


SE4JOBS CASE STUDY

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in the MENA Region"

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Cover Pictures: (*from left to right*): 1. A construction worker is taking insulation measures. © GIZ / O. Benbila. - 2. Solar equipment for cooking on Ashram roof (thermal & PV), India. © GIZ / D. Ostermeier. - 3. Building a wind park on Cape Comorin in Tamil Nadu, India © D. Ostermeier. / 4. Energy efficiency measurement. © Shutterstock.

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RE-ACTIVATE is working on behalf of the Federal Ministry for Economic Cooperation and Development (BMZ) to help develop markets for employment-intensive renewable energy (RE) and energy efficiency (EE) applications in the countries of the MENA region.

SE4JOBS was launched as a collaborative effort and working platform of several GIZ projects dealing with different aspects of sustainable energy and socio-economic development promotion. RE-ACTIVATE serves as a coordinator and “secretariat” of the project.

Several GIZ sector project have been actively involved in SE4JOBS, specifically those working on “Sustainable Economic Development”, “Innovative Approaches of Private Sector Development”, and “Employment Promotion in Development Cooperation”.

The project has been supported by a consortium of adelphi, a Berlin-based think tank and public policy consultancy for climate, environment and development issues, and the Centre for Environmental Policy Research (FFU) of the Free University of Berlin (FU).

SE4JOBS aims to identify and assess available worldwide experience and good practices in developing and emerging countries on how to strengthen the link between socio-economic development and sustainable energy. The focus is on employment and value creation.

The goal is to support international know-how exchange and policy dialogue by offering a set of specific, application-oriented instruments and recommendations that help policy makers and planners to develop better approaches and institutional settings for an optimal valorisation of the socio-economic benefits of sustainable energy applications while adapting them to the specific needs and conditions of their countries and organisations.

The following key deliverables have been produced in the framework of SE4JOBS:

- A set of good-practice case studies assessing in greater analytical depth and according to a single methodology the specific approaches and trajectories of six selected global front-running countries in Asia, Africa, and Latin America.
- The creation of an application-oriented toolbox based on the results of these studies as well as on available global experiences in this regard, including from MENA.
- A set of capacity building and training modules allowing for the targeted dissemination of the findings and the conclusive strengthening of local stakeholders.

A series of national and international outreach activities and expert workshops was organised by RE-ACTIVATE throughout 2015. Participants mainly included government representatives, technical experts, and practitioners from international organisations who provided insights and inputs that proved in fact instrumental for the success of the project.

These meetings allowed for the first-hand presentation of intermediary results, the collection and integration of comments and suggestions and the consequential refining of the SE4JOBS products. They also permitted an interactive exchange with local stakeholders, which moreover came at an auspicious moment as many of the involved countries are currently in the process of scaling up their RE/EE deployment, often in conjunction with ambitious industrial development and job creation schemes. The outcomes of these exchanges could therefore be used to support and enrich discussions and decisions on the ground.

The authors of the study are Klaus Jacobs and Holger Baer from the FFU. The text was reviewed by Steffen Erdle from RE-ACTIVATE as well as by GIZ experts working in India, notably Devyani Hari. Proofreading was done by Malte Forstat.

All contributions received in this context are gracefully acknowledged.

Contents

List of figures

List of tables

Abbreviations

AD	Accelerated Depreciation
BAU	Business as usual
BEE	Bureau on Energy Efficiency
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CEEW	Council on Energy, Environment and Water
CERC	Central Electricity Regulatory Commission
CII	Confederation of Indian Business
CSP	Concentrated Solar Power
ECA	Energy Conservation Act
FIT	Feed-in Tariff
GEF	Global Environmental Facility
GIZ	Gesellschaft für Internationale Zusammenarbeit
IFC	International Finance Corporation
IREDA	Indian Renewable Energy Development Agency
JNNSM	Jawaharlal Nehru National Solar Mission
MNRE	Ministry of New and Renewable Energy
NAPCC	National Action Plan on Climate Change
NCPRE	National Centre for Photovoltaic Research and Education
NMEEE	National Mission for Enhanced Energy Efficiency
NRDC	National Resource Defence Council
NTPC	National Thermal Power Corporation
NVVN	Vidyut Vyapar Nigam Ltd.
PAT	Perform, Achieve and Trade
PSU	Public Sector Undertakings (state-owned businesses)
PM	Prime Minister
PPA	Power Purchase Agreement
PV	Photovoltaic
R&D	Research and Development
REC	Rural Electrification Corporation
RPO	Renewable Portfolio Obligation
SIDBI	Small Industries Development Bank
SHS	Solar home systems

SWH	Solar thermal water heaters
TERI	The Energy and Resources Institute
T&D	Transmission and Distribution
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Outcomes

1.1 Focus of the case study – Why is India a case of good practice?

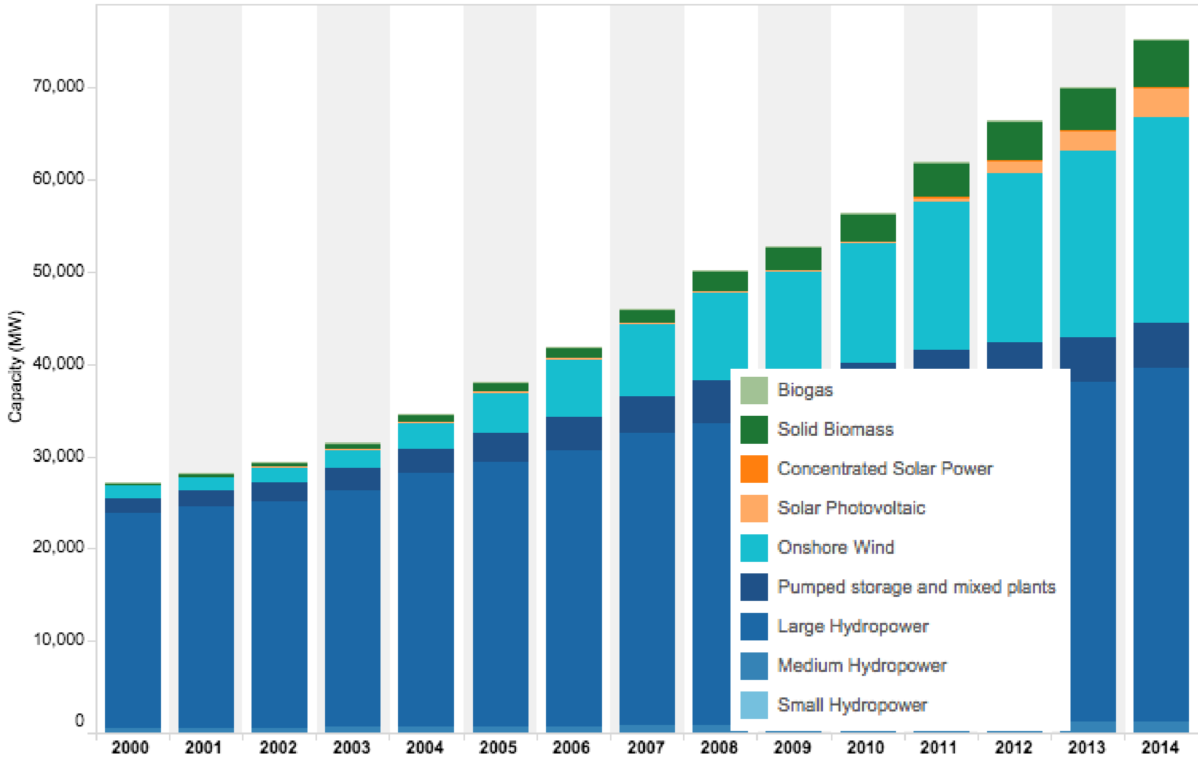
The case study analyses wind and solar power development as well as the strategy and policy instruments to foster energy efficiency in industry, buildings and households in India. The country provides excellent natural conditions for the production of energy from wind and solar resources, and its National Solar Mission had started with high hopes. A number of problems related to the implementation of policies have however slowed the development and have created insecurity among investors in recent years. But the 2015 upward revision of the official RE goals has shaken up the entire sector and is likely to provide another push for RE and EE in India. Given the implementation problems in the past, it remains to be seen if the very ambitious new targets can be met. Even if not, the level of ambition displayed is likely to boost investor confidence and accelerate domestic markets, manufacturing and employment – largely due to the enormous amount of announced expansion of RE power generation. This trend is supported by falling generation costs for solar and wind power on the one hand and growing prices for fossil imports on the other.

