending, creating competition within infrastructure sub-sectors.

Yes Bank) have taken a more proactive stance, though their total share is extremely small (only six projects out of a total 249).

Solar Energy Corporation of India
At the end of the first phase of the NSM the NTPC's role was revisited. Deciding that a more permanent, dedicated body required a presence in the 'tripartite' agreement and as a signal to mitigate policy risks, the Solar Energy Corporation of India was founded as a separate institution. In addition, as a body headed by officials of the MNRE, the corporation's formation places the implementation of the mission and coordination with state utilities within the purview of the MNRE. The solar energy corporation, a body with technical and financial capabilities, recently acquired a trading license, and its formation was an attempt to build capacity and agency within the MNRE to manage the NSM. The budgetary support for the corporation also comes from the central government, routed through the MNRE. The corporation's role is crucial as projects in the second phase have offtake agreements directly signed with this body instead of state utilities, and have a lower payment/executing risk rating due to the sovereign guarantee. How this translates in the future remains to be seen.

4.1.2 Assessment of relationships between actors

Ministry of New and Renewable Energy and Ministry of Power
The relationships between the ministries were both formal and informal. Senior bureaucratic officials within both ministries took the lead in implementing the mission, and maintained connections through the professional network within the Indian Administrative Service. India's former Special Envoy for Climate Change was the 'glue' in the relationship and helped both parties plan the roll-out.

The explicitly formal aspect of the relationship is clear in the governance of the Solar Energy Corporation of India, which is governed by MNRE representatives in a directorial capacity. These two ministries also have a productive, formal relationship with the Prime Minister's Council on Climate Change.

Ministry of New and Renewable Energy, Ministry of Power and Central Electricity Regulatory Commission
This three-way relationship is formally maintained. The Central Electricity Regulatory Commission, although institutionally responsible for specifying the norms of the NSM, is also headed by the former secretary of the Ministry of Power. The commission aided the speedy institutional set-up of the Solar Energy Corporation of India.

Rajasthan government, Rajasthan Electricity Regulatory Commission and Ministry of New and Renewable Energy
These relationships are both formal and informal. The chairman of Rajasthan's regulatory commission and the former secretary of the MNRE are connected through the Indian Administrative Service network. The chairman also served with the chief minister of Rajasthan for many years before assuming his current position. The commission's introduction of a solar renewable purchase obligation coincided with his office.

4.1.3 Key observations

- The NSM is an example of a system transformation, where an initial idea within one ministry was moved under the purview of the central government, allowing access to a wider array of resources. Even here, however, coordination between ministries appears to be transitory
- The solar mission shows a well implemented policy, where the involvement of federal government players reduced some of the risks that investors were facing. The involvement of a body to provide a 'sovereign guarantee' seems to have improved investment attractiveness
- Challenges in procuring debt have been flagged as a key area by stakeholders. A roadmap for integrating participation from private sector lenders and public banks is notable in its absence.

4.2 Solar power case study 2: Moser Baer Ltd – manufacturing growth in the solar sector and the domestic content requirement, 2006–09

Prior to the launch of the NSM, some firms had bet that demand for solar would eventually grow. Although these investors were few, they were early entrants in a fledgling solar industry that, theoretically, had access to many conducive elements: access to engineering talent; global footprints to acquire technology that was, at the time, in its nascent stages of deployment; and the ability to take advantage of the local semiconductor industry. However, with the lack of any policy framework driving the demand side, the motivations and strategies of such early investors can provide experiential knowledge and useful lessons.

In addition, when the mission was eventually launched, it included provisions to support a domestic solar industry, including some relatively controversial measures such as imposing a domestic content requirement. Despite these measures, however, the Indian solar manufacturing industry has not taken off. Nonetheless, the influence of these early entrants may still be considerable and understanding the priorities and constraints of these actors may also provide lessons for future policy design endeavours.

The information and supporting facts for this case study have been drawn from interviews with the MNRE (November 2013), a former official at Moser Baer Ltd (July 2013) and from the author's observations of an NSM stakeholders' meeting (February 2013).

Table 4.3 Moser Baer – chronology of events

Date	Event
2005	Parent company decides to diversify in order to reduce business risk, and solar is seen as the next big market to exploit.
2006	May: Signed technology memorandum of understanding with the Institute of Technology, Banaras Hindu University, to expand R&D capabilities. In-house R&D centre is approved by the Ministry of Science and Technology (research on thin film sputtering technology).[40] August: Parent company invests US$17m into Moser Baer Solar to set up facilities. September: Invests undisclosed amount into Solaria, a concentrated photovoltaic (CPV) technology company based in Fremont, US.[41]

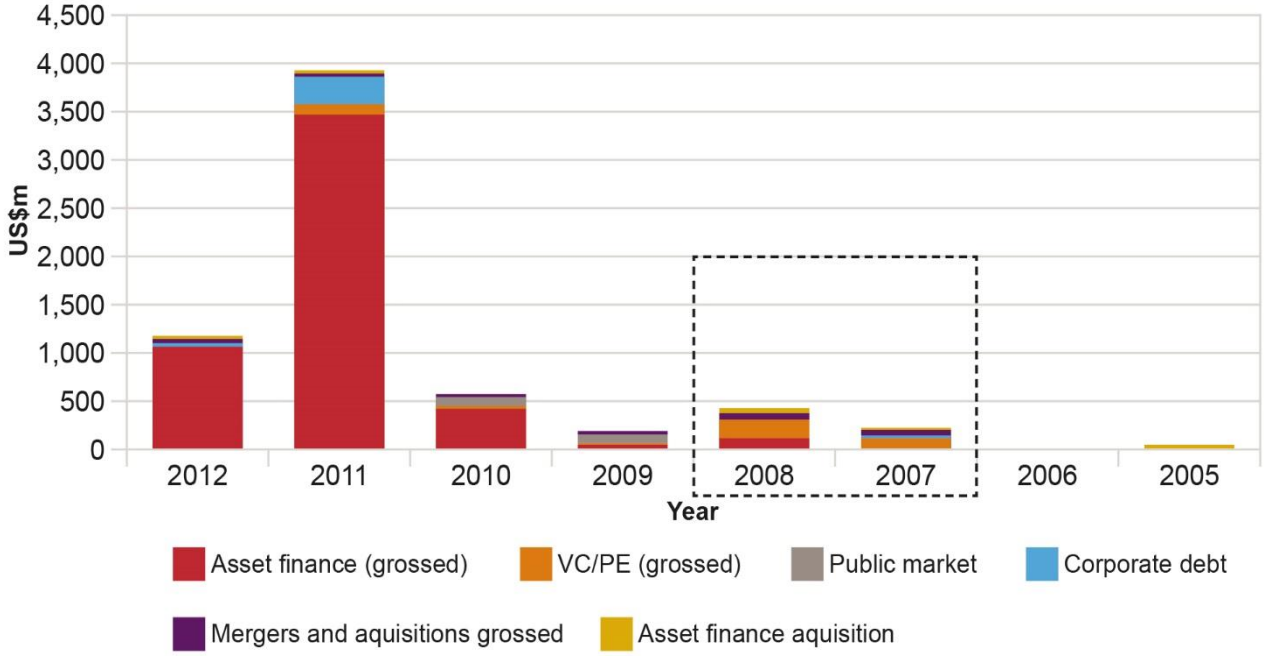
[40] Thin film sputtering is a method of depositing material on surfaces (in this case, silicon wafers) used to manufacture thin film solar cells.
[41] Concentrated photovoltaic technologies use curved optical surfaces such as mirrors or lenses to concentrate large amounts of sunlight onto a small area of photovoltaic cells to generate power. These systems use fewer solar cells as compared to a

	October: Invests US$7m in the final closing of SolFocus's Series A funding. Strategically, Moser Baer's manufacturing facilities were complementary to SolFocus's innovative concentrated photovoltaic technologies. November: Invests undisclosed amount into Stion Corporation, a cutting-edge nanotechnology firm, working on producing multiple junction high-efficiency cells.
2007	February: Acquired OM&T BV, a Philips-owned optical technology and R&D subsidiary based in the Netherlands. Announces strategic sourcing tie-up with Deutsche Solar AG, a silicon wafer manufacturing firm. March: Acquires 40 per cent stake in Solarvalue AG (Slovenia) to ensure supply of silicon wafers. Announces the start of trial runs of 40MW c-Si[42] PV production facilities. Grows to 80MW by end of year. Announces planned investment of US$250m to set up thin film manufacturing capacity of 200MW by 2009. The investment was planned to incorporate and directly springboard off the then-recently announced IT and semiconductor fabrication policy. Enters into a technology partnership with Applied Materials Inc, US. June: Launches US$150m worth of foreign currency convertible bonds with a tenure of five years from their allotment. Announces receipt of orders and memoranda of understanding worth US$100m from global investors. July: Launches eight-year take-and-pay contract with REC Solar (Norway) for supply of high-quality multi-crystalline silicon wafers. October: Raises US$100m through a consortium between IDFC Private Equity, the Commonwealth Development Corporation Group (CDC Group – the United Kingdom's development finance institution), and GIC Special Investments. The firm also positions itself for eventual initial public offering. November: Signs memorandum of understanding with government of Rajasthan to set up a 5MW solar farm (then India's largest) at a Resurgent Rajasthan summit between Moser Baer and the Rajasthan Renewable Energy Corporation.
2008	February: Plans 600MW thin film PV capacity expansion with investment of over US$1.5bn. April: Enters into a ten-year take-or-pay, market price-linked contract with LDK Solar for supply of high-quality multi-crystalline silicon wafers. May: Completes trials for Gen 8.5 a-Si (amorphous silicon) thin film modules – then the world's most efficient technology. September: Currently with annual capacity of 120MW c-Si and 40MW thin film modules, Moser Baer raises US$100m from a group of investors including Nomura, CDC Group, Credit Suisse, Morgan Stanley, IDFC Private Equity and IDFC. The firm is valued at US$1.4bn. October: Enters into long-term, fixed-price, take-or-pay obligations with a number of European system integrators for supply of modules. The cumulative value of contracts is estimated at US$500m.
2009	NSM announced: domestic content requirement proposed. January: The thin film line at Greater Noida plant (SunFab line) is ready for production. February: Moser Baer's 40MW thin film line receives international certification from the International Electrotechnical Commission. September: Awarded engineering, procurement and construction contract to develop a 1MW solar farm in Maharashtra.

non-concentrated PV system of the same rating, but can be more expensive due to the added costs of other optical components. These technologies are not as mature as conventional PV systems and are still the subject of intense R&D.

[42] c-Si monocrystalline silicon – single crystal wafer cells.

Figure 4.3 Investments in solar energy in India, 2005–12



Notes: Asset finance: money borrowed by firms by using balance sheet assets such as accounts receivable, short-term investments or inventory; VC/PE: venture capital/private equity; public market: stock exchanges where firms raise money by selling equity shares to any willing investor; corporate debt: i.e. bonds sold to investors, with the debt repaid over time; mergers and acquisitions grossed: mergers (when two companies merge their operations and assets) and acquisitions (when one firm buys out all or almost all of the stakes of another).

Source: Authors' own, based on data from BNEF (2014).

4.2.1 Key actors, roles, priorities and constraints

The key private actors were: Moser Baer Ltd, the Confederation of Indian Industry, Federation of Indian Chambers of Commerce and Industry, India Electronics & Semiconductor Association, and private equity investors (e.g. Nomura, IDFC Private Equity and Blackstone).

The main actor for central government was the Ministry of Communications & Information Technology.

There were two significant overseas actors – one a group, the American suppliers (although they did not act collectively); and the other the Export-Import Bank of the United States (US Exim Bank).

Ministry of Communications & Information Technology

The information technology (IT) ministry's priority was to ensure a profitable IT industry, but it was constrained by its inability to rapidly shake up local industry.

In 2007, the Indian semiconductor industry had come under intense pressure from Taiwanese competitors, in both foreign and domestic markets. In response, the IT ministry launched a special incentives package, under which the union government would underwrite 20 per cent of the capital expenditure in fabrication units within special economic zones and up to 25 per cent on units outside the zones. With a minimum threshold of investment amounting to 10bn rupees, few firms had the financial ability to avail themselves of this, although interest was exceedingly high.

Instead, domestic manufacturers latched onto the idea of a protected local industry to provide a guaranteed market. A similar manoeuvre had been implemented previously: in

response to a growing threat from Taiwanese manufacturers of optical media, the Indian semiconductor industry had followed suit with American and European markets to impose anti-dumping duties, effectively delaying the death of local manufacturers. Moser Baer had been one of the prime beneficiaries of this protection, as it meant that the domestic market for storage media had been insulated from its global competitors, such as RITEK. (However, by 2003/04, it had become clear that maintaining volumes, even in India, would not be enough to save the business as margins had fallen to less than a third of 2001/02 values.)

Moser Baer Ltd

Moser Baer's main priority was to make a profit, but it was constrained by a lack of financial and technical means to establish the same economies of scale as its Chinese competitors.

Diversification

Founded in the 1980s by Deepak Puri (who has also been part of high-level discussions on the NSM), Moser Baer Ltd had been a respected manufacturer of optical storage media (e.g. DVDs, CDs) for many years – it was the world's largest manufacturer of amorphous silicon-coated CDs. Facing increasing pressure from new technologies, slowdown in global growth and cost pressures from oversupply in the global market, it decided to diversify its business. Ratul Puri, the son of the managing director and current executive director, persuaded the board to move into solar photovoltaics, leveraging the capabilities they had built over the years in handling silicon materials and surface coatings. With an initial investment of US$17m, Moser Baer Solar Ltd was founded in 2006.

Strategy and investments

The strategy was to replicate something that it had achieved in the CD business – combine India's low-cost manufacturing capabilities with foreign technology to create a base for low-cost solar photovoltaic cells. Moser Baer expected to serve markets in Europe and the more developed economies in East Asia, and indeed, its initial purchase agreements and contracts reflected a sound strategy. Domestically, there was already some talk that India would look at solar in a bigger way – internally, the firm had placed an estimated demand of 1,000MW per year in a couple of years – across multiple segments.[43] The goal was to procure silicon from proven global manufacturers; manufacture the PV cells in India, where both capital costs and operational costs are lower (such as for module assembly, labour, etc.); and to profit from the considerable gap between the cost of manufacture in India and global prices for solar panels. The firm also acquired technology firms in the US (SolFocus and Stion), which were both developing radically new technologies at the time, which would have given it a strong differentiating factor as well as an international benchmark for the quality of its technology quality.

Domestically, under the IT ministry's special incentive package scheme, Moser Baer Solar invested in a fabrication unit in a special economic zone near New Delhi and announced a planned investment of 20bn rupees in Tamil Nadu.

Challenges

By the fourth quarter of 2008, however, the company faced a series of challenges. Beginning with a supply glut in silicon (a capacity of 12GW against a projected demand of 7GW) brought about by the rapid expansion of Chinese firms and shrinking growth in the European markets, the margins in the global PV module market eroded considerably. At the same time, thanks to the global financial crisis, subsidies and fiscal incentives dried up in Spain, Germany and other European leaders in the solar market. Moser Baer Solar, now a 100+MW firm, could not compete with the heavily subsidised, large-scale Chinese firms that were looking to expand their capacities up to 1GW. In addition, Moser Baer's investment in

[43] When asked in the interviews whether the firm had foreseen a solar mission in the future, the reply was that there was an expectation that solar would pick up in India, seeing the global trend. The form of the policy push, however, was unexpected.

R&D had failed to yield a competition-beating technology, especially with the massive drop in silicon prices that essentially eroded any performance advantages. The only way out, to build scale or scale back, was a false choice.

Renewable Energy Committee of the Confederation of Indian Industry; India Electronics & Semiconductor Association; and Federation of Indian Chambers of Commerce and Industry

During this period the NSM had begun to take shape within the MNRE. The managing director of Moser Baer Solar, who had been the head of the Renewable Energy Committee of the Confederation of Indian Industry and a member of the Federation of Indian Chambers of Commerce and Industry, was a part of these early discussions about how to promote India's solar sector. The India Electronics & Semiconductor Association in this period also made a series of consultative presentations and representations to the MNRE, with the focus on how a push for solar power could help the Indian semiconductor industry.

These industry representatives also argued for protection for Indian manufacturers from outside competitive forces. So, in the first phase of the NSM document a domestic content requirement was introduced, extending over the cells and modules to be used in its projects. Crucially, however, this requirement covered only crystalline silicon as that was the only technology under widespread development in India at the time, and the only technology for which all manufacturers had developed competencies. This had some unintended effects as developers subsequently went for thin film technologies instead, sourced from foreign firms, even though the thin film PV modules had been found to work less efficiently in other countries. The reasons for the developers' choice were multiple. Firstly, they claimed that locally manufactured modules were not cost-effective, even as manufacturers such as Moser Baer rushed to extend delayed payment schemes and long lines of credit for takers. Secondly, despite the mad push for competitive lending domestically, the Chinese and American Exim Banks provided extremely cheap debt finance (at rates below seven per cent) for any developers interested in purchasing products from the banks' home countries. As a result, 75 per cent of the projects in the first phase of the NSM utilised thin films. In 2011, the only other local manufacturer of the same scale as Moser Baer, Tata BP Solar, announced that the two stakeholders (Tata and BP) would part ways. By the beginning of the NSM's second phase in 2013, total manufacturing capacity in India had barely touched 1,500MW.

Moser Baer Projects Ltd

With dwindling sales, in 2008, Moser Baer launched a project development arm as a vehicle for its own PV cells, as well as to further diversify within the power business. Moser Baer Projects Ltd was incorporated in 2008 with verticals across solar power, thermal, hydropower and turnkey contracts. Moser Baer Projects launched plans for constructing India's then-largest solar power plant under the Gujarat state Solar Policy, totalling 45MW, and began talks with the Tamil Nadu state government for a 7.5MW plant. (Tata BP Solar, now relaunched as Tata Solar, made the same decision, entering into EPC arrangements in 2011.) Moser Baer's change of tack worked, and the firm attracted a US$300m equity infusion by Blackstone in the third quarter of 2010.

The question of how to foster a domestic solar manufacturing industry in India still remains. After introducing six different options for a domestic content provision (including a domestic content requirement on total cost instead of components, to benefit the downstream manufacturing industry supplying all the other elements of a solar power system such as inverters manufacturers, wiring, switches, etc.), phase 2 of the mission has stipulated a much higher domestic content requirement (75 per cent) on both crystalline silicon and thin film technologies. With analysts predicting the stabilisation of prices in panels worldwide, it remains to be seen whether Indian manufacturing can catch up. Both Tata Power and Moser

Baer retain their stake in their respective manufacturing arms. With phase 2 only now beginning to move ahead, the goal of creating a local market may yet be achieved.

4.2.2 Assessment of relationships between actors

Ministry of Communications & Information Technology and manufacturing firms
Through the semiconductor industry associations, the solar manufacturing firms maintained formal relationships with the IT ministry.

MNRE and manufacturing firms
The manufacturers, as incumbents in the solar industry prior to the launch of the mission, were consulted extensively and formally.

Moser Baer Solar and manufacturing associations
Apart from being a member of trade associations, the managing director of Moser Baer Solar was a senior member of these industry bodies.

4.2.3 Key observations

- The indigenous solar manufacturing industry is, in principle, heavily dependent on policy support in light of the current global competitive scenario in the industry
- Many risks in the Indian solar industry are external to the country
- Finding the right mix of instruments to develop a local solar manufacturing industry is proving to be complex, especially in terms of managing existing firms in the system
- There are significant vested political interests in protecting a domestic industry that may arise out of the industrialisation imperative, although the findings could not confirm the motivations (and the political economy of these policy decisions are also beyond the scope of this paper)
- Interactions between actors in different arenas (such as federal government actors in renewable energy and other aspects of industry) may be important influences on decision-making in the future, with respect to the solar industry.

4.3 Solar power case study 3: developers in solar power – SunBorne Energy

While the previous case studies have focused extensively on larger sets of investment events and policy changes, it is important to understand how the nature of the actors also changes. Just as with wind power, where we see the emergence of IPPs capitalising on maturing market instruments, in the solar power market, in addition to the big-ticket industrial investors and diversified firms, we can see the emergence of pure play developers and service providers. Many of these firms are also backed by foreign equity and capital, unlike the diversified conglomerates that have simply raised credit on the strength of their existing balance sheets. SunBorne Energy, notable for its technological expertise, is one of those backed by foreign venture capitalists.

This case study, then, aims to provide an (non-exhaustive) overview of the kind of company that attracts foreign capital, the facilitative elements and the risks faced by developers (particularly at the state and project level), and the spaces in the market where such entrepreneurs find opportunities.

The interviewees for this case study were SunBorne's CEO and founder (November 2013), a representative for Bridge to India (July 2013) and participants at a meeting of NSM stakeholders (February 2013).

Table 4.4 SunBorne Energy – chronology of events

Date	Event
2008	SunBorne Energy set up with initial seed funding from Khosla Ventures (established 2004, venture capital firm with a clean technology focus).
2009	SunBorne secures US$5.2m from General Catalyst Partners (a US-based private equity fund). Bids successfully for first NSM project.
October 2010	International Finance Corporation invests US$10m in equity. Another US$5.9m raised through compulsory convertible debentures.
2010	Enters into a joint R&D agreement with the MNRE to develop solar thermal technologies.
May 2011	Enters into an agreement with Chinese company Suntech Power for the supply of 100MW of solar panels until 2013.
June 2011	Enters into an agreement with a local infrastructure developer and IPP to establish a 5MW concentrated solar power plant in Andhra Pradesh.[44]
August 2011	Receives a loan of US$30.6m to build its 15MW solar PV plant in Gujarat (later to be expanded beyond 50MW). Investors include the State Bank of Patiala, Canara Bank, Exim Bank of India and State Bank of Travancore.
March 2012	Completes a 3MW plant in Rajasthan for an IPP.
July 2012	Raises US$5m in another round of equity funding and announces future plans for a 50+MW thermal project plan in Karnataka. Analysts expect firm to raise over US$20m in future rounds.
2012	SBI Capital Markets funds 5MW Rajasthan PV project. Three projects commissioned – power purchase agreement signed with Gujarat.
March 2013	Bidding under Andhra Pradesh Solar Policy, SunBorne is able to put in the lowest cost bid for a solar thermal plant of 5MW.

4.3.1 Key actors and their roles

The private sector actors were SunBorne Energy Ltd and its venture capital investors. The public sector actors were, at a national level, the MNRE; and then the governments and various agencies of the states of Rajasthan, Gujarat, Karnataka and Andhra Pradesh.

SunBorne Energy

The company was incorporated in 2008 in the US as SunBorne Energy Technologies Pvt Ltd. Its founder, James Abraham, was able to attract venture capital investment from clean technology-focused Khosla Ventures based in Silicon Valley, US. Within the next two years the firm successfully managed to build some of the lowest cost and lowest risk plants in the early stages of solar power in India. Although still a relatively smaller player in terms of total capacity installed and targeted – as compared to large infrastructure developers such as Lanco Solar (which has already bid for over 200MW and in 2012 announced a move to integrate vertically) – the firm has quickly gained a reputation for reliability and, along with the MNRE, set up India's first public–private partnership in solar thermal technologies.

SunBorne set out to be primarily a technology and EPC-focused player, in essence differentiating itself on the basis of competencies in developing technology, managing project risks and providing services in asset development. When SunBorne entered the

[44] Concentrated solar power (CSP) systems use mirrors or lenses to concentrate a large area of sunlight onto a small area. Electrical power is produced when the concentrated light is converted to heat, which drives a heat engine (usually a steam turbine) connected to an electrical power generator – solar thermal power.

market most competitors were focusing on financing, project development and ownership, with none focused on improving technology and providing EPC as a service. Mr Abraham's view was that as the sector developed over a long period, not only would there be a requirement for good technical skills, but there was also scope for the technology to improve. As such, despite newcomers also offering EPC services, SunBorne is still one of the few companies looking to access and develop next-generation technology, and with the ability to do so through its international links.[45]

Early stages

In the early stages, SunBorne focused on building momentum and striking up good relationships wherever it operated rather than immediately looking to scale up. The risk environment that developers were operating in was not transparent, and so it was important to proceed with solid, good projects. In the early period (2008–11), internal rates of return from solar power could be as high as 16 per cent but there were a number of risks involved.

Firstly, nearly two years after the global financial crisis (which also affected India, after a short lag, though capital markets benefited) financing for infrastructure as a whole slowed down considerably. Existing power assets, especially in thermal power which was hit by shortages of coal and so lost money, became extremely cheap. As a result, there was not much interest in creating new assets and instead more interest in trading existing ones. New assets with relative value were difficult to find.

Solar had value because of the returns offered by policy, but as evidenced by the events of the NSM there were few takers for such a new and therefore risky technology. Solar PV power was hardly proven in India, and solar thermal was even more risky, hardly proven anywhere in the world. Thirdly, and most importantly, as Mr Abraham noted, the overall policy environment was extremely unpredictable. As solar power is heavy on capital expenditure and loans tend to be front-ended, investors require certainty about the long-term prospects.

R&D

The key differentiator for SunBorne has been its ability to leverage international links in technology and its increasing focus on solar thermal power. So far, investments in this technology in India have been few, and mostly by developers who already have experience elsewhere. At the end of phase 1 of the NSM, 470MW of solar thermal projects had been allocated and, as of now, the costs of these are much higher than comparable PV ones. However, solar thermal offers some advantages that could be crucial for India. Firstly, the peak load hours in India are closer to the evenings, when lights are switched on, in addition to air conditioning; however, at this time, solar PV cannot function. Solar thermal, where a few hours of storage is possible through purely physical means, could be an excellent way to match production to demand. SunBorne is therefore a major investor, developing R&D capabilities for solar thermal power. In addition, the firm has been able to negotiate with the MNRE to set up a public–private partnership vehicle to manufacture the necessary components in India. The view is that with greater investment in R&D in areas where India has technical capabilities and expertise (such as mechanical engineering and handling industrial processes) there is a great scope for creating technologies that will not just attract foreign investors, but will give Indian industry a global comparative advantage. Mr Abraham stated in his interview that engineering capability for solar thermal power in India already exceeds that of anywhere else in the world. Whereas solar thermal plants can take up to US$4m to build in other parts of the world, in India the costs are already down to US$3.3m (some 40 per cent of the costs being for labour, which is relatively cheap in India).

[45] The authors note that while both Khosla Ventures and General Catalyst Partners backed SunBorne, other venture capital firms have not focused on technology in the same way. Bessemer Ventures, for example, has backed firms which have followed a more traditional EPC model.

Project development and execution
In actual project execution, the process of land acquisition and managing that process was deemed to be the most significant risk. To manage it, firms need to move early, begin negotiations with the governments involved and wait until approvals are received from all relevant authorities. Mr Abraham said that Rajasthan and Andhra Pradesh were both relatively efficient bureaucracies in converting agricultural land to non-agricultural land (a key step in the approval process) and that obtaining large tracts of land across good sites early was important. In the former case, the government acquires land on behalf of the solar developer and allots it. Conducting all negotiations through the government can help avoid problems later, for example, rising prices as farmers and landowners notice that their otherwise unused land is extremely attractive as a solar project site. A smooth land acquisition process, free of legal hassles, is thus an important factor for success. Those developers who arranged power purchase agreements before acquiring land have found it very difficult to execute projects in time.

One of SunBorne's key competencies is the ability to put up plants quickly. When the firm started with its first plant it took 13 months, and now the same process takes just four months, including the two weeks it takes for the local inspectors and transmission authorities to examine the site and commission the project. In each of its projects, in addition to carefully managing the process of land acquisition, SunBorne found that the cooperative utility board also played an important role, especially in putting up transmission lines. In Gujarat, the utility delayed putting up lines by eight months; in the end SunBorne had to do it itself. This is an interesting parallel with the wind sector, which also saw manufacturing firms setting up the infrastructure to transmit power away from their projects (see wind case studies in Sections 3.1, 3.2 and 3.3).

State-specific issues

Gujarat state government and utility
In terms of policy fickleness, Gujarat is an excellent example. Although the state has taken a leading role in developing solar power through its own state policy, with investors locked into a 25-year power purchase agreement, in 2013 the state announced retroactive tariff cuts for PV solar plant owners on the grounds that developers' costs were far lower than they had originally stated, as they submitted them when the PV module prices were high, but did not actually construct the plants until after global prices had fallen (EFYTimes 2013). SunBorne, along with Moser Baer Solar and other operators in Gujarat sought redress from the local electricity regulatory commission. Despite pressure from the state utility, the commission rejected the appeal to enact retroactive tariff cuts. In August 2014, the commission's decision was upheld by the Appellate Tribunal for Electricity (the highest judiciary body in charge of resolving disputes in the power sector), rejecting the utility's appeals. Nonetheless, Gujarat's offtake agreements are among the strongest of all the states (see below).

Andhra Pradesh state government
Andhra Pradesh is another state where the political environment has suddenly changed. A group of separatist agitators from a less well-developed part of the state who had been campaigning for a separate government finally got their way, resulting in a decision to split the state into two (see Vakulabharanam 2013 and Karri 2013). Thanks to the administrative overhaul required, many decisions on land, power and infrastructure will now have to wait.

Off-takers
The view of the utility board must be appreciated especially in the light of payment risks. Many developers have said that utilities did not like solar power. This was particularly because of its intermittency, expense and its 'must-run' status, which makes it difficult for them to cycle through and manage solar with other sources when there is a large concentration of solar power in any one region. However, in Gujarat, Rajasthan and Andhra

Pradesh the off-takers' payment records were good. In Gujarat especially, their utilities account for payments to solar power projects easily because of the long-term locked FIT. In addition, as the utilities manage to pool the solar-generated power with conventional power and because solar is still only a small part of total production, they are able to sell to high-voltage electricity consumers at a higher margin than their cost of purchase, thus making a profit (subsequent losses, of course, accruing because they have to provide free electricity to the agricultural sector). In Rajasthan, the proposed terms are somewhat different: the off-taker for solar power is the Rajasthan Renewable Energy Corporation Ltd (the state energy development agency), rather than the utility. In addition to the corporation's good payment records, it also extends a payment guarantee to developers by giving them access to a third-party bank account from which developers can draw funds with a letter of credit, in case of payment delays or defaults.

In this environment, the power purchase agreement is crucial. In the power sector as a whole the only protection against arbitrary changes in policy is the contract for the sale of power. Across the sector, developers and manufacturers have found that the regulatory machinery can come into force and protect them only if the initial contract is strong enough. This puts the state electricity board and its management (whose bureaucrats typically have long terms in charge) in a very important position as a facilitator of renewable energy projects. In general, developers across the solar sector have been very happy with the proactive nature of bureaucrats in Rajasthan and Gujarat, as well as their energy development agencies. Mr Abraham stated that no developer or investor seemed to be concerned about the change of governments as no political party had ever decided to change the contracts or conditions on which previous investments took place.

Structural/sectoral issues

Finance

In this risk environment, however, securing long-term credit from an Indian bank would depend on the strength of the firms' balance sheet. For SunBorne, a new company, the strength of the equity funding from previous venture capital rounds was an important consideration. More important for banks were the exact projects that were being executed. In Gujarat and Rajasthan, SunBorne bid for projects that were less than 20MW. With smaller projects being easier to manage, easier for the state utility to absorb power from and also to learn from, the firm preferred to bid for small projects in the earlier phases – which are also more attractive to banks. Lately, one large domestic bank, SBI Capital Markets, with a mandate to expand its investment in renewable energy, was signed on as a partner. Its involvement is seen to be important because of its ability to syndicate future loan requirements.[46]

Overall in the solar power sector, funding flowed easily for projects in Gujarat, where the power purchase agreements and the solar energy policy were clear. It was also easy to get funding in Rajasthan – where the chief lenders were large public sector banks such as the SBI – because of the low resource and payment risk. Most of the banks that SunBorne approached earlier about funding have been willing to experiment with smaller investments, but yet deem the sector as a whole to be one that is still immature for large-scale lending (which is different from wind power). However, in general, there has been no talk from the government about instruments such as debt guarantees, where larger bodies such as development finance institutions could be engaged. The view among the industry is that

[46] Loan syndication as a project financing mechanism has increased over the past decade. It involves several different lenders in providing various portions of a large loan, which is larger than what any single lender is willing or able to provide. Several lenders work together to provide the borrower the required loan at a rate agreed by all the lenders.

much more can be done to engage financiers, although developers as a whole understood their wariness.[47]

Again, large firms such as Tata Power, Mahindra, Lanco Solar and Welspun, for whom solar power is just one small part of a larger conglomerate, have managed to leverage existing EPC experience to venture successfully into turnkey projects for solar, and also managed to access debt finance very easily because of their strong balance sheets.

Lobbying and policy advocacy

The solar power sector is marked by three major lobbies: the Solar Power Developers Association, the Confederation of Indian Industry, and the Federation of Indian Chambers of Commerce and Industry, which have both developers and manufacturers among their members. Prior to the first phase the role of developers was relatively limited in policy advocacy as there were few of any significance.

However, what has been noticeable about the solar mission so far is that governments themselves consulted extensively about the policy process. Mr Abraham remarked that for all the policy documents released so far, firms like his have been consulted at every step and governments have sent the policy documents for comment. However, stakeholders' influence on the final decision is not entirely clear. A particular illustration is the case of the domestic component requirement. Before the launch of the mission's second phase, a 100 per cent domestic component requirement was mooted. Developers who stood to lose competitiveness and funding channels if such a provision was enforced reacted strongly. Over the course of various meetings, it seemed that this had some effect and the domestic component requirement was reduced to 75 per cent.

4.3.2 Key observations

- Despite the immaturity of the solar energy policy, firms and investors have emerged in the solar power sector which take a long-term view
- Even in solar power, the role of the utility is critical. Project risks and operation depend on the quality of the utility's support
- Investors expect services and technical skills to play a critical role – both in terms of reducing risk as well as improving yield
- The nature of the firm in solar power in India is different from that involved in wind power, with the primary players capturing a different part of the value chain rather than the supplier-driven manufacturing model prevalent in the wind sector.

[47] In the first phase of the solar mission, the net debt provided by scheduled commercial banks was less than 30 per cent. The International Finance Corporation was the largest single contributor with 20–30 per cent of the finance involved. The rest came from Exim Banks, who were interested in pushing technologies from their home countries in the wake of cut-throat competition between photovoltaic manufacturers globally.

5 Summary and key findings

5.1 Investment signals: state-level policy vs federal government policy

Formal financial incentives and service delivery have been critical for driving investment in wind and solar power. However, whereas the initial focus was on deriving additional benefit from renewables on a cost basis, the market has gradually shifted to mainstreaming renewable power alongside conventional generation. The level of this integration is at the state level and so policies there are much more important.

The case studies, both for wind and solar power, reveal that the crucial determinants of investment decisions are the state-level policies and environments. The MNRE, with its limited budget and influence over state-level governments, has only been able to extend a few – albeit important – incentives to craft the 'retail' business model. However, the attractiveness of a project is determined by particular policies at the state level and to what extent the federal government policy guidelines have been adopted and implemented. Clearly, despite inducements such as accelerated depreciation, generation-based incentives and renewable energy certificates across all states, some states have built up their wind and solar power sectors far more successfully than others and investments have followed sound implementation.

5.1.1 Tariffs and renewable purchase obligations

At the state level the most important roles have been those of tariffs and the provision of infrastructure and renewable purchase obligations which provide market certainty. Tariffs, calculated on a cost-plus methodology for both wind and solar, do depend on the initiative taken by the regulator/government in judging what aspects of costs and returns are feasible, and thus, despite the transparency, still have many subjective components. The renewable purchase obligations are even more subjective – electricity regulatory commissions can fix them so that procuring renewable power for obligated entities is not burdensome and the market can grow to provide it. However, striking a balance between growth, controlling costs and providing certainty has proven tricky.

5.1.2 Political mandate *vis-à-vis* systematic implementation

In the case of solar energy, the main political interventions so far have been the NSM – which has also seen a remarkable bias in favour of a certain state, namely Rajasthan – and the Gujarat state Solar Policy. In each case, however, the prime mover was a member of the political class, and the strong mandate to carry forward a 'risky' sector was extremely important to ensure that the respective bureaucracies implemented the policies and coordinated their different elements and participants – in the NSM's case, between various ministries and the agencies in Rajasthan, and in the case of Gujarat, between the regulators, the state electricity board and the utilities.

5.1.3 Role of the political class

The reasons for decisions at state level are not always clear, but the role of the political class, when aligned in favour of renewables, has been significant. Sharp investment peaks have occurred when the support of the political class has shown a clear intent toward renewable energy. This 'intent', although difficult to sustain as political parties come and go, has never been wholly negative toward renewable energy projects and all interviewees remarked that, across the board, politicians have been receptive and sympathetic. This has not always translated into public finance (as in the case of Tamil Nadu), but has been a necessary condition for action at all levels.

5.1.4 Climate change as a motivation

In all of the states where the case studies are based, the renewable energy policy documents have stated climate change mitigation as an objective in promoting renewables. However, if this is the case then an integrated framework for evaluating impact is conspicuous in its absence throughout – and this includes the NSM. With this in mind, it may be premature to say that climate change is an important driver. Power sufficiency has been much more consistent as a driver across all states, with Gujarat as a notable anomaly – a power-surplus state that is still investing in renewables – although even there, renewable electricity contributes less than four per cent of total electricity. In the case of Tamil Nadu it is much starker, where wind alone contributes 16–18 per cent of the state's power, and the shortages are severe enough to justify heavy investments even in intermittent wind. In each interview the motive of power sufficiency was the key explanatory variable, followed by industrial growth and 'prestige'. This implies that climate change concerns may not have been as important a driver as energy security and sufficiency.

5.2 Key roles of certain agents

The introduction of policy measures has depended to a large extent on the leadership of individuals within the bureaucracy and political class. Many of these individuals, particularly within the government, have had long-standing professional relationships, which enabled manoeuvres for policy and organisational innovation.

In comparison, relationships between private actors and state actors have been in formal settings such as the proceedings of regulatory hearings and formal advocacy activities. An alignment of interests has occurred primarily when policymakers have taken a strategic view of renewable energy in terms of energy sufficiency, sustainable development or climate change.

5.2.1 Role of manufacturers in the wind sector

Investment peaks in India have clearly followed two signals: macroeconomic conditions and state-level policy. However, in wind power the role of the firm (especially the manufacturer) has been important in driving the sector forward. Between 2003 and 2007, in organising the sector, marketing wind power, pushing for policy reform via organised groups during the electricity regulatory commission hearings and also in sensitising members of the political class, the manufacturer takes centre stage. However, informal relationships were not revealed in the interviews.

5.2.2 Leadership within electricity regulatory commissions

What can be seen, however, is the important role of the regulatory commissions – wherever the regulators have taken it upon themselves to promote renewables adequately (as in Maharashtra and Rajasthan), investors have responded well to the policy signals. Now both formal and informal relationships are common throughout the bureaucracy, and the role of such relationships in coordinating or brokering policy ideas between the central-level bureaucracy and the state level seems to have been important (in both directions). One interviewee candidly stated so, speaking of the case of the inclusion of renewable purchase obligations in the National Tariff Policy. Particularly in the wind power sector, as players are anticipating growth in the renewable energy certificate market (which in principle would yield higher returns than the FIT market), those states with a good record of compliance with the renewable purchase obligation and strong stances taken by the state regulators, are likely to attract investments.

5.2.3 Central government leadership

For solar power, as a nascent sector, the scenario is somewhat different. Firstly, there is a strong central-level signal, which is backed by a sovereign guarantee – thus the safest kind of signal from an investor's perspective. Secondly, since the implementation has a clear institutional home which is more 'permanent' – the MNRE, with states playing a supporting role – there is some confidence that political changes will not affect the mission. This is in contrast with investment in the states which follow their own 'boom and bust' cycles and where short-term policy fickleness is a larger problem.

5.2.4 Connections across state and centre

As seen in the case of Maharashtra with the introduction of the generation-based incentive and later the implementation of the NSM, the connections between individuals across institutions and agencies at the central and state levels have been important in driving both policy reform and implementation. These individuals have had a shared professional background or connections through the Indian bureaucracy, and these roles and the movements of professionals across agencies and their leadership have been instrumental in creating momentum to drive reform and implement certain policy measures.

5.2.5 Political interests of critical agents

Finally, in terms of actual project implementation and risks, in the case of both wind and solar power the role of the state electricity board and utility takes centre stage. Whenever the state electricity boards have been cooperative, projects are bid for and executed quickly. There may, however, exist a coalition of interests that opposes renewables by creating inertia in the existing system of cross-subsidisation. Managing the operations of the state utilities and their service provision is critical.

5.2.6 Evolution in the nature of the firm and its interests

Especially in the case of wind, the role of the manufacturers has been very important. Not only do they organise the sector and carry out joint marketing activities, but their actions as a combined voice of the industry in lobbying for macro-level policy reform has been crucial for keeping things on track. As independent power providers are stepping into the picture, the scenario may be changing and the interests of manufacturers and investors may differ. In solar power particularly, there is greater disintegration along the value chain – investors in projects may be separate from developers and manufacturers. Specialisation in services and R&D are emerging as ways to gain competitive advantage.

5.3 Nature of policy/interest bundling

Over time, organisational arrangements and instruments have attempted to manage the expectations and interests of various actors through formal approaches. However, there are many areas to be addressed.

5.3.1 Managing the political economy conditions of the wider power sector

Within each sector there are some clear misalignments of interest that have not always been resolved, and these have most often caused poor policy implementation or coordination, which has damaged the wind power sector severely in the past. As seen in both Tamil Nadu and Maharashtra, the state electricity boards and especially the governments have been receptive to wind power only so far as it involves no major commitment of financial resources, although this is crucial for critical elements such as infrastructure. The electricity regulatory commissions, although empowered to issue orders in such a case, do not have the powers to ensure implementation, and, as in the case of Tamil Nadu, their interests sometimes align with the interests of the state electricity board. Other central government-mandated policy moves, such as the renewable purchase obligations, also failed to bring

about alignments. As seen in the case of IPPs, the renewable energy certificate market has failed in so far as some states simply did not comply with the renewable purchase obligation. In Tamil Nadu the regulatory commission fixed a renewable purchase obligation that could easily be met with the existing generation capacity. In the case of Maharashtra, although the renewable purchase obligation was fixed, compliance was poor and only now has the regulator taken strong action (Shrimali *et al.* 2012). Unfortunately, these moves have only created further conflicts of interest and the policy has failed to take off.

5.3.2 Using 'co-benefits' to drive renewables

However, policies have tried to take advantage of the 'co-benefits' narrative to attract various parties to a common benefit, in particular at the federal level, and some states (such as Gujarat, and previously, Maharashtra) have used this to bundle, at least publicly, the prerogative of energy sufficiency and sustainability with climate change mitigation concerns (see Dubash *et al.* 2013). This has also been useful in creating a negotiating position with which to interact with other actors, such as the one the Maharashtra Energy Development Agency adopted when creating the Green Energy Fund or the one that the Rajasthan Renewable Energy Corporation adopted to enact reforms to land acquisition procedures. On the whole, however, industrialisation and attracting investment seem to have played a more important role in securing the buy-in of the political class. While no interview revealed the exact nature of these negotiations, in both Rajasthan and Gujarat, which are now moving toward a power-surplus position, the political prestige associated with greater 'development' and foreign investment seems to have been important. In Rajasthan, the fact that the local government is taking advantage of deployment to encourage a local PV manufacturing industry by imposing a state domestic content requirement, also points to the same (analyst interview).

5.3.3 Fleeting organisational arrangements

Wherever aligned interests have resulted in innovations to bypass such difficulties (such as the role of the Maharashtra Energy Development Agency in setting up infrastructure funds, or the MNRE's role in the NSM in reducing costs for utilities, thus using policy as a tool to avoid potential conflicts of interest) the results have been emphatic. As in the case of the IPPs and the execution risks they have faced, coalitions or at least short-term coordinated actions have had to extend to the highest echelons of power at the state level. By nature, each of these seems to be short lived and transitional rather than a true long-term engagement, with only certain actors' institutional roles being permanent (such as the MNRE or the electricity regulatory commissions). Informal relationships have been important, but in terms of policy implementation, within the bureaucracy it has been the leadership of key individuals and bodies that has made the difference.

5.3.4 Lack of common fora

On this note, it is also interesting to see what has *not* happened. There are clearly many stakeholders in the wind sector that are pursuing similar goals, including manufacturers, IPPs, other investors, state nodal agencies and the MNRE. On the other hand, there are important stakeholders who passively or actively oppose wind (such as utilities and transmission companies). However, as more than one interviewee remarked, there are no common platforms for all the involved bodies to come together. Actors such as the Planning Commission and its state level counterparts, who have a removed, but respected role, are not even engaged with the implementation issues. There are already pockets of action across the industry, with talk of a Wind Task Force and a Renewable Energy Forum, and also talk of a National Wind Energy Mission in the latest National Five-Year Plan, but this has yet to emerge.

Coalitions have rarely shown active cooperation unless it has been for policy reform or precipitating policy implementation. As such, their nature seems to be short-term and event-

based. This is not entirely true for coalitions within the public sector and government, where long-term institutional relations have helped a particular world-view take shape. Even here, however, the longevity of actors in particular positions is a question.

5.4 Changing nature of the wind and solar power sectors

The policy approach, the nature of the firms engaged in the sector and the nature of coordination between various actors have changed considerably over the course of the past ten years.

5.4.1 Policy learning

In both wind and solar power the move toward market-based mechanisms in creating greater returns and widening the scope of the market is noticeable. In particular, the MNRE, by introducing inducements such as the renewable purchase obligation, renewable energy certificate and generation-based incentive (there existed a generation-based incentive for solar power as well, although the returns were not as attractive as bidding under the NSM), is trying to provide more and more options for different classes of investors, to promote scale and also improve the uptake of renewables within the conventional power sector. This is a significant shift from the depreciation and feed-in tariff-driven industry where the returns were stable, but not high, and there was less incentive to compete with conventional power producers.

5.4.2 Changing firms

The wind power industry, led mostly by manufacturers, is now seeing large investors emerge and there is greater differentiation along the value chain. In solar power, which has yet to stabilise, we see much more variety. There are firms, like manufacturers in wind, trying to integrate along the entire value chain (such as Moser Baer), then firms who are only looking to operate solar power plants (such as NTPC and GAIL), and then there are firms who are only looking to provide services (such as SunBorne). Much depends on the risk appetite of the parties involved; where large investors such as Tata Power or IPPs in wind, by virtue of their size, can negotiate with utilities and other end-customers or even think of more attractive group captive models to trade power on the open market, smaller players may prefer the security of a state-backed power purchase agreement.

5.5 Macroeconomic tripping wire: finance

Coalition or government activity has failed to stimulate finance for renewable energy in particular areas (risk capital, long credit, etc.).

5.5.1 Supply as a bottleneck?

The story of finance in both sectors is quite telling. In India, apart from IREDA and a few international banks or development finance institutions, there are no banks who lend on a per-project non-recourse basis,[48] which is what is preferred for renewable energy assets worldwide. For many years, this put manufacturers in an important position as providers of credit for their investors. However, over time, with the focus on export markets and securing first-mover advantage, the strong growth models meant that manufacturers would borrow heavily, which was not always sustainable. Globally, Suzlon's model of inorganic growth through acquisitions and Vestas's financial difficulties in Denmark from 2008 to 2010, also played out in Indian markets. Unable to find enough balance sheet finance to cover their expenses abroad (and in Vestas's case, to sustain their activities domestically), Suzlon is undergoing a period of intense corporate debt restructuring and financial consolidation and Vestas has pulled out of the Indian market completely.

[48] Non-recourse funding: a loan where the lending bank is only entitled to repayment from the profits of the project the loan is funding, not from other assets of the borrower.

5.5.2 Lack of project finance

On the other hand, project-based non-recourse finance, that is freely available in developed markets such as in Germany or the US, continues to elude investors in India. IREDA is the only body that provides loans on a non-recourse basis; however, its market share has declined over the years for two main reasons. Firstly, its due diligence is quite stringent for each project and in the face of inadequate data, as is often the case, it takes time for the agency to sanction loans. Secondly, investors have preferred building up long-term partnerships with banks. Interviews with Suzlon, SunBorne, ReNew Power, independent analysts and lending institutions all confirmed that, with experience and over a track record of good execution, banks prefer to lend to companies with whom they have previously executed projects so they can authorise loans quickly. This process becomes even easier when there is a close, formal relationship, with members of the bank's management sitting as directors on the firm's board.

5.5.3 Nature of debt

Despite this, on average, the terms of credit for infrastructure as a whole and particularly solar are stringent indeed. Not only are loan tenures extremely short (10–15 years), there are few avenues where firms can raise additional funds such as corporate bond markets, which are highly underdeveloped in India. This puts large conglomerates in a highly advantageous position as they can get better terms, and raise money through multiple channels (2008 was an excellent year for initial public offerings in India, which saw major firms such as Reliance Power and Shriram EPC listed on foreign and domestic capital markets). In addition, there are caps on channels such as external commercial borrowings that limit the ability of entrepreneurs to raise funds.

In solar, particularly solar thermal power, there is very little risk capital that is available, and this is stifling growth and blocking opportunities to learn through setting up plants.

5.5.4 Possible avenues

The common view in the industry is that unless low-cost loans and bond markets for renewable energy infrastructure pick up, growth will remain stifled. Concerted action is required from the central government and there have been encouraging measures led by the Prime Minister's Office such as the establishment of a Green Energy Fund in 2011, which saw an influx of capital from both bilateral agencies and the private players (although its efficacy has been questioned – see Paliwal and Goyal 2013), and a move by the Ministry of Power to set up green corridors for the transmission of renewable energy (see Saikia 2013), saving both utilities and renewable energy firms the cost of infrastructure. How this turns out, however, is yet to be seen.

Annex
List of interviewees

No.	Organisation, individual	Date
1	Bloomberg New Energy Finance	17 October 2013
2	Bridge to India	12 July 2013
3	Bureau of Energy Efficiency	4 November 2013
4	Idam Infrastructure	1 November 2013
5	Indian Renewable Energy Development Agency	25 September 2013
6	Indian Wind Energy Association	2 December 2013
7	Indian Wind Energy Association	4 July 2013
8	A prominent IPP firm	30 September 2013
9	Maharashtra Energy Development Agency, former official	21 October 2013
10	Maharashtra Electricity Regulatory Commission, former official	5 November 2013
11	Ministry of New and Renewable Energy	15 November 2013
12	Ministry of New and Renewable Energy, former official	14 November 2013
13	Moser Baer Ltd, former official	26 July 2013
14	National Solar Mission stakeholders' meeting	12 February 2013
15	National Solar Mission phase 2 stakeholders' meeting	27 September 2013
16	A prominent solar power developer	22 April 2013
17	A prominent solar power system manufacturing firm	21 June 2013
18	ReGen Powertech	3 March 2014
19	SunBorne Energy, CEO and founder	8 November 2013
20	Suzlon Energy Ltd	5 August 2013
21	Suzlon Energy (Business Development department)	10 March 2014
22	Suzlon Energy (Regulatory Affairs department)	11 September 2013
23	Tamil Nadu Electricity Board, former official	10 June 2013
24	World Bank, official	28 October 2013

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Brighton BN1 9RE

T +44 (0)1273 606261
F +44 (0)1273 621202
E ids@ids.ac.uk
www.ids.ac.uk