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Rent Management and Policy Learning in Green Technology Development

The case of solar energy in India

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Abstract

To avoid irreversible damage to global ecosystems, new “green” technologies are needed. Some of those are still far from commercial maturity. In such cases, governments may create temporary rents to make investments “artificially” attractive. The creation of such rents, however, involves risks of misallocation and political capture. This article looks at rent management in the case of India's National Solar Mission. So far, the mission has been remarkably effective in triggering solar investments and keeping the necessary subsidies manageable through a process of competitive reverse bidding for tariffs. Moreover, policy design and implementation showed a good deal of experimentation and learning. Some risks remain, especially regarding the enforceability of renewable energy quotas at the level of Indian states. On the whole, however, first experiences indicate that “green rents” have been managed in a fairly effective way.

Disclaimer

In researching for this article, we interviewed a number of market participants from the public and private sectors. Private sector interviewees were particularly apprehensive about being quoted directly about their strategy, business practice, expectations or challenges regarding this early-stage market that is developing dynamically. Many aspects of the market lack transparency. In order to protect the interviewees’ anonymity without sacrificing insights that are important for our analysis, we agreed on a modified version of the ‘Chatham House Rules’ whereby we would not attribute quotes to individuals. Over the course of 2011 and 2012, we spoke with staff from the following companies:

1. Investors/project developers: Azure Power, Moser Baer, Solaire Direct, Kiran Energy, Welspun, Mahindra, Aditya Birla, SAIL, GAIL, GreenInfra, SaiSudhir, PR Fonroche.
2. Module manufacturers: First Solar, REC, Sharp, Q-Cells.
3. Inverter manufacturers: Solar One, Bonfiglioli, SMA.
4. Providers of Energy Performance Certificates: Juwi, Larsen & Toubro, Vikram Solar, Warree, Soleg, IBC Solar.
5. International cooperation agencies and other market observers: World Bank, Asian Development Bank, International Finance Corporation, GIZ, KfW, DfID, Council on Energy, Environment and Water and the Centre for Science and Environment.

Indian Government bodies including Ministry of New and Renewable Energy, Central Electricity Regulatory Commission, State Electricity Regulatory Commissions and the Low Carbon Task Force of the Planning Commission.

Abbreviations

CERC	Central Electricity Commission
CSP	Concentrating Solar Power
DfID	Department for International Development
EPC	Engineering, Procurement, Construction
GDP	Gross Domestic Product
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GW	Gigawatt
IPP	independent power producer
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau
MNRE	Ministry of New and Renewable Energy
MW	Megawatt
NSM	Jawaharlal Nehru National Solar Mission
ppm	parts per million
PV	photovoltaic
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligations
SERC	State Electricity Regulatory Commission

Contents

Introduction

Sir Nicholas Stern has called climate change "a result of the greatest market failure that the world has seen,"[1] because it has potentially huge global effects for the whole world's inhabitants. In order to keep global warming within tolerable limits, new mitigation technologies must be developed and many conventional greenhouse gas-emitting technological trajectories disrupted. The areas in which it is necessary to accelerate major technological breakthroughs are well known: renewable energy and energy storage technologies, carbon capture and storage technologies, new resource-saving materials, new mobility concepts and more eco-efficient agricultural technologies – to name just a few. In most cases, it could take years, or even decades, until carbon-efficient technologies become competitive in the market place. To accelerate their development, reliable long-term policy frameworks are required with attractive subsidies and/or guarantees that reduce the risk and bridge early development and commercial success. In economists' terms, *rents* need to be created, that is, investors need to be able to earn above-average returns in the new green industries for as long as needed to build up physical capacities, acquire capabilities and make these industries competitive.

Creating rents for supporting specific industries can, however, have two undesirable effects (Chang 2006). Policymakers tend to act on incomplete information that can lead them to make wrong choices and support technologies which never become commercially viable, and the possibility of earning above-average returns in regulated markets creates a strong incentive for rent-seeking, that is, lobbyists will try to influence regulations in order to increase their rents or stretch them over longer periods of time than are necessary for developing the new industries ('political capture'). Thus the challenge for policymakers is to *manage rents* so that they reach the targets with a minimum of political capture and waste of taxpayer and consumer money.

Rent management is especially demanding when pressing environmental problems require that established technological trajectories be disrupted and new generations of technologies developed. In such cases, policymakers must often design support schemes without knowing which technologies will become the commercially successful 'dominant design' (Anderson / Tushman 1990) – or the specific capital requirements, the speed with which economies of scale will reduce unit production costs, how long it will take until the new technologies reach cost parity with incumbent technologies, and to what extent the new activity will create knowledge spillovers in related activities. All this makes it very difficult to determine the necessary amount and duration of subsidies or protection. At the same time, uncertainty increases the scope for rent-seeking: industry lobbies have strong incentives to overstate the need for subsidies and protection. Governments must take the trial-and-error approach to testing various policy options and continuously adjust their support in view of the market's changing realities.

This article explores how the Government of India creates and allocates rents in its attempt to promote solar energy generation, how it tries to minimise political capture and how it tests and fine-tunes its policies. This case is particularly interesting for two reasons. First, energy from the sun is a socially desirable source of energy that deserves and requires long-term policy support: it is practically emissions-free, is more abundant than other renewable energies in many countries, and can be locally generated, which furthers development. At the same time, solar energy remains considerably more expensive than energy from other sources (conventional, as well as hydro or

1 http://www.guardian.co.uk/environment/2007/nov/29/climatechange.carbonemissions

biomass) and therefore requires steadfast support until it achieves grid parity. The Government of India has recently adopted a 'National Solar Mission' that includes a range of new incentives, and some Indian state governments are also experimenting with support measures. India thus provides a unique 'laboratory' for learning about solar policy.

This article has four sections. Section 1 explains why governments need to create rents in order to channel resources into environmentally more sustainable new technologies. It also addresses the risks of government failure and political capture. Section 2 explores the rationale for using solar energy in India and provides an overview of the country's solar energy policies. Section 3 analyses two key aspects of these policies from the perspective of rent management: (a) how governments determine the right level of preferential tariffs for solar energy, and (b) how state-level renewable energy targets are politically negotiated and linked to a certificate trading scheme. Both aspects have far-reaching implications for the creation and transfer of rents. Section 4 concludes.

1 The promotion of green technologies and the creation of rents

1.1 The enhanced role of public policy in promoting "green" technologies

New resource-saving technologies are needed in order to avoid major, often irreversible, damage to global ecosystems. The development of these 'green technologies' must be policy-driven – much more than in other fields of technology development, where market-driven search processes prevail (Altenburg / Pegels 2012, 11 ff.; World Bank 2012, 65 ff.). This is because the current rate of global-ecosystems degradation threatens to reach environmental tipping points that will create ecosystem disequilibria with unparalleled negative consequences for mankind (Stern 2007). Developing and deploying technologies for the sustainable use of resources is of utmost urgency. Furthermore, this must be achieved quickly, especially with regard to climate change mitigation. If global greenhouse gas emissions continue to increase for another decade, many consequences may become irreversible, while the cost of abatement will grow exponentially (IPCC 2007; McKinsey 2009).

Innovation processes should be as market-driven as possible in order to ensure that demand is met effectively. Incentives should preferably aim at general policy targets, such as energy saving or emissions reduction, without prescribing specific technological solutions. Governments can achieve a lot by enhancing market transparency, educating the general public, training technicians, setting standards and certifying market players, or taxing the use of scarce resources. With regards to innovations for sustainable development, however, market-based allocation alone is not likely to suffice for developing the necessary new technologies and replacing the unsustainable old ones before the onset of irreversible environmental damage.

1. Many environmental innovations require more than a decade or two to develop a new technology, run pilot tests and establish full-scale commercial operations (Kramer / Haigh 2009, 568). Given the risk of environmental tipping points, unsustainable technologies need to be replaced quickly.

2. Cumulative market failures are holding back investments in innovations for environmental sustainability (Stern 2007). Similar to other public goods, the social value for current and fu-

ture generations of many ecosystem services is not reflected in their cost. Moreover, investing in new technologies that are far from the commercial frontier requires early investors to risk the full costs of failure, while in successful cases, much of the potential gain is likely to be reaped by other market actors. Finally, information and coordination failures are particularly severe when systemic changes are needed – such as changing from high to low-carbon energy or transport systems (Altenburg / Pegels 2012, 12).

3. Lock-in effects such as path-dependent consumer behaviour and incentives to continue exploiting aged, depreciated industrial infrastructure hinder efforts to replace outdated technologies (Unruh 2000).

4. With regard to energy systems, investments in renewable-energy technologies such as solar, hydro and wind are often not 'bankable' because although the running costs are minimal, considerable capital investment must be made upfront. In contrast, in conventional power plants a larger share of running costs are distributed over the plant's lifetime and can be adjusted to changes in the energy market, thereby reducing investment risks for banks. In addition, it is more difficult to access credit for new technologies without established track records than for old ones.

Public policy is needed to correct these market failures and make green technologies more profitable than less sustainable ones. In economic terms, policies must create ***rents*** to lure capital into socially desirable green investments. Rents are defined as "payment[s] to a resource owner above the amount his resources would command in their next best alternative use" (Tollison 1982, 577), or more simply, returns that are higher than opportunity returns. 'Opportunity returns' (and also 'rents') cannot be precisely quantified since investors expect different rates of return for specific activities, depending on the perceived risks and strategic considerations.

Already temporary rents have accelerated mass production and deployment in a range of green technologies, spurred technological learning and permitted producers to reap economies of scale. In the case of photovoltaic (PV) solar technology, the cost of electricity generation has decreased by 22% each time the globally installed cumulative generation capacity doubled (IRENA 2012, I); the figure for wind turbines is 10% (Staffhorst 2006). The German Advisory Council on Global Change estimates similar learning curve effects for electricity generation from biomass and solar thermal-power plants (WBGU 2011, 167 f.). As a result, the cost gap in relation to competing incumbent technologies has decreased substantially, meaning that subsidies can – and should be – reduced, and soon may be discontinued.

1.2 The risks of government failure

Creating rents through policy decisions can be risky:

For starters, policymakers may take the wrong decisions and support technologies that never become commercially viable. Critics of technology selection have long argued that governments do not know who will win any better than markets do (Pack / Saggi 2006). This argument overlooks two aspects: First, governments bring a public welfare perspective. Certain technologies may be socially more desirable than others, perhaps because of environmental externalities, or due to dynamic spillover effects that are not adequately reflected in the decisions made by individual investors: the best choice of a technology from the perspective of an individual investor may not be the best for the society as a whole. Second, governments may facilitate technology-specific collective action and thereby help overcome failures of coordination in the market place (Lin / Monga 2010). These arguments justify technological targeting. The risks of faulty allocation should not be underestimated, however: examples abound of governments wasting resources on technologies that never achieve maturity.[2] While failed experiments are part of research, subsidised processes should be closely monitored and have built-in learning loops that allow policymakers to adapt instruments and keep policy costs as low as possible (Altenburg 2011).

Further, government intervention creates incentives for rent-seeking and political capture, that is, attempts to lobby for government regulations that enable the lobbyist to capture economic rents (Krueger 1974; Murphy / Shleifer / Vishny 1993). The scope for rent-seeking is particularly large in green technology promotion, because urgent environmental problems force policymakers to support the search for new technologies with incomplete information. The more immature the technology, and the more it depends on broader policy changes, the greater the uncertainty about which technological alternative will become commercially viable first and how long competing technologies will take to become commercially viable; if investing early will give the country an advantage in the form of new exports, additional employment and/or knowledge spillovers; the size of such effects relative to the investments required upfront; and the amount of subsidy or protection needed to most efficiently achieve these targets. The choice of technologies also implies trade-offs – such as between nuclear risks and carbon emissions – and therefore involves subjective value judgements that can, and usually are, politically contested (Altenburg / Pegels 2012). All this increases the uncertainty, and thus the scope for rent-seeking. Empirical evidence shows that where rents have been created to promote green technologies, rent-seeking and political capture have often been observed. Helm (2010) demonstrates this for the European Emissions Trading System and renewable energy subsidies. Gerasimchuk et al. (2012, 21 f.) explain why beneficiaries of bio-fuel subsidies are successfully lobbying against subsidy reform; annual bio-fuel subsidies are expected to increase from USD 22 billion in 2010 to USD 67 billion in 2035, despite increasing evidence that questions their record regarding greenhouse gas (GHG) emissions reduction and food prices (ibid.).

The challenge for policymakers is thus to accelerate the development and deployment in ways that minimise the political capture and waste of taxpayer and consumer money. Given the quantity of resources concerned – Stern estimates that reducing greenhouse gas emissions to avoid the worst impacts of climate change will cost around 2% of global annual GDP[3] – climate policy expenditures must be prevented being turned into unproductive rents. Helm (2010, 182) argues that rent-seeking and political capture are likely to drive the actual costs of carbon mitigation much higher than the Stern Review estimated.

2 For example, beginning in the 1960s, fast breeder-reactor development was heavily subsidised, but after several decades of expensive experimentation most countries abandoned the technology or shut down plants for economic or safety reasons (Waltar / Reynolds 1981).

3 The Stern Review (Stern 2007) originally estimated 1%, but in 2008 the author raised his estimate of the annual cost of achieving stabilisation between 500 and 550 ppm to 2% of global annual GDP (The Guardian, 26 June 2008).

1.3 Rent management

The concept of 'rent management' enters here. Rent management refers to the way governments create or withdraw rents and they influence allocation for different purposes among various actors. Using the findings of Khan (2004; 2008) and Altenburg (2011), effective rent management is understood as the capability to:

1. **Clearly define political targets and priorities and translate them into policies.** Rents should be increased as long as they accelerate the accumulation of physical and human capital in specific desirable technologies that will pay off in the future. When investors pocket rents without reinvesting them in the desired capacities and capabilities, the optimum rent has been surpassed. In developing green technologies, policymakers may pursue various targets, and allocate rents accordingly. Typically, policies are driven by several concerns – such as climate change mitigation, local pollution and energy security – while they also exploit opportunities for new competitive advantages and additional jobs. The way rents are allocated depends on the prioritisation of targets. When governments seek to accelerate deployment to mitigate climate change, they link the rents to emissions avoidance, whereas if they wish to focus on technological learning, they may use local content requirements or trade restrictions to privilege domestic over foreign producers. Possible trade-offs include restrictions on investment and trade that increase costs and retard the diffusion of greener technologies. Trade-offs need to be carefully assessed to determine the most appropriate mix of instruments and allocation of rents. More complex, multidimensional policy regimes increase the likelihood of political capture (Zenghelis 2011, 13).

2. **Determine the amount of rents needed at any given moment.** This task is particularly challenging for three reasons: *First*, rents are returns above 'opportunity returns'. Ideally, policymakers should be able to assess the level of subsidies that are needed to make certain investments more attractive than alternative investment opportunities. Investors expect different returns on investment depending on their perception of the risks involved in each specific activity. It is especially difficult to assess 'decent' subsidy levels when information on key parameters – such as industry-specific risk premiums, future prices of different inputs and outputs, rates of technological progress and environmental externalities – is incomplete. The difficulty increases when governments promote the shift to fundamentally new technological trajectories (e.g. combustion engines to electric vehicles) and several technologies compete to become the dominant design (e.g. fuel-cell vs. battery-electric vs. hybrid vehicles). *Second*, rents must be adapted to the life cycle of the respective industry. Rents must be higher for immature industries, while they can be reduced when firms are able to produce more efficiently due to technological learning and economies of scale. In addition, it is not easy to determine the right moment to enter an emerging industry: it could be opportune to promote the industry in its infancy to gain early-mover advantages but it also might be better to wait until pioneers elsewhere have solved the initial problems and proven the industry's viability. *Third*, principal-agent problems increase the policymakers' level of uncertainty (Eisenhardt 1989). Principal-agent problems arise when the economic actors who implement the policy (the 'agents') are not pursuing the same interests as the governments (the 'principal') and the former take advantage of the latter's lack of information about concrete operation parameters. Agents may, for example, try to increase their rents by falsely claiming greater production costs and social benefits (such as employment effects and knowledge spillovers). Rent man-

agement refers to efforts to discover the actual costs in view of information asymmetries so as to establish the optimal rents levels.

3. **Make credible long-term commitments.** Policies that pursue long-term goals, such as switching from high- to low-carbon energy or transport systems, must guarantee stable rents for fairly long periods, especially when the upfront investments for infrastructure, research and manufacturing are high, future market prospects are uncertain, and a lot of time is needed to lower costs to competitive levels. It is difficult to guarantee long-term rents because people are often unable to accurately balance current and future costs and benefits ('cognitive myopia') and don't want to make immediate investments even if the future gains may be large (World Bank 2012, 50). In the same vein, politicians tend to prioritise actions that increase their popularity among current (rather than future) constituencies; in parliamentarian democracies, actions usually have to show results within the same electoral cycle. Tensions can arise between *the need to make credible long-term commitments* and *the need to experiment and continuously adjust policies to changing market realities*.

4. **Increase, cap, or withdraw rents despite political lobbyists.** Rent management is about reallocating rents among producers, consumers and taxpayers. To begin with, creating rents is likely to be resisted by those who have to foot the bill. Then, as infant industries get closer to commercial parity, the rents have to be discontinued. If new industries experience very successful uptake – thereby increasing the absolute level of rents to be borne by taxpayers or consumers – subsidies may become unsustainable and require capping.[4] Any reduction or elimination of rents is imposed on their earlier beneficiaries. The necessity of adapting rents over time conflicts with the investors' need for calculable policy frameworks that can bring returns on investments above the 'usual' rate of returns. When it is not possible to give long-term guarantees for the absolute level of rents (such as a fixed 25-year premium on energy purchases), it is necessary to have clear and reliable rules regarding the adaptation of rents.

Briefly, policy must create rents to trigger the development and deployment of *specific* technologies, often over *protracted periods* and under considerable *uncertainty* regarding the rents that are needed and the timeframe before the rents can be phased out. This is particularly true for the energy sector because of its environmental externalities, long investment cycles and major infrastructural challenges that require political negotiations with many stakeholders. These sector conditions increase the scope for rent-seeking and make rent management a formidable task. Rent management presupposes what Evans (1995) calls 'embedded autonomy': The state must be so 'embedded' with market actors that it understands cost structures and the rationale of investment decisions and can determine the most efficient level and duration of rents. At the same time, the state must be authorised to increase or cut rents without falling prey to rent-seekers. This calls for policy-learning skills. The great uncertainties that lie in the pathways for green transformation require policymakers to experiment with various policies, and continuously adapt them based on their performance and changes in the framework conditions.

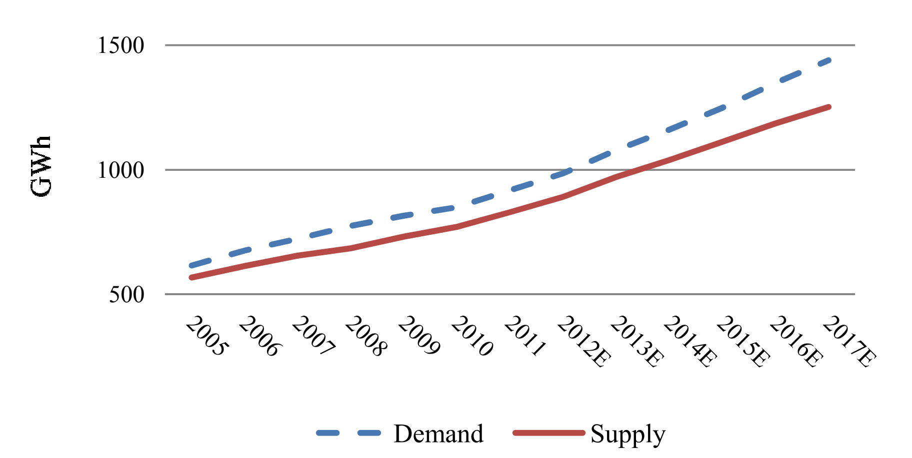
4 In Germany, for example, net subsidies for electricity from renewable sources soared from USD 0.9 billion in 2000 to USD 12.4 billion in 2011 (IW 2011), which the led to a substantial revision of the subsidy regime.

2 Solar energy use in India: Rationale and policy

2.1 The rationale for solar energy use in India

India has a huge energy deficit. In 2009, 40% of Indian households were not connected to electricity grids (Greenpeace 2009). Power cuts cost an estimated EUR 39 billion per year, while over the past 30 years the gap between electricity generation and consumption has widened (Figure 1). The power deficit is expected to reach 600 GW by 2050 (dena 2012, 35).

Figure 1: Increasing power deficit



Source: Central Electricity Authority

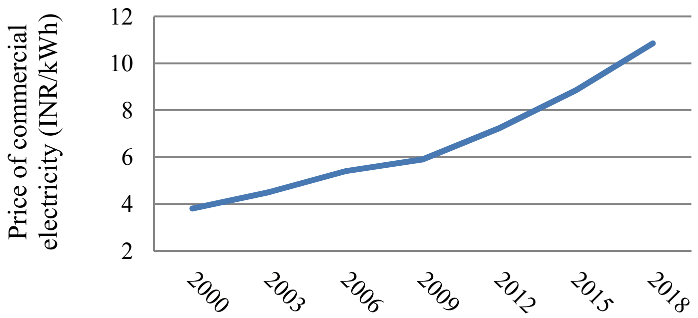
The 11th Five-Year-Plan (2007–2012) set the ambitious target of an annual increase of 9.5% in electricity production (MoP 2010). In India, power generation relies mainly on fossil-fuel sources – in 2008, it was 82.3% (IEA 2010) – and greenhouse gases emissions per kWh are high because of the use of outdated technologies.

At the same time, India has huge potential for solar energy. On average, India enjoys 300 sunny days each year and receives an hourly radiation of 200 MW/km^2. According to one estimate, if 1% of India's land mass was used for solar energy projects, installed solar capacity would reach 800 GW, or around five times India's current total installed power capacity (Engelmeier et al. 2011). Solar power could cover India's long-term power requirements. Solar energy could also reduce the emissions intensity of India's energy mix and save a lot on foreign exchange. In 2009, oil and derivatives accounted for 26.4% of all Indian imports (dena 2012, 21).

Climate change mitigation is not the main driver of solar energy promotion in India. Although the 'National Solar Mission' policy was declared in India's National Action Plan on Climate Change, improving energy access and securing energy provision have higher priority. India's government expect that old industrialised countries – who bear historical responsibility for the accumulation of greenhouse gases in the atmosphere and whose current per-capita emissions are still far above the average of developing countries – should assume the bulk of mitigation costs (see Rajamani 2007).

While India's solar power installations were almost negligible at the end of 2010, one and a half years later, in August 2012, India's installed solar capacity (mostly PV) surpassed 1 GW.[5] This sudden, rapid growth resulted from government policies that created attractive rents (see Section 2.2). Solar power prices cannot yet compete with traditional sources of energy, however. In July 2011 solar power from utility-scale systems cost more than three times as much as coal power (Engelmeier et al. 2011). Other renewable energy sources – particularly hydro and wind power – are closer to grid parity, the point where it becomes economically attractive for investors to shift from finite and polluting fossil to infinite and clean solar energy sources (World Bank 2010, 22 ff.). But since the most appropriate sites for these technologies are already being exploited, there is limited potential to expand capacity. Solar and other renewable energy sources are already competitive in a number of niche markets, especially where users are not connected to grids and where they can complement (without storage) or replace (with storage) the costly diesel back-up systems that mitigate India's frequent power cuts. Given the steep increase of energy prices in India over the last years (Figure 2), solar energy is a very promising source of renewable energy.

Figure 2: Rising electricity costs in India



Source: own calculations on the basis of data from State Electricity Regulatory Commissions

The rapidly rising demand for power and increasing fossil-fuel prices are expected to swiftly reduce solar energy's relative cost disadvantage. As shown by IRENA (2012, I), economies of scale in production and deployment have lowered international PV module costs by 22% with every doubling of capacity, and the prospects for continued cost reductions are very good due to the very rapid growth of the PV market as well as strong competition. Hence, there is a rationale for temporarily subsidising the production and deployment of solar energy technologies in order to reach grid parity as soon as possible.

Subsidies, however, are politically very sensitive. Given that several hundred million Indians are poor and deprived of basic services, it is hard to justify using scarce public resources for projects that are not directly linked to alleviating poverty and might even result in higher prices for consumers. Renewables do not rank particularly high on the energy policy agenda. Political priorities include energy security, increased power generation and grid capacity, and improving access to energy grids. The fact that energy for agricultural use currently costs nothing in some parts of In-

5 http://www.energynext.in/grid-connected-solar-power-capacity-india-reaches-1040-67-mw-2012-says-mnre-minister/

dia while electricity theft is prevalent indicates the difficulty in charging rates to cover the costs of energy (to say nothing of pricing environmental externalities). As a consequence, utilities run huge losses (Power Finance Corp. Ltd. 2011; Joseph 2010). Against this backdrop, promoting new sources of energy that are not yet price-competitive is a formidable task, although in the long term it is highly desirable for economic development and the environment.

2.2 India's solar energy policies

In India, solar energy research and local pilot schemes have been promoted at a low level for many years. In 1981, a Commission for Additional Sources of Energy was created, which in 1992 became the world's first ministry dedicated to renewable energy promotion (since 2006, it has been known as the Ministry of New and Renewable Energy, or MNRE). Renewable energy promotion received a boost with the National Electricity Policy 2005, which obliges licensed utilities and producers of captive electricity to purchase certain amounts of renewable energy. In recent years, a number of specific federal and state-level incentive schemes have been created for specific purposes, ranging from rooftop PV installations to large-scale power plants. The National Rural Electrification Policy of 2006 offered a range of incentives for renewal energy projects, and a generation-based incentive scheme was introduced in 2008. In 2009, the Government of India launched the Jawaharlal Nehru National Solar Mission, or NSM (see MNRE 2010). The NSM is the most comprehensive policy to date and marks the first coherent and ambitious attempt by the federal government to increase solar power generation and develop domestic capabilities and capacities in solar technology. The NSM's aim is to increase solar power generation (from PV and Concentrating Solar Power/CSP technologies) so that retail grid parity (currently about USD 0.12/kWh) is achieved by 2022 and parity with coal generation (currently about USD 0.05/kWh) by 2030. The NSM intends to trigger 20 GW on-grid and 2 GW off-grid solar energy plants by 2022.

At the federal level, solar energy promotion includes a range of instruments:[6]

- *Preferential feed-in tariffs*. Tariffs for photovoltaic and solar thermal power plants are guaranteed for 25 years. Thus far the tariff level has been established through reverse auctions (see Section 3.1).
- *Renewable Purchase Obligations (RPO) and the Renewable Energy Certificate (REC)*. To increase pan-Indian demand for renewable energy and also encourage project development, so-called 'obligated entities' must purchase a certain minimum share of renewable energy. To fulfil their RPO, obligated entities may produce renewable energy themselves, purchase directly from power producers or buy RECs through a renewable-power-producers exchange (Section 3.2).
- *Domestic content requirements*. Among the NSM's ambitions is developing domestic technological capabilities for solar energy. Access to preferential tariffs linked to domestic content requirements provides an incentive to produce in India. Auctions for solar thermal power plants stipulate a minimum domestic content of 30%. For PV-power plants, the first round of auctions required that crystalline modules be sourced nationally while cells could be imported; in the second bid, crystalline cells had to be locally manufactured, too, and only thin-

6 Some incentives can be cumulated, while others are alternative options. Most importantly, beneficiaries can only apply for preferential feed-in-tariffs or RECs trading.

film technology was allowed to be imported. The NSM also offers a range of supply-side incentives for technology development.

- *Other incentives.* Tax holidays, attractive options for the accelerated depreciation of investments, soft loan schemes and simplified procedures for project clearance are also granted. Renewable energy projects may be awarded generous long-term leases for land at symbolic rates. The NSM partly assures payment risks, which are key to project bankability.

Besides the federal government NSM, several Indian states are also pursuing solar policies that provide additional or alternative incentives. Gujarat, in particular, stands out with a solar policy that has created incentives for even more installations than the NSM. Karnataka and Rajasthan also have dedicated solar policies. These state packages differ from each other and from the federal ones. For example, Gujarat offers a predetermined feed-in-tariff instead of following the reverse auction system of the federal government and most other states, and has no domestic content requirement; Rajasthan and Gujarat have established solar parks as special economic zones with dedicated infrastructures; Rajasthan reserves part of its solar bids for companies that produce a certain share of their equipment locally (Bridge to India 2012a). India's diversity of policy approaches provides an interesting laboratory for testing the effectiveness of various ways of managing renewable-energy rents.

3 Solar energy policy in India - A rent management perspective

Developing new energy sources that are fairly expensive at first but are desirable for long-term energy security and environmental protection is particularly challenging in view of the pressure to invest available resources in cheap, short-term solutions that address basic development needs, including large numbers of households with no access to energy or frequent power cuts, and social deprivations in areas unrelated to energy, such as health, education and nutrition. It is also difficult when consumers – many of whom are poor – are extremely price-sensitive and are used to substantial energy subsidies whether they are poor or not (Bandyopadhyay 2010).

This is precisely the situation in India. The following two sections explore how, despite these restrictions, rents for renewable energy development are created, and how they are allocated among competing interest groups. Two aspects are especially relevant:

1. How governments (both federal and state) determine the right levels of preferential feed-in tariffs for solar energy. The challenge is to create sufficient rents to leverage a considerable flow of commercial investments into this industry, while keeping energy prices affordable (Section 3.1).

2. How the RPO are set, and how this impacts the creation and transfer of rents. The system of tradable quotas is meant to set 'fair' incentives for states with very different initial conditions for the generation of renewable energy. Defining the RPO level is a state matter, with RPO varying significantly from state to state, reflecting not just differences in energy sources but also in political ambitions. An interesting aspect of the political economy of RPO is that the instrument creates a perverse incentive for state governments: If State A sets ambitious targets, the obligated entities in its jurisdiction may end up purchasing RECs from entities in State B that have made less effort to develop renewable energy, but have nominal excess quotas because the state government set modest targets (Section 3.2).

3.1 Determining the right level of rents

Determining the right level of rents is difficult. Levels that are too low may fail to attract the required investments, while rents that are too high may indicate an unproductive transfer of resources from households – that are often very poor – to technology companies. Finding the right balance is further complicated by the fact that many price determinants are largely unknown. No reliable long-term solar irradiation data exist for solar energy projects. It is also unclear if PV-module prices will continue to fall rapidly, how the prices of other energy sources will evolve, if the grid will be able to cope with the infirm power generated by PV plants and how solar energy performs in niche markets. Hence, it is difficult to establish the appropriate level and duration of subsidies.

Under the NSM, the Indian government promotes different types of solar energy projects. The NSM has defined three development phases, with targets gradually increasing from 1,300 MW in Phase 1 (to March 2013), an additional 3,700 MW in Phase 2 (to 2017) and 17,000 MW in Phase 3, thus reaching a total of 22,000 MW in 2022. Phase 1 projects have been divided into 500 MW for utility-scale PV projects and 500 for solar-thermal power plants (Concentrating Solar Power, CSP), with the remaining 300 MW for small roof-top and off-grid projects. Then the Phase 1 allocations were split into two batches. The first batch included 150 MW of PV and 470 MW of CSP projects. The PV part in particular, with a maximum project size of just 5 MW, can be considered a test run. At the start of the program, the government offered a fixed feed-in tariff of EUR 0.27/kWh for PV projects and EUR 0.24/kWh for CSP projects. These tariffs were based on the first estimates of the Central Electricity Regulatory Commission, or CERC, of the capital costs of the technologies, the cost of the debt and the expectations of market return. There was some concern that the NSM might not be able to attract enough investors. But the response to the initial tariffs was so positive that the challenge became selecting the investors.[7] Companies were requested to offer discounts on the previous feed-in tariff, and the winning bidders were offered 25-year guaranteed tariffs. In the second round of projects, the remaining 350 MW of PV projects were offered, now with an increased project size of up to 20 MW and allowing individuals or consortia to bid for a maximum of three projects adding up to 50 MW.

Such competitive reverse bidding had been successfully implemented in conventional energy projects. The advantage of this mechanism over predefined feed-in tariffs is that it elicits the price market at which actors are willing to develop projects – something that policymakers cannot otherwise ascertain because they lack information about all the relevant project parameters (Lesser / Su 2008, 985 ff.). Some investors may be willing to sacrifice profits in their first projects in order to secure entry into an emerging market. Competitive reverse bidding helps governments establish the level of rents needed to attract sufficient investment for the solar industry.

The first auction led to a strong drop in tariffs. Applications were made for more than 5,000 MW – more than 30 times the available project volume. Successful bidders offered PV projects at prices between EUR 0.17 and 0.20/kWh. In the second bid, the average tariff bid dropped to EUR 0.14/kWh. The lowest tariff bid was EUR 0.11/kWh for PV and EUR 0.17/kWh for CSP.

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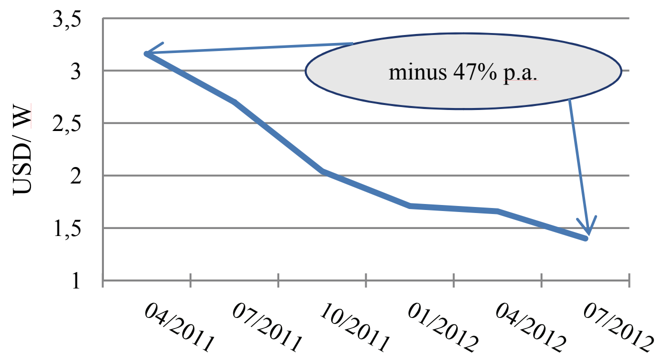
7 Interview with Mr. Shyam Saran, formerly the Prime Minister's Climate Change Envoy, in August 2011

At first glance, the reverse auctions were very successful, overwhelming the expectations of the MNRE and most observers. The low bids reflect the strong international trend of falling prices for PV-modules (Figure 3) and cost reductions anticipated from the scale and localisation of parts for CSP plants (Bloomberg New Energy Finance 2012).

Figure 3: Declining PV module prices in India



Source: own market research

Doubts remain about the viability of solar energy projects at such low prices. In fact, the 'adventurous bidding' observed in other countries that experimented with reverse auctions, resulted in projects not being implemented or being unduly delayed (Kreycik / Couture / Cory 2011; Becker / Fischer 2012). Low bids can also jeopardise the bankability of future projects. The Indian government applied some safeguards to reduce the risk of adventurous bidding: it requested bidding fees and also bank guarantees that would be lost in different tranches in case of delays.

Notwithstanding these precautions, there have been delays after NSM auctions. Only twelve of the 30 projects auctioned in Batch 1 fulfilled their legal requirements on time. Investors claim that the delays were due to difficulties with land acquisition and inadequate power evacuation or transmission infrastructure. While this may account for some of the delays, their large number and the nature of the investors who submitted the lowest bids – many of whom had no prior experience in the solar industry – suggest that some bids were indeed 'adventurous'.

Most delays have been penalised – which is necessary to discourage adventurous bidding in the future. The regulations foresee that bidders lose their bank guarantees in tranches of 20% for a delay of one month, 40% for the second month and the remaining 40% for the third month. Some 14 projects saw the first tranche of their bank guarantees drawn, a total of EUR 4.3 million. Seven projects in Rajasthan initially managed to shirk penalty payments although they were late because they received commissioning certificates from the competent state authority (Bridge to India 2012b, 9). While by imposing penalty payments the federal government seems determined to send investors an unambiguous message that adventurous bidding will not be tolerated, at the state level loopholes may still exist. Besides the NSM, projects have been delayed under the Gujarat Solar Policy, where the Gujarat Electricity Regulatory Commission imposed penalties on 370 MW worth of projects for missing the 31 December 2012 deadline to commission.

In order to judge whether bids were miscalculated or presented realistic project costs, it is necessary to examine the bidders' rationale. To this end, interviews with company representatives and sector experts were conducted in early 2012. The comments should be treated with caution as bidders may have been unwilling to fully disclose their strategic considerations, and some allegations cannot be verified – especially when interviewees hinted at money laundering and speculation. Nevertheless, the assessment by industry insiders provides insights into the diversity of potential motives for especially low project bids:[8]

1. Some investors had no experience in the energy business and may have simply underestimated project development costs or expected that penalties would not be enforced.

2. Some industry players appear to be pursuing long-term strategic goals: one is to use solar energy projects to get a foot into India's heavily regulated energy industry; another is to gain visibility as a pioneering investor in an emerging industry, which could help the company get listed on the stock exchange and attract international funding or sell to a market aggregator at a later stage. Some companies may be willing to absorb losses in their first bids in order to make headway towards their long-term goals.

3. There may also have been tactical bidding from bidders willing to take a bet that costs would continue to fall between the tariff auction and the actual purchase of equipment. Some bidders further leveraged on the deferred payment schemes that module manufacturers offered and the low interest rates based on the strength of their balance sheets. (The rapid reduction in module costs in 2011 ‘saved’ such bidders).

4. Indian PV-module manufacturers have been severely hit by the recent fall in demand in Europe, which is by far their main export market. Some winning (low) bids have come from module manufacturers, for whom investing in their own PV projects serves to allocate surplus production and diversify risks. Some international module manufacturers have offered their lowest prices on the Indian market – perhaps because there they see a strategic advantage in having early reference projects or because they see India as a volume (rather than a margin) market that helps them achieve high levels of manufacturing-plant utilisation that holds down unit costs.

5. Some bidders are captive consumers (e.g. owners of textile factories) who can use PV plants as back-up energy suppliers for their own electricity needs. These investors may use the energy thus generated to complement diesel back-ups and sell to the grid at fairly low prices when their electricity supply is functioning well. For this group, the small project size of the first batch was especially advantageous.

6. Solar energy projects may be used for money laundering, that is, creating legal investments for unregistered income.

7. Some investors may be interested in the investment’s co-benefits – especially long-term leases on cheap land that later could used for other purposes.

8. Some investors are intermediaries who hope to resell the concessions in the future at higher prices. Although restrictions on the sale of projects are intended to discourage this practice, some project owners have found ways to circumvent them.

8 Interviews with investors and/or project developers (see the disclaimer for details) in 2011 and 2012

It is not possible to assess the relative importance of these motives; in many cases, a combination of them may have led to low bids. Most of these motivations imply investor rationale to develop solar power projects, while doubts surface about the nature of the commitment when an investor is mainly interested in leasing land or reselling concessions (Nos. 7 and 8). But even in such cases, investors may still develop their investment projects, especially if threatened with penalty payments. The main risk to NSM objectives comes from inexperienced bidders. The penalty payments mean that undeveloped projects do not burden the taxpayer, but non-compliance can retard solar energy deployment. While any early-stage industry should expect some hitches in its development, there probably is a tipping point beyond which solar technology as a whole will lose the trust of investors and banks in India.

It seems that Indian solar policy is set to achieve its targets despite some delays. Installed solar capacity in the country increased from 18 MW in late 2010 to over 1 GW in August 2012.[9] The NSM has boosted investor interest for the next implementation phases, and since investments are picking up, the government has been able to lower tariffs in an unprecedented fashion, from EUR 0.24 to 0.11/kWh (the lowest bid for PV). Following the success of competitive bidding at the federal level, Rajasthan and Karnataka are emulating that model, with other state governments likely to follow. Rajasthan has already announced that it may also apply competitive reverse bidding to wind parks.

3.2 Pushing the states for RPO and establishing a trading mechanism

To further encourage renewable energy, the federal government, through the Central Electricity Regulatory Commission (CERC), has introduced RPO for renewable energy in general, and solar power in particular. RPO are the minimum percentage of solar energy that obligated entities – distribution licensees, open access and captive[10] consumers (1MW and above) – must have in their electricity mix. Some of these entities are private, such as Reliance Power and Tata Power, while the most important ones are state-owned.

Indian energy policy is concurrent: the federal government develops guidelines, which have a political signalling function, and all state governments and obligated entities are expected to shift towards renewable energy. Setting concrete targets and implementing them, however, is left to state governments, particularly the State Electricity Regulatory Commissions (SERCs). For the time being, RPO for solar energy are not very ambitious (0.25% of the energy mix) because the Indian energy market is very price-sensitive and solar energy is still expensive, even compared with other renewables. In general, RPO for renewables vary widely from state to state; some have set RPO at 10% or more (see Table 1 below).

Complementing the RPO, Renewable Energy Certificates (RECs) have been introduced for trading purchase obligations amongst obligated entities, with separate certificates for solar and non-solar energy generation. Obligated entities that have difficulties meeting the targets set by state regulators which can purchase RECs to offset their obligations. Conversely, RECs create an incentive for

9 http://www.mnre.gov.in/mission-and-vision-2/achievements/ (accessed 25 September 2012)

10 Open-access customers purchase electricity directly from an independent power producer (IPP) instead of the local utility. Captive consumers own the plant and generate and consume power on-site and locally.

power producers in resource-rich states to increase renewable energy production beyond the state targets and sell their certificates to other states. Utilities with renewable energy projects can choose to apply for a preferential feed-in tariff or sell RECs.

Implementing the system of RPO and RECs is a challenging task. From the perspective of rent management, two issues are particularly tricky:

1. Ensuring that state governments set fair RPO that reflect their specific situations and avoiding strategic behaviour which would allow some states to maximise rents at the expense of others.

2. Establishing the credibility needed to establish a trading scheme.

Regarding the *first challenge*, India's federal states are not equally endowed with renewable energy resources. Some states are well endowed with wind sites, hydro-power or constant solar irradiation, while others have very limited renewable energy potentials. RPO need to take this into account; indeed, state targets and actual RPO achievements vary greatly (Table 1).

Table 1: Status of RPO in selected states (2010–2011)

State	RPO target (%)	RPO achieved (%)
Karnataka	10.0	11.0
Haryana	10.0	0.2
Maharashtra	6.0	5.0
Tamil Nadu	13.0	12.0
Madhya Pradesh	10.0	0.2
Gujarat	2.0	2.0
Punjab	2.0	1.0
Rajasthan	9.0	n.d.

Source: Bridge to India (2012a)

When states are free to set their own targets, while state-level entities that do not comply with RPO are required to purchase RECs elsewhere, there is a perverse incentive for all states to set their targets as low as possible: The mere stroke of a pen would reduce their outlays for purchasing certificates or increase income from tradable surplus production.

Table 1 shows how state governments treat RPO very differently. In early 2012, some states still had not set a target. Gujarat and Punjab have very low targets. Tamil Nadu and Karnataka, where wind energy is well established, have higher yet conservative targets that they have more or less achieved. In contrast, Haryana and Madhya Pradesh have set ambitious renewable energy targets although they are still in the early phases of developing renewables. The case of Tamil Nadu indicates that states behave strategically to improve their positions in the emerging RECs market: when the decision was taken to introduce RECs, Tamil Nadu lowered its targets.

Why are some states willing to set more ambitious goals than others although their obligated entities (most of which are heavily indebted state-owned enterprises) may be forced to transfer rents to other states? Interviewees offered the following explanations, which largely refer to informal power relations and ties, on condition[11] they were quoted anonymously:

1. Some state governments have embraced the promotion of renewable energy – and/or climate change action in general – more than others. For example, Gujarat, Rajasthan and Karnataka have their own solar policies. Gujarat regards solar energy projects as an economic opportunity and is striving to develop first-mover advantages. It is the first state in India to set up a separate department for climate change, and its Chief Minister describes himself as a leading promoter of climate change action.[12] The Gujarat Electricity Regulatory Commission also has been strict in imposing penalties on companies that fail to meet the agreed deadline for project implementation (Bridge to India 2012b, 8). States that promote renewables as a policy priority most likely are not very concerned by the risk of having to make payments to other states.

2. The targets were set by the SERC who are independent regulators and do not merely implement policies of the respective state government. The SERCs often mediate between CERC (the central government regulator) and state utilities. The SERC's degree of independence, however, varies from state to state: in some states, the SERC is headed by former CEOs of state utilities who may tend to protect those utilities.

3. The CERC grants the states specific shares of electricity to be fed into or taken from the national grid. This competence implies a position of power that the CERC may use to nudge a SERC to comply with federal policy guidelines. States' responsiveness to such nudging, however, varies depending on a range of economic (e.g. whether states are net energy importers or exporters) and political factors (e.g. the closeness of state governments to the federal government).

4. Not all state governments are convinced that RPO will actually be enforced. Since state utilities are already heavily indebted and passing along higher energy prices to consumers is politically sensitive, many interviewees expect that RPO will be negotiated on a case-by-case basis and state utilities may be exempted. Selective enforcement would undermine the credibility of the RECs market and in that case, over- or under-achieving RPO targets would not have major economic consequences.

The *second rent management challenge* related to RPO/RECs is to ensure the credibility of RPO enforcement, which is indispensable for developing a trading scheme. If obligated entities can negotiate exemptions in some states, establishing a certificate-trading scheme will be difficult. RPO have not yet been enforced, and many interviewees doubt that they ever will be. As a result, the RECs market is evolving very slowly. In February 2011, RECs trading was launched on the Indian Energy Exchange, but trade volumes remain low. The first solar RECs were traded in May 2012 – in negligible quantities.[13]

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11 This information comes from interviews with MNRE, CERC and SERC officials, as well as senior energy analysts from international organisations and consultancy firms in Delhi.

12 In 2010, Chief Minister Narendra Modi published a book titled "Convenient action: Gujarat's response to challenges of climate change" (Modi 2010).

13 http://www.iexindia.com/Reports/RECData.aspx

On the other hand, there are some stakeholders – both state governments and private sector – who do invest in renewable projects because they expect that RPO will be enforced. In order to meet its solar RPO, the government of Odisha (formerly Orissa) has allotted five PV projects cumulatively worth 25 MW in Rajasthan. The private energy actors, Reliance Power and Tata Power, are also investing in solar projects to offset their own RPO. The fact that they are registered under the RECs trading scheme implies that they forego preferential feed-in tariffs and shows that these companies are betting on a functioning RECs market in the future. If such a market develops, early investors may benefit from the short supply of RECs and concomitant high prices. Supply shortages may persist for some time, since new projects need about a year from their conception and clearance before they produce RECs.

In sum, we do not yet know whether RPO and RECs can be implemented successfully. Much depends on the federal–state power relations, and on the ability and willingness of energy system actors in each state to absorb higher deficits or pass along higher energy prices to the consumers. Doubts remain regarding universal enforceability. However, the introduction of RPO and RECs trading, backed by statements from the federal government that it is determined to implement these instruments, has led to additional solar investments, and states as well as large private investors are getting prepared for emerging RECs markets.

4 Conclusions

New resource-saving technologies are needed in order to prevent irreversible damage to global ecosystems. Some of these technologies are still far from commercial maturity, which means that governments may need to create rents to make investments in these technologies ‘artificially’ attractive. Temporary rents allow for testing the new technologies, learning, and increasing the economies of scale that are necessary for commercial success. Solar energy technologies are a prime example: Because solar energy is climate-neutral and abundant, it is a key element in the future energy mix. As long as environmental costs are not figured in, solar energy will not be able to compete with fossil fuels. To bring solar energy in India to grid parity over the next few years, various forms of temporary rents have been created, including preferential feed-in tariffs and the option of selling RECs.

The creation of such rents, however, risks faulty allocation and political capture, especially in solar and other technologies that are far from being price competitive. Because governments are not fully informed about the cost structures of various solar technologies at different locations, they do not know how to set the necessary amount of subsidies or protection, or the timetable for withdrawing rents without jeopardising the emerging industry.

This article has examined rent management in India's solar energy policy, in particular its National Solar Mission. This policy exemplifies the complexities of managing rent to develop and deploy green technologies. It shows that the creation and distribution of rents is an eminently political process with great leeway for policy choices. How rents are actually allocated, and the extent to which they serve strategic long-term goals rather than facilitate unproductive rent-seeking, depends on how the policies are designed and the power constellations among various interest groups.

Not all the projects that were allocated were actually constructed. There were also a number of glitches in executing the policy, such as certifying commissioning before commissioning actually took place, or allowing too many project rights to be collected in the first batch by a single project developer, Lanco, who then created bogus companies to win more bids.[14] This is an early-stage industry: both the private sector and the institutions need to learn the ropes. An analysis based on Bridge to India's extensive project database indicates that the industry is rapidly maturing. The share of project developers with significant industry and project financing experience (with a high project-completion ratio) is increasing, while that of developers who have very little solar expertise is decreasing.

Thus far the NSM has been remarkably effective in stimulating solar investments and managing the necessary subsidies. It has managed to put solar energy on the political agenda and create a functioning ecosystem of technology companies, lenders/investors and regulators. While Indian governments had supported small-scale solar energy projects for many years, the NSM was the first coherent policy approach to give the industry a real boost. It sent a strong signal that the government of India is determined to develop solar energy as a relevant part of the national energy mix. Moreover, the NSM established a clear target – achieving retail grid parity in 2022 – as well as concrete milestones for three phases of deploying solar energy by 2022.

Despite the political sensitivity of raising retail prices of electricity, the NSM recognised the need for rents and successfully organised the first rounds of competitive reverse bidding with the dual purpose of mobilising investors and eliciting information about the necessary rent levels. Thus far the auctions have been successful, with huge investor interest and bids for more than 5,000 MW in the first batch – that had only tendered 150 MW of PV projects. Although actual project implementation is behind schedule, solar investments are clearly picking up, surpassing 1GW of installed capacity in August 2012.

The auctions were even more successful with regard to their second objective of determining the lowest tariff rate at which investors would pursue solar projects. The government has been able to bring down tariffs – and thus public subsidies – from EUR 0.24 to 0.11/kWh for the lowest cost bid. Due to this cost digression, analysts now expect retail grid parity to be achieved around 2017, five years earlier than the NSM had envisaged. While external observers cannot know the cost calculations of each and every investor so as to assess the level of rents created for the Indian solar industry, many analysts assume that some of the lowest bidding projects will make losses, and that in any event, returns on investment are unlikely to be above average.[15] Interviews indicate that many investors are willing to sacrifice short-term profits for the long-term gains they hope to reap as early movers in an emerging industry.

Policy design and implementation also reflect a good deal of experimentation and learning. As CEEW/NRDC (2012) observes in its assessment of Phase 1 of the NSM, the mission "follows a phased approach that allows the government to modify guidelines and policies based on the experiences gained and lessons learned in earlier phases". Most observers agree that competitive reverse bidding was well designed, starting with a small test run that brought down prices significantly, raising interest among a broad range of potential investors and helping to identify some loopholes in the bidding process that were eliminated in subsequent periods. In the second batch, project volumes were increased to address larger, experienced bidders. The NSM approach of

14 http://cseindia.org/userfiles/LANCO.pdf

15 Mr Soumya Banerjee, energy analyst at the International Finance Corporation, Delhi (interview 4 April 2012) and Mr Rao Karbar, Asian Development Bank, Delhi (interview 29 March 2012)

competitive reverse bidding has been adopted by several state governments, and states such as Gujarat, that are using an auction system, benefit from the reference price established by the NSM auctions. At first, reverse bidding auctions were heavily criticised by industry players who would have preferred predetermined fixed tariffs for taking initial decisions on whether or not to enter the market. In retrospect, however, it seems that this did not stop many investors from taking part. Our interviews reveal that the Indian solar market is regarded as so promising and strategically important that investors were willing to accept the inconvenience and risk of the auction process.[16]

Some winning bids of the solar auctions may not materialise because of inexperienced bidders' miscalculations. However, it appears that this is not causing the market to derail, and instead is regarded as a teething problem of a maturing market. The industry is awaiting the first actual generation data from plants to understand if the low tariffs have affected construction quality. This data will significantly impact on banks' readiness to lend to future solar projects on a non-recourse basis – which could boost the industry to the next stage.

Significant uncertainty remains with regard to the actual implementation of Renewable Purchase Obligations and the Renewable Energy Certificate trading mechanism, which depends on RPO enforcement. The fact that the first state utilities and private energy corporations are investing in RECs projects shows that big players in the energy system are preparing themselves for the RECs market. But many doubts remain about whether the RECs market will ever succeed on a large scale.

Overcoming these problems requires the federal government's capability to enforce policies. So far, the government of India has been consequent in penalising bidding companies for project delays – although documentation exists about cases in which the competent state authority certified due project progress when investors had not made any tangible investments. It will be much more difficult to ensure that meaningful RPO are set in all states and to enforce RPO compliance against the predictable resistance of large, state-owned and loss-running utilities.

So far, the NSM has been a success. Within just two years it has made India one of the top five global markets for solar energy and created a functioning ecosystem at highly competitive costs. The first experiences indicate that 'green rents' can be managed fairly effectively, and governments can find ways to trigger new industries at a pre-commercial stage – while also keeping subsidies at an affordable level. This is an important lesson for the green-transformation agendas of many other developing countries.

16 Interviews with investors, project developers, banks and EPC contractors in 2011 and 2012 (see disclaimer for details)

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