1.2 Renewable energy in India

1.2.1 Structure and key properties

RE generation in India reached an installed capacity of over 70 GW in 2014. Its largest sources are hydropower, accounting for about half of that capacity, and wind power. The solar PV market shows great momentum – particularly driven by India's Jawaharlal Nehru National Solar Mission (JNNSM). Wind and PV accounted for 70% of the investments in RE capacity (in 2013) – however, given the overall growth in electricity capacity, the investments in RE make up only about a sixth of total investments in electricity generation capacity in India (REN21, 2014, p. 27).

Figure 1: Installed renewable energy capacity in India, in MW, 2000–2014

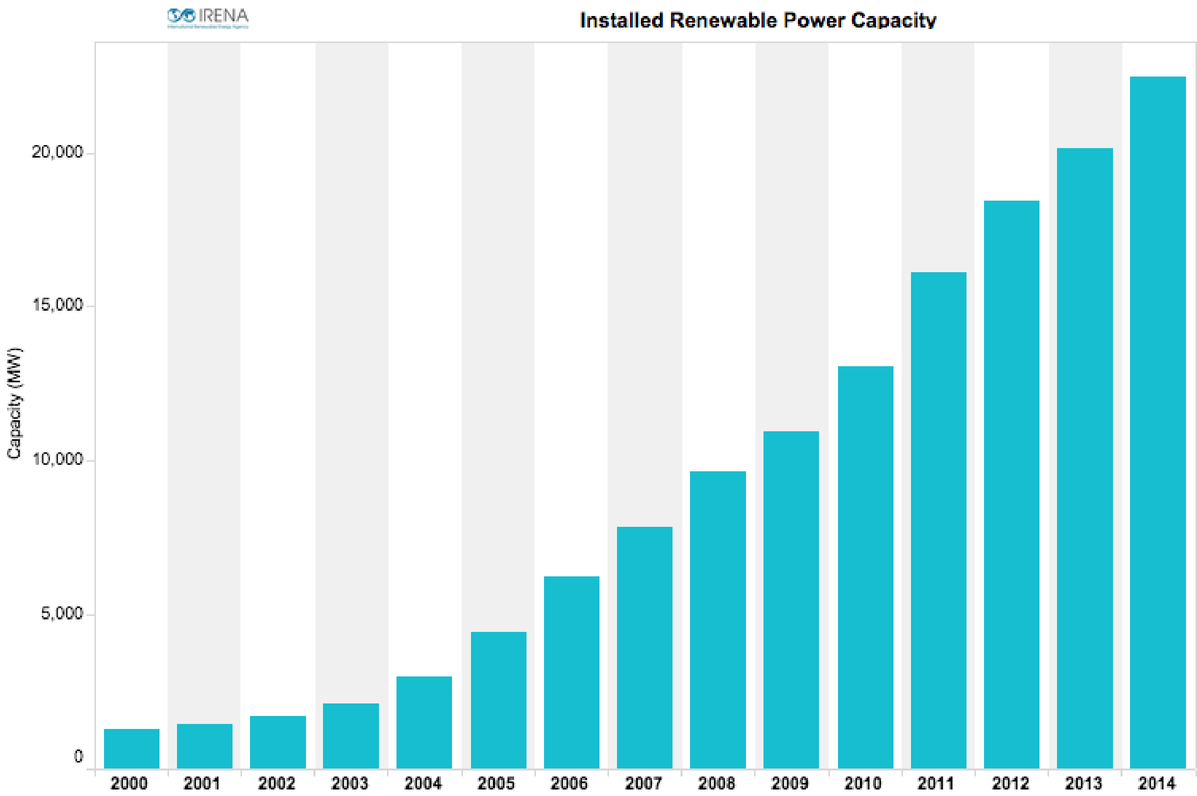


Source: (IRENA, 2015)

1.2.2 Wind power in India

Wind power capacity in India has steadily increased over the last decade, reaching 22.5 GW of installed capacity in 2014. The country added more than 2 GW in 2014 alone, making the country the fifth largest wind market in the world by capacity added and by total installed capacity (REN21, 2015, p. 71). The market attracted the fifth highest investments worldwide totalling US$3.6 bn (FS-UNEP Collaborating Centre, 2014, p. 21; 2014). What the data does not yet show is the slump in investments in 2013 and 2014 that resulted from the devaluation of the rupee and the removal of two important policy support instruments in 2012 - the Generation-Based Incentive (GBI) and Accelerated Depreciation (AD) support tools - which were subsequently reintroduced in 2014 (for more information on the instruments, see section 4.4.1). There is no data available on installed offshore wind power capacity.

Figure 2: Cumulated installed wind power capacity in India, 2000-2014



Source: (IRENA, 2015)

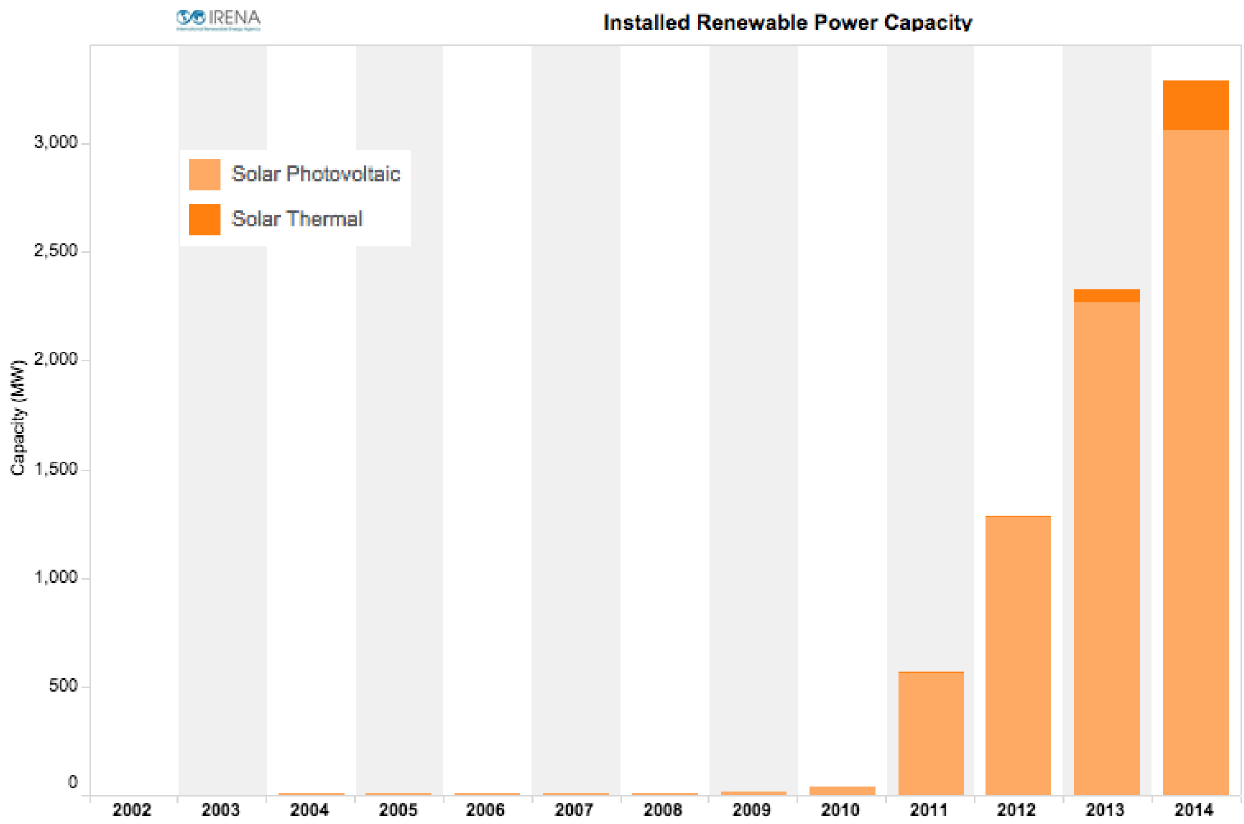
1.2.3 Solar energy in India

Solar power capacity in India had reached more than 3GW in PV and 231 MW in CSP by 2014 (see below). While the total installed capacity is still relatively small given the size of the country, its rate of growth is fast. India's solar PV capacity increased by more than 700 MW in 2014, making the country worldwide the tenth largest solar PV market (in terms of capacity) and the eighth in terms of solar PV capacity additions (REN21, 2015, p. 59). This expansion is also driving down prices for solar PV, which in turn fosters its competitiveness as a power source. The recent largest solar PV auction in India – in the state of Telangana – with a total capacity of 2GW serves as an indicator for that. It was oversubscribed by project offers by 250% and saw prices drop to US$ 0.08 per kWh (Oettinger, 2015).[1]

With regard to CSP, India quadrupled its capacity in 2014 – among others by installing Asia's largest CSP plant as part of the JNNSM with a capacity of 125 MW in Rajasthan.

[1] In July, a solar PV auction in Madhya Pradesh resulted in similarly low prices.

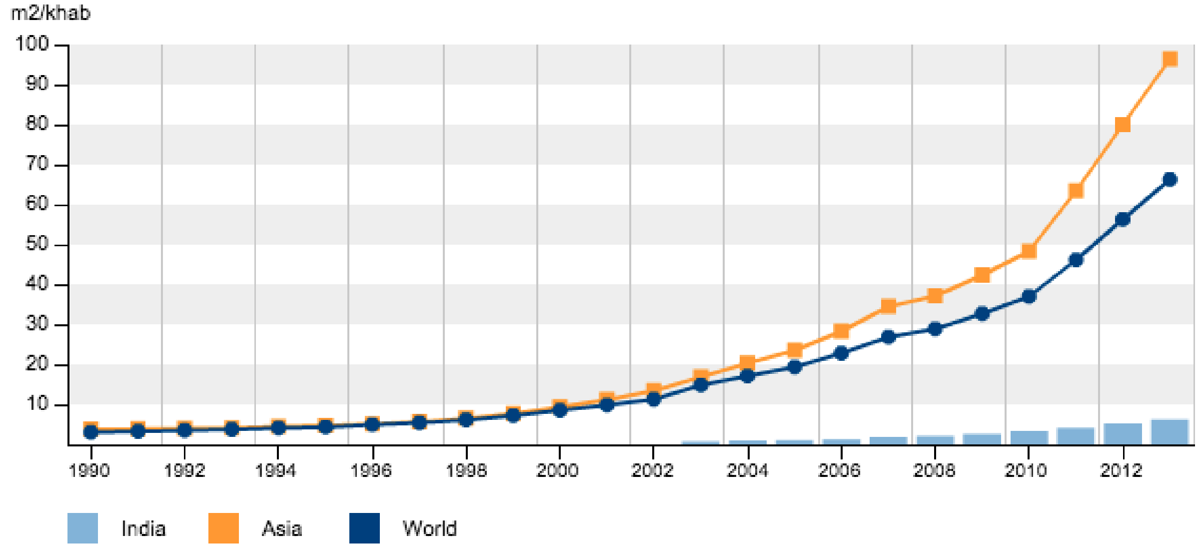
Figure 3: Cumulated installed solar power capacity in India, 2000-2014



Source: (IRENA, 2015)

The global market for solar thermal water heating and cooling is dominated by China which accounts for 70% of worldwide installed capacity alone. As a consequence, the growth in the Indian SWH market (per capita) does not look that impressive anymore (see below).

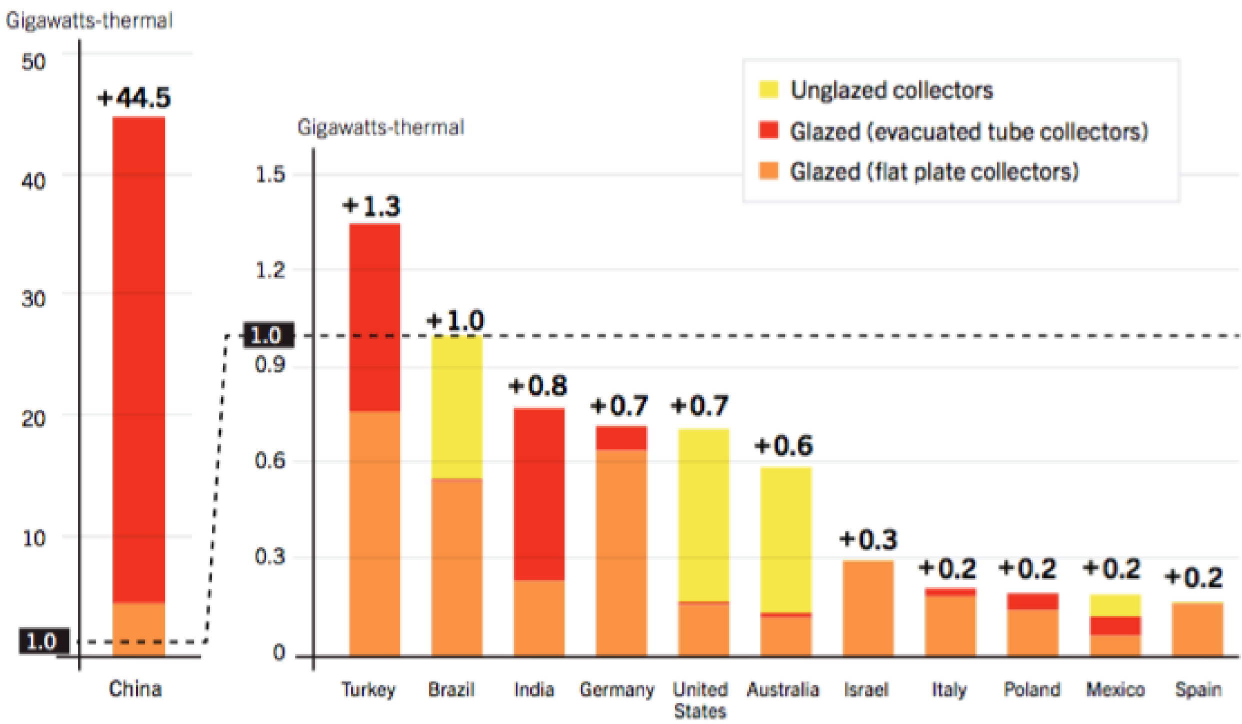
Figure 4: Solar thermal water heaters per thousand inhabitants in India, m^2/khab



Source: (World Energy Council, 2015)

However, India is the seventh largest SWH market worldwide in terms of installed capacity and has seen the third-highest capacity additions in 2013, only trailing China and the United States, even though with its 4.7 GW_{th}, the country still only accounts for 1.2% of the total globally installed capacity (REN21, 2015, p. 66).[2]

Figure 5: SWH capacity additions in 2013, worldwide, in GW_{th}



Source: (REN21, 2015, p. 67)

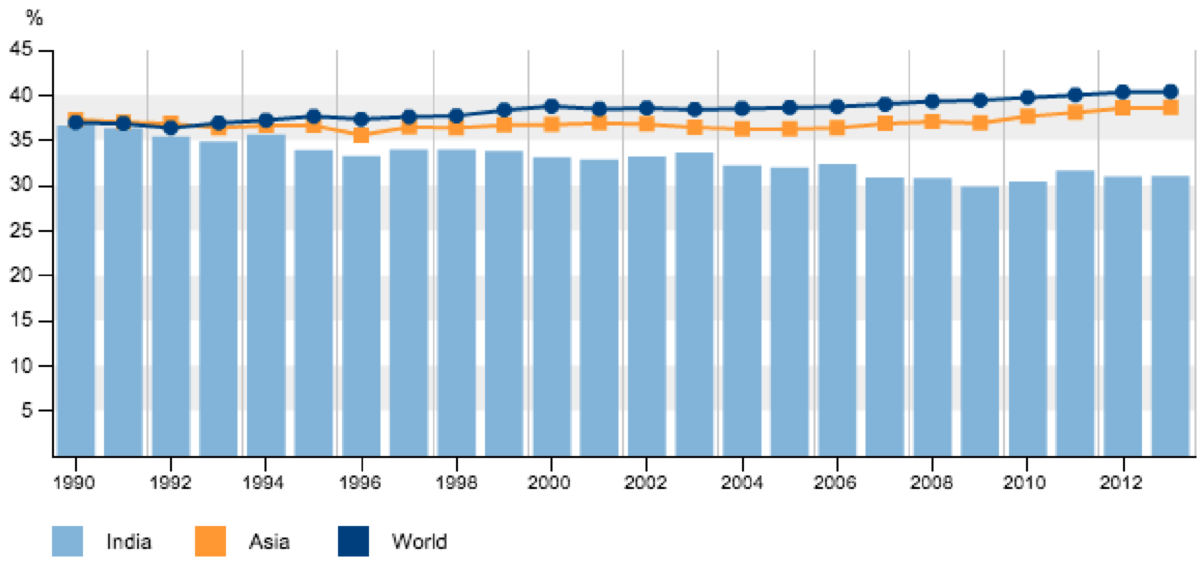
1.3 Energy efficiency in India

1.3.1 Energy efficiency in power generation

The aging power generation infrastructure results in losses in efficiency. India has fallen below the world and Asian average in terms of efficiency of power plants. While the efficiency of India's gas-powered plants is on a par with the global average, the sub-standard overall efficiency is due to the country's aging coal-fired power plants.

[2] There are inconsistencies in the SWH data reported, as the MNRE counts all SWH capacity that was ever installed, but does not subtract the capacity no longer in use. This fact might explain why REN21 reported a higher overall capacity for 2014 than for 2015.

Figure 6: Efficiency of power plants in India, 1990-2013

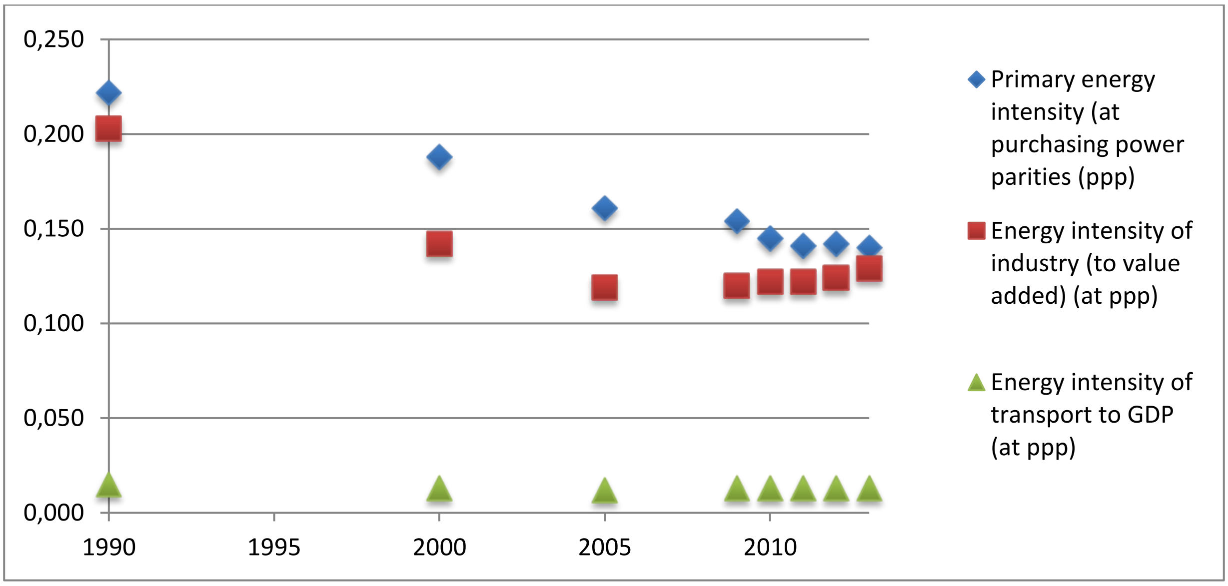


Source: (World Energy Council, 2015)

1.3.2 Energy intensity in different sectors of the economy

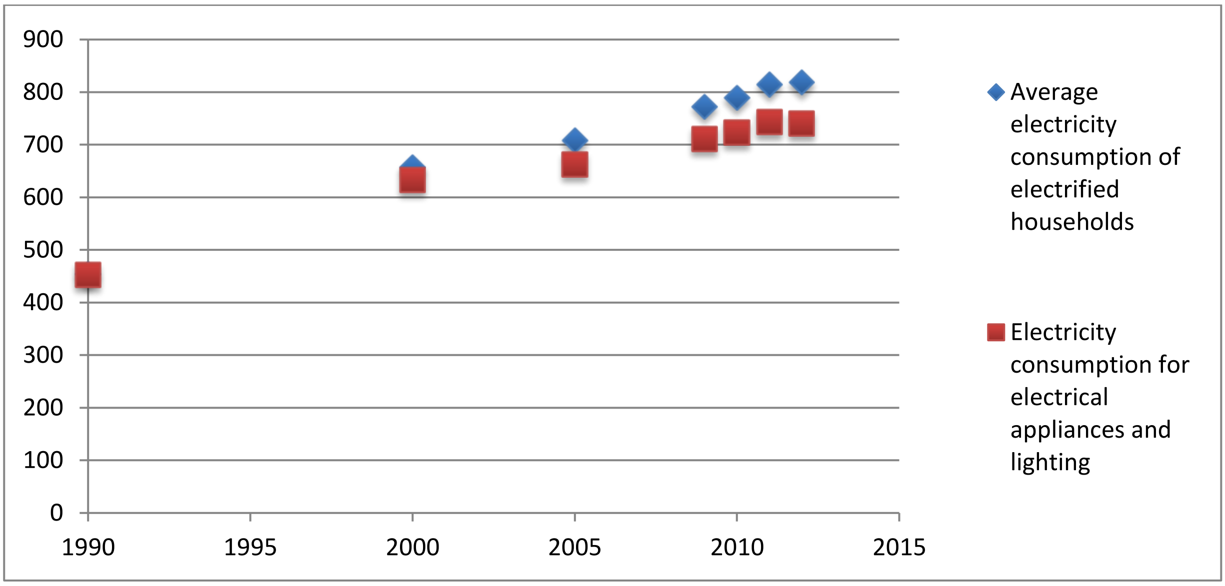
The efficiency in the use of primary energy in the Indian economy has improved by an annual 2% since 1990 and 2.2% between 2000 and 2013. Industrial energy efficiency, however, developed in a slightly different way: It improved significantly in the 1990s, but decelerated afterwards (2% annual improvements for 1990-2000; 0.7% for 2000-2013). India's development is very similar to the world and Asian average (World Energy Council, 2015).

Figure 7: Development of primary energy intensity, energy intensity of industry and in transport in India, 1990-2013



Source: (World Energy Council, 2015)

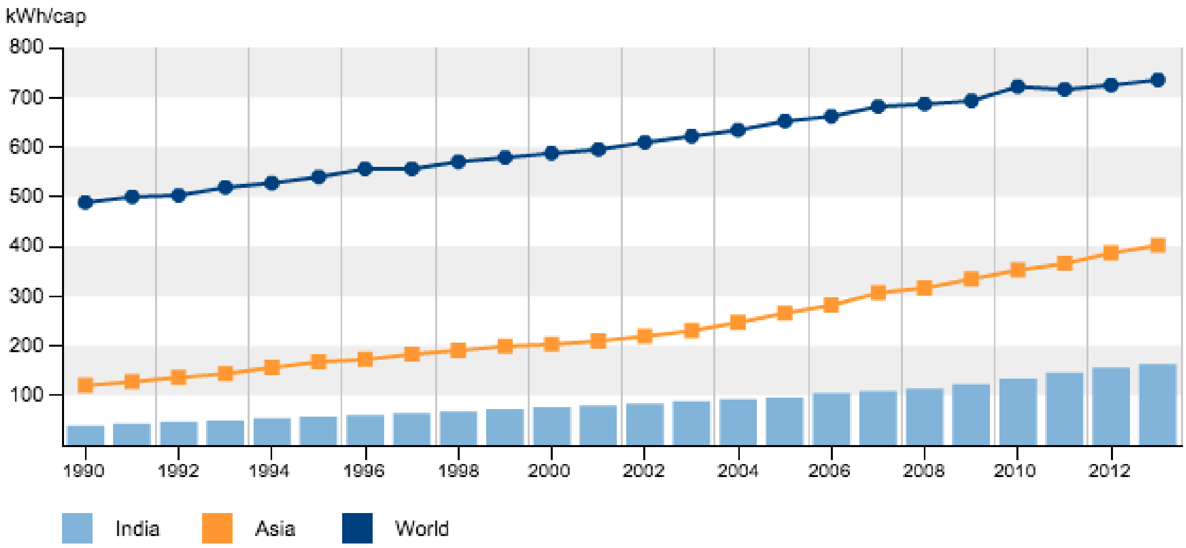
Figure 8: Development of electricity consumption of households compared to the consumption for electrical appliances and lighting, 1990–2013, in kWh per household



Source: (World Energy Council, 2015)

While the electricity consumed by households in India has significantly increased at around 6% per year, the total electricity consumption per capita is still far below world and Asian average values and its growth rate has been significantly below the growth recorded by other Asian countries since 1990 (see below).

Figure 9: Electricity consumption in India, per capita, 1990-2013



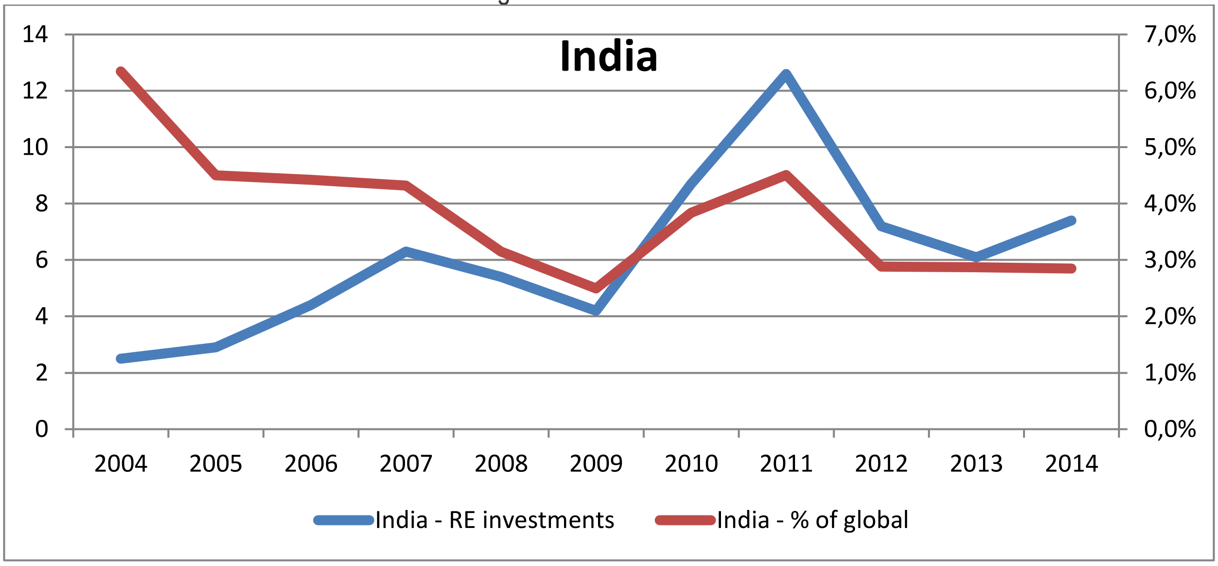
Source: (World Energy Council, 2015)

1.4 Domestic value added and employment

1.4.1 Investments in RE and EE

India attracted a total of US$7.4 bn of investments in RE in 2014 (out of a global US$260 bn)[3]. Similar to the global level, the RE investments in India had stagnated over the last few years. Between 2013 and 2014, they increased by 14% as a result of the reintroduction of policy incentives and solar capacity auctions. The volatility in investments can be almost entirely attributed to the dominant role of asset finance – dropping from a high of US$11.8 bn in 2011 to a low of US$5.4 bn in 2013 (FS-UNEP Collaborating Centre, 2014, p. 25 f.). Some of the reduced investments were due to uncertainty about policy – which is particularly true in the case of India's wind energy programme – but the trend also reflects the falling equipment costs for RE generation (REN21, 2014, p. 71). Part of that is in line with the overall contraction in RE investments after 2011, which has hit most countries in the world and not just India (FS-UNEP Collaborating Centre, 2014).

Figure 10: Investments in renewable energy in India, 2003–2014, in US$ billion, and their share of global investments



Source: Own figure based on data by UNEP & Bloomberg New Energy Finance in (FS-UNEP Collaborating Centre, 2015)

1.4.2 RE manufacturing in India

The Indian solar PV manufacturing sector is focused primarily on serving the domestic market. Increasing competitiveness as a key condition for international success has in comparison been considered less important. Local PV manufacturing companies are therefore under increasing pressure by cheap(er) imports from China. Companies' positions have further been weakened by the fact that the domestic demand is developing more slowly than expected. This is essentially due to delays in the bidding process for solar PV capacity in the first phase of the JNNSM, meaning that "most manufacturing capacity was idle or operating at low utilisation

[3] By comparison, US$121.7 bn of these were invested in developed economies; US$56.3 bn in China and US$43.3 bn in the rest of Asia (excl. India and China).

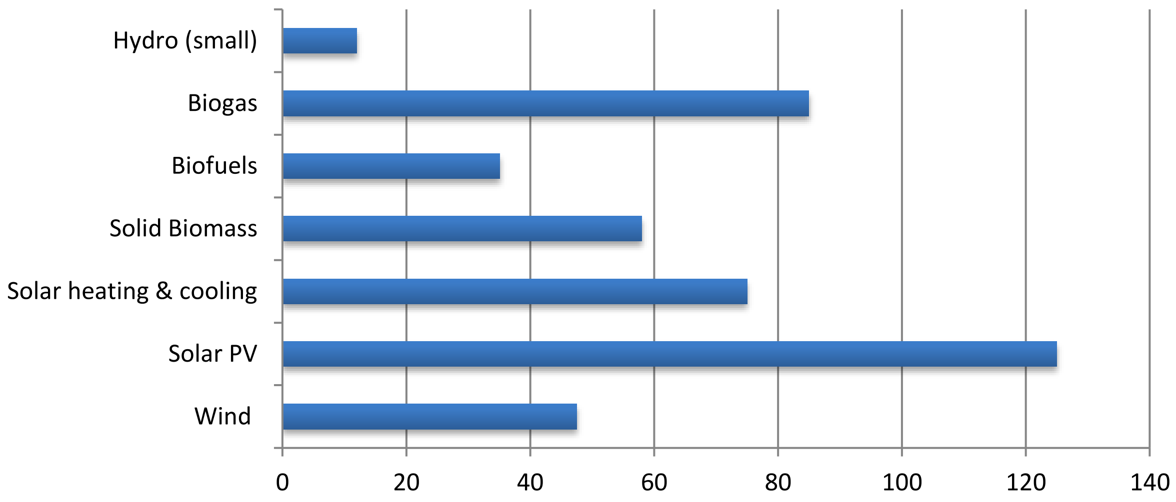
rates, primarily because it was uncompetitive due to lack of scale, low-cost financing, and underdeveloped supply chains” (REN21, 2014, p. 48).

Similarly, wind manufacturers are struggling to compete with foreign competitors. This is also true for India’s largest manufacturer of wind turbines, Suzlon, which has recently lost its position as market leader in India (REN21, 2014, p. 59). The company had been running up losses between 2009 and 2014 and defaulted on some of its debt in 2012. Part of the explanation has been the slump in the domestic wind power market that resulted from the withdrawal of the Accelerated Depreciation (AD) and the Generation-Based Incentive (GBI). Another factor in the company’s problems, however, is related to its financial over-stretch as a result of global acquisitions. 2015 marked the first year since 2009 in which Suzlon has shown profits (Datta, 2015).

1.4.3 Employment

Latest figures by IRENA on overall employment in RE technologies estimate that as of today there are more than 400,000 jobs (direct employment) in India. The largest share of employment in RE technologies is in the solar PV sector with about 125,000 jobs.

Figure 11: Direct employment effects in RE sectors in India, in 2015, number of jobs in thousands



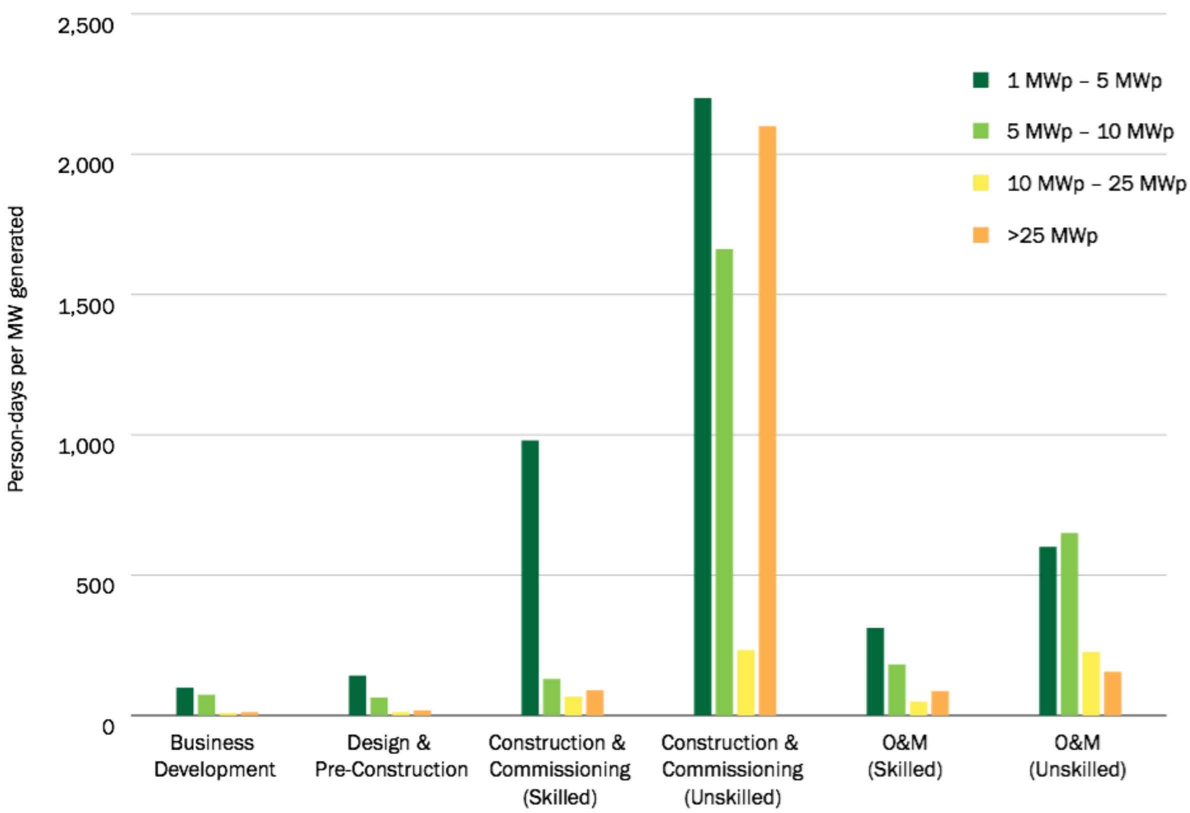
	Wind	Solar PV	Solar heating & cooling	Solid Biomass	Biofuels	Biogas	Hydro (small)
India 2015	47,5	125	75	58	35,1	85	12

Source: (IRENA, 2015, p.37)[4]

[4] The figure contains the most recent data available. It should be noted that the estimates refer to different years between 2010 and 2014. For more details, see the source.

However, there is widespread confusion about current employment figures in India as the government does not publish data (Council on Energy, Environment and Water National Resources Defence Council, 2014). A study by the Confederation of Indian Industry and MNRE already concluded in 2010 that there were a total of 350,000 direct and indirect jobs in RE (see table in section 5.2) (Confederation of Indian Industry & MNRE, 2010).

Figure 12: Person-days generated in each phase of the PV value chain, per MW



Source: (Council on Energy, Environment and Water & National Resources Defence Council, 2014, p. 15).

A study by the Natural Resources Defence Council and the Indian Council on Energy, Environment and Water analysed direct and indirect jobs across various steps of the value chain in India. The findings suggest that a total of 23,884 jobs were created under the JNNSM projects that have been connected to the grid between 2011 and 2014. The study also finds that smaller projects are significantly more labour-intensive. Most of the job creation falls into the construction and commissioning phase of the value chain. (Council on Energy, Environment and Water & National Resources Defence Council, 2014). The same is true for the wind sector (see Council on Energy, Environment and Water, 2014b, p. 10).

A number of studies have been conducted on current PV employment and have produced numbers ranging by a factor of four:

Figure 13: Variation in current employment estimates (for the PV market)

Study	Year	Jobs Estimate
MNRE–CII *"Human Resource Development Strategies of Indian Renewable Energy Sector"*[27]	2010	76,000 direct & indirect jobs (as of 2010) 25,000 in manufacturing
Lanco Infratech Ltd., *SPV Power Technology in India*[28]	2012	15 direct and indirect jobs per MW ≈ 37,005 jobs[29]
Jain & Patwardhan "Employment Outcomes of Renewable Energy Technologies: Implications of Policies in India," *Economic and Political Weekly*[30]	2013	7.7 to 13 jobs per MW ≈ 19,000 jobs to 32,071 jobs[31]
Ministry of New and Renewable Energy estimate[32]	2013	50,000 direct jobs created from 2010–2013

Source: (Council on Energy, Environment and Water & National Resources Defence Council, 2014)

Numbers on employment in the wind sector show the same picture. While one study by the MNRE (with CII) shows 42,000 wind power jobs in 2009, another study by the ministry estimates only 2,000 for the same year. Assumptions vary widely and the absence of official data on RE employment limits the usefulness of job creation estimates (Council on Energy, Environment and Water, 2014b).

2 India's framework conditions

2.1 Natural conditions

2.1.1 Wind power

At a consultation for the country's National Wind Energy Mission, India's wind energy potential was estimated at around 100 GW (at a height of 80 metres) (MNRE, 2014). This amount is close to half of the country's current electricity generation (Council on Energy, Environment and Water, 2014a). A recent study by the National Institute for Wind Energy on behalf of the MNRE estimated the total potential for on-shore wind power (at a height of 100 metres) to be significantly higher – at 302 GW – with the largest potentials in the states of Gujarat (84GW), Karnataka (56GW) and Maharashtra (45GW) (Mittal, 2015a).

A wind map of India can be found in the annex in section 8.1.

2.1.2 Solar power

India provides very favourable natural conditions for solar power in the west and south of the country, with many regions reaching close to or higher than 2 kWh/m2 of solar irradiation. The NAPCC estimated that 1% of the land surface would be sufficient for India to meet its electricity requirements until 2030 (Government of India, 2008). Data by Deutsche Bank suggests that this huge potential has not even remotely been exploited yet, with current capacity using only half of one per cent of the available potential natural capacity.

Figure 14: Natural potential for RE generation in India and degree of utilisation (in %)

in MW	Installed capacities	Potential	% utilized
Wind Power	23,444	102,772	23%
Solar power	3,744	748,990	0%
Small hydro	4,055	19,749	21%
Total	31,243	871,511	4%
Others- Biomass & Bagasse	4,418	22,536	20%

Source: (Puri, 2015, p. 16)

A solar map of India can be found in the annex in section 8.2.

2.2 Demographic information

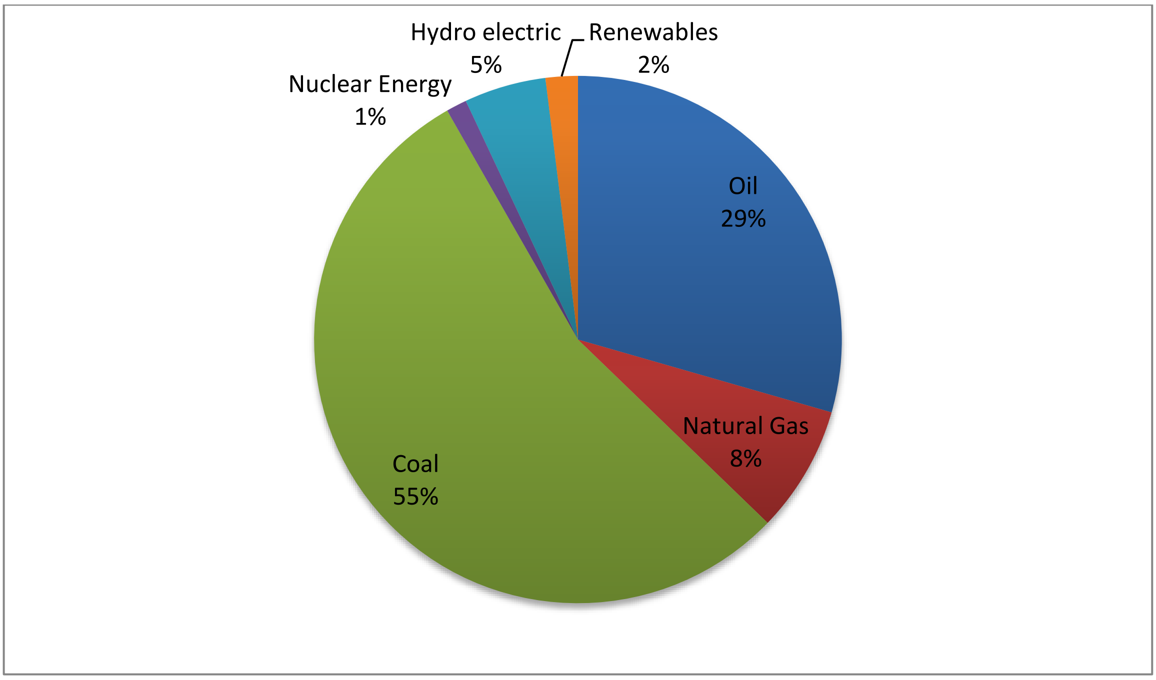
There are a number of demographic data sets that show that the demand for energy and the efficient use of it will be key drivers for the development of the Indian energy sectors for decades to come. Population is still growing very significantly at 1.3% annually, the share of the people living below the poverty line has dropped rapidly from 37.2% (2005) to 21.9% (2012) as per capita incomes have risen fast from US$2,240 (2002) to US$5,080 (2012) (World Bank, 2015). Additionally, a large number of people will get full access to the electricity grid in the coming years, which – despite existing off-grid solutions – is likely to further increase demand for energy and electricity. Data by the World Bank shows the enormous difference in access to electricity between urban areas (>98% of the population have access to electricity) and rural areas (<70% of the population have access to electricity).5 The about 300 million people that are still unconnected and the growing middle class will be major drivers for the increase in demand for electrical devices (ranging from refrigerators to microwaves, televisions etc.) (IEA, 2015, pp. 110).

2.3 Energy system

2.3.1 Structure and key properties of energy consumption and electricity production

India's energy consumption is heavily dominated by fossil fuels: Coal and oil make up 84% of total primary energy consumption. While the country has significant own resources of coal and gas, its import dependency with regard to crude oil – more than half coming from the Middle East – and coal – coming mostly from Indonesia and Australia - is ever growing.

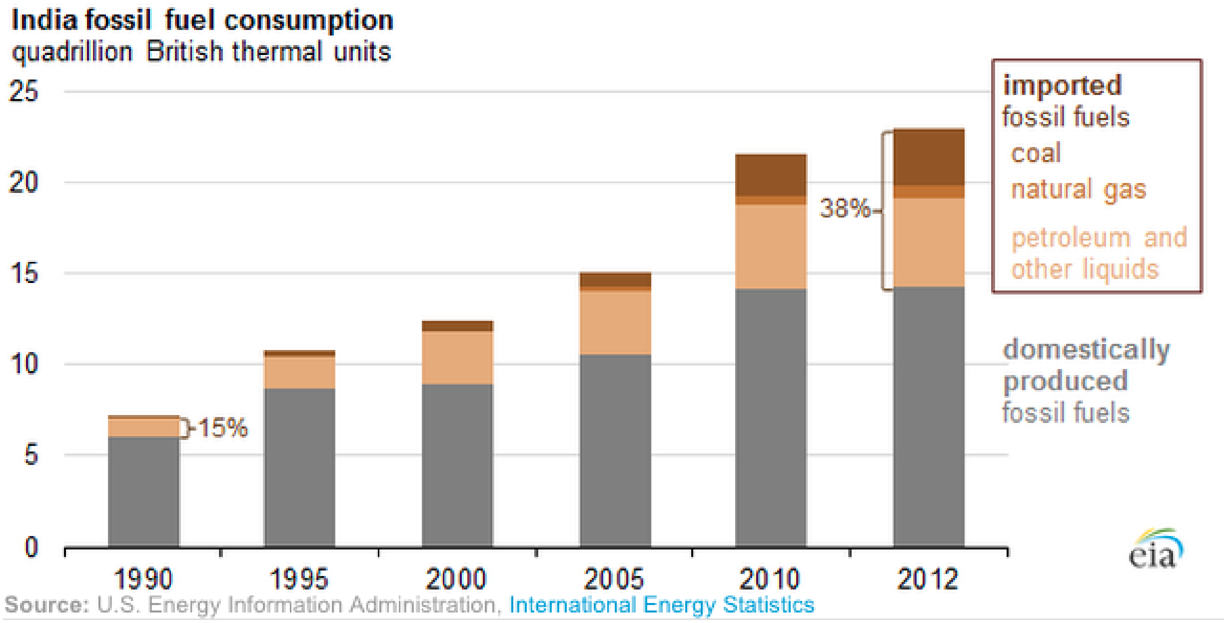
Figure 15: Primary energy consumption in India, by fuel, 2013



Source: (BP, 2014)

[5] Numbers are based on the World Development Indicators for 2012. More recent data is not available for India.

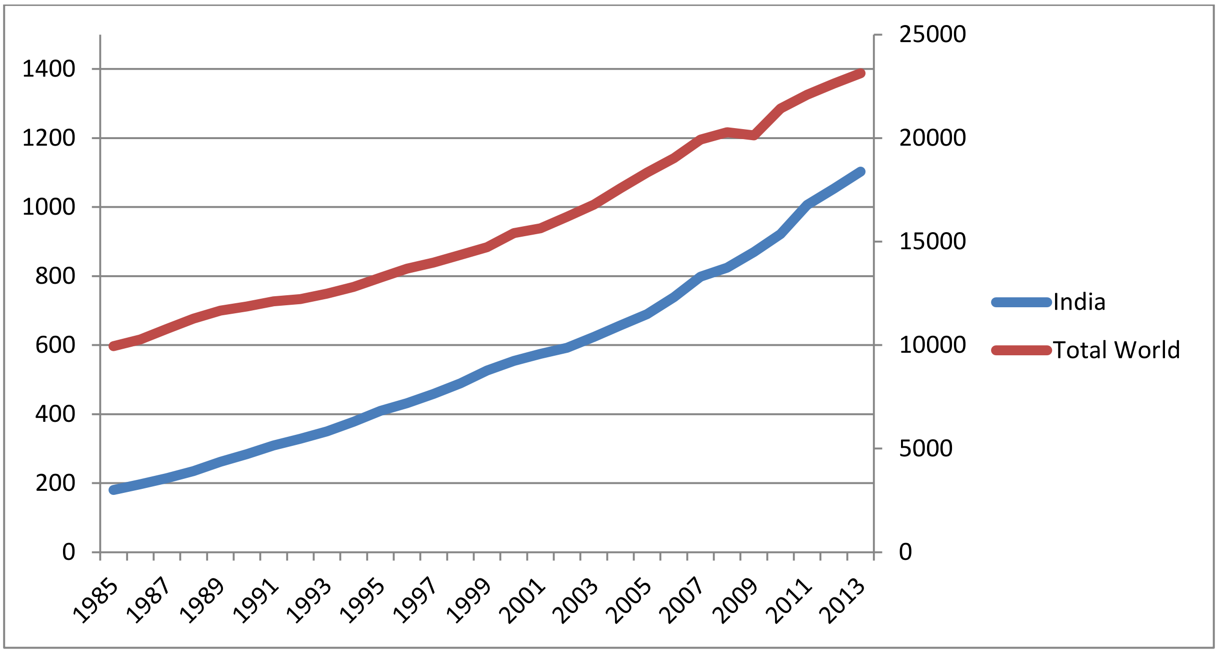
Figure 16: India's growing dependence on fossil fuel imports



Source: (US Energy Information Administration, 2014b)

The growth in energy and electricity generation in India has been profound in the last decades and will very much continue while the country is still in the process of expanding electricity provision to all of its citizens (see infrastructure section below) and since per capita consumption is still low by global comparison. India's electricity generation has expanded faster than the world average (see below) – however, it is not expanding quickly enough to meet the growing demand, driven by economic and population growth. Symptoms of the inability to expand power generation capacity fast enough are instances of load shedding, frequent blackouts and subsequent problems for electricity users.

Figure 17: Development of electricity generation in India (primary axis) and the world's total electricity generation (secondary axis) since 1985, in TWh

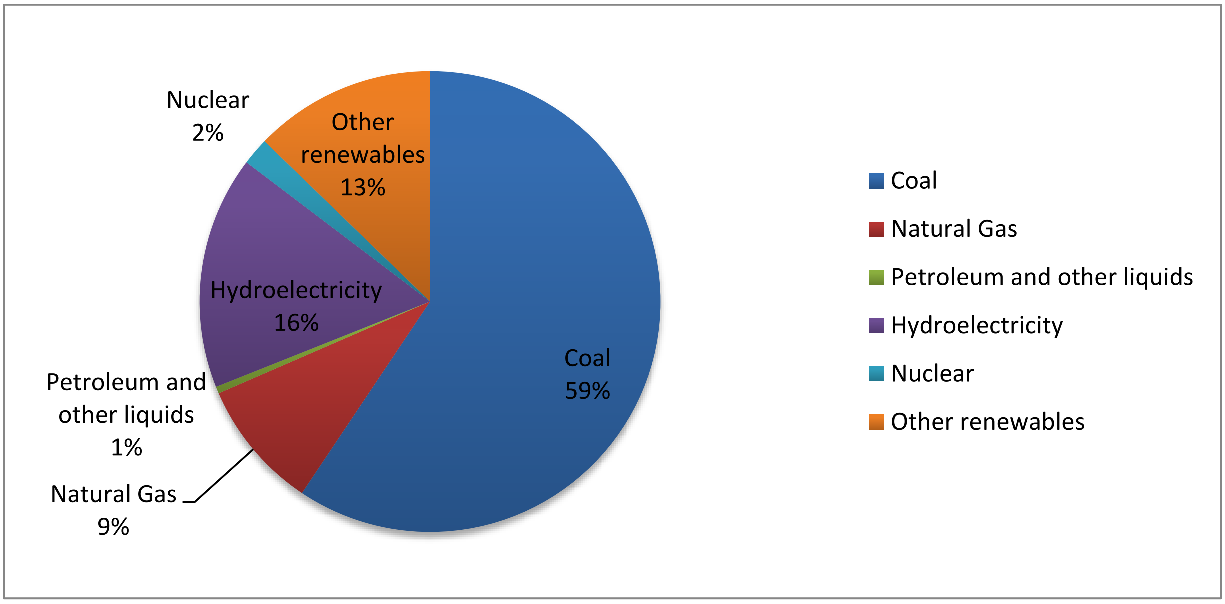


Source: (IEA, 2015)

India's electricity generation is similarly dominated by coal and gas, which account for more than two-thirds of it. In order to expand power generation capacity more quickly, the government started to open up electricity generation to private companies via tenders for conventional sources in 2004, which led to some investments in large coal and gas power plants. However, there have been significant problems with these investments as the power purchase agreements that formed their legal basis specified power prices that did not reflect real-life generation costs. The reason for that were rising coal prices in the world market, along with difficulties in importing sufficient amounts of coal from Indonesia (Buckley, 2014, p. 2 f.). Recent data suggest a further increase of India's dependence on imported coal, as imports grew by 34% alone in the 2014/2015 fiscal year (Das, 2015).

Power generation from gas accounts for a mere 9% of the electricity produced in India, less than the share of large hydropower (16%). Similarly, oil and nuclear power play a minor role as sources of power generation. Electricity imports to India are negligible.

Figure 18: Installed power capacity in India, by source, in 2013



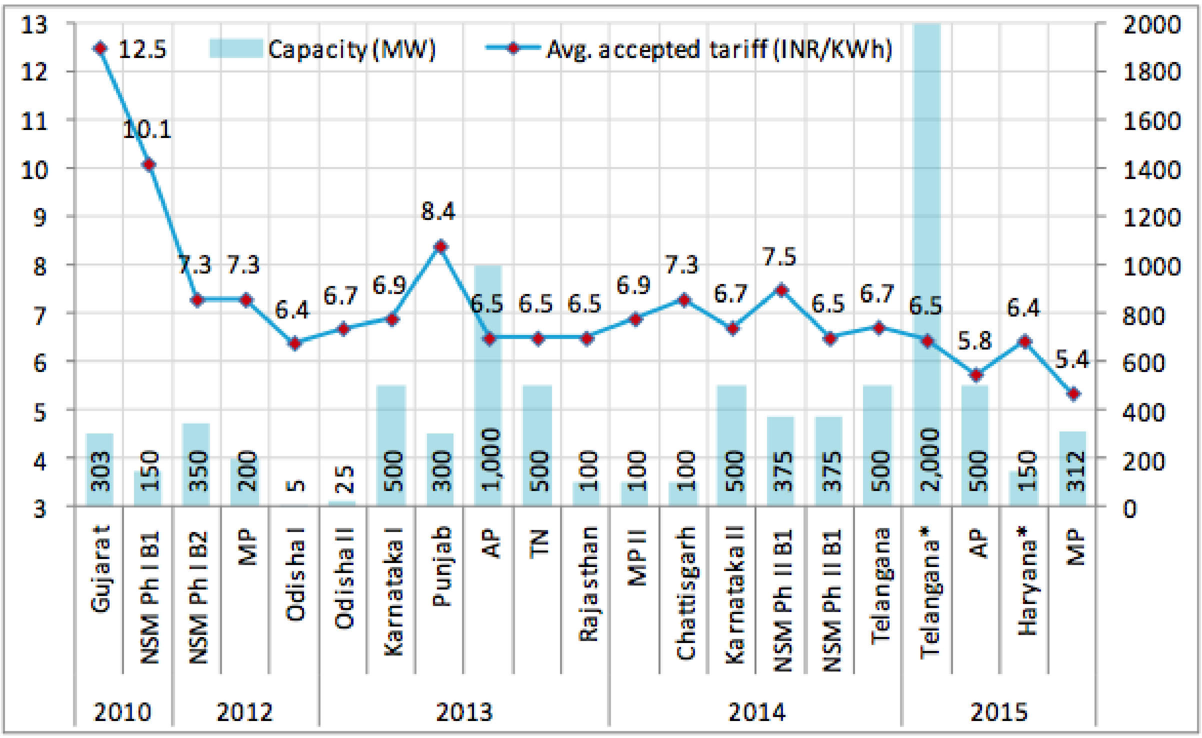
Source: (US Energy Information Administration, 2014a).
Data provided by India's Central Energy Authority.

2.3.2 Electricity prices

Electricity tariffs per kWh paid by consumers in India are very low by international comparison. They are regulated and vary considerably between user groups: Electricity for the agricultural sector and for domestic uses is highly subsidised and about half of the tariff paid by industrial and commercial businesses – putting a significant financial burden on the state governments, which have to cover the difference (Buckley, 2014, p. 11).

The wholesale price for electricity in India is currently between INR 3 and 4 (US$0.05–0.06) per kWh (Buckley, 2014, p. 6). While wind and solar power prices are still significantly higher, they have shown a very clear downward trend in the last four years.

Figure 19: Solar PV tariffs resulting from central and state government auctions[6]



Source: (Puri, 2015, p. 18)

It is important to put the development of RE prices in perspective to the cost of adding new power generation capacity from coal. Given the problems in developing the power supply from coal outlined in the previous section, it is clear that new coal power plants will have to rely on (more expensive) coal imports (particularly from Australia). An economic analysis estimates that truly cost-reflective prices for new power generation from imported coal would require an electricity tariff of INR5.73 (US$0.086) per kWh. A comparison with current and expected wholesale electricity costs for wind and solar power in India shows that the costs of new coal power are already higher than those of the latter.

[6] A recent article referenced an auction in Andra Pradesh for grid-connected PV power with a 50 MW project by SunEdison that was awarded at an "historically low" tariff of INR4.63 per kWh. See: **http://www.business-standard.com/article/economy-policy/india-s-solar-power-rates-at-historic-low-115110401119_1.html**

Table 1: Wholesale electricity costs – imported coal vs. wind vs. solar PV, forecast

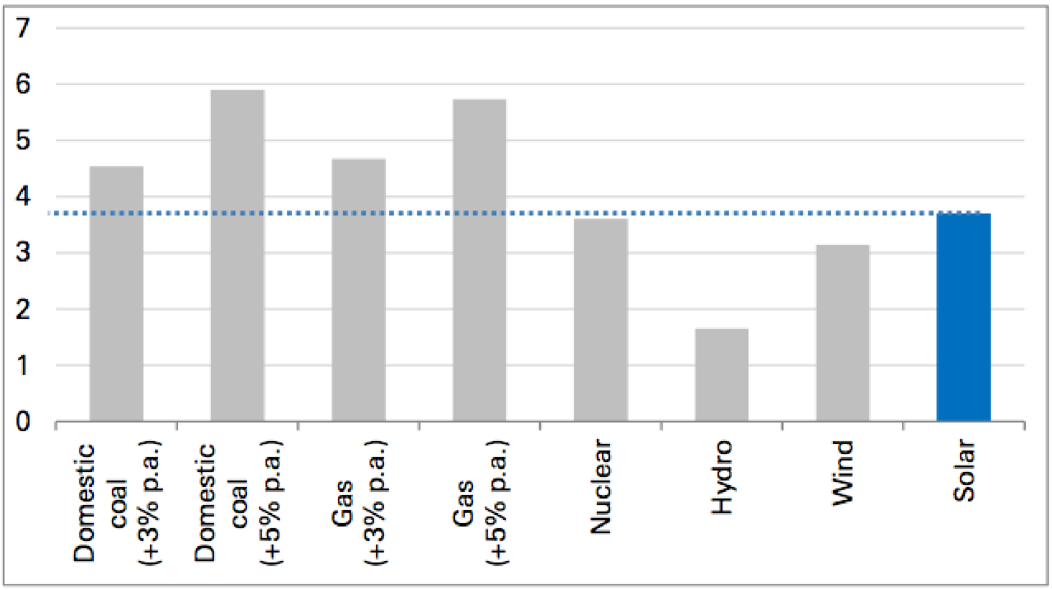
	FY2018	FY2020	FY2025	FY2030
Tariff (Rs per kWh)				
Supplied using Carmichael Coal	5.73	5.99	6.85	8.31
Supplied using Alpha Coal	5.41	5.62	6.37	7.68
Wind power - 2015 commissioning	4.60	4.60	4.60	4.60
Solar power - 2015 commissioning *	5.50	5.50	5.50	5.50
Solar power - 2018 commissioning *	4.00	4.00	4.00	4.00
Tariff inflation (yoy)				
Supplied using Carmichael Coal	6.0%	2.3%	3.1%	4.9%
Supplied using Alpha Coal	6.0%	2.0%	2.9%	4.8%
Solar power - assumed deflation pa	**10.0%**			
Relative cost of Renewables vs Imported Coal				
Wind vs imported coal - 2015 commissioning	80%	77%	67%	55%
Solar vs imported coal - 2015 commissioning	96%	92%	80%	66%
Solar vs imported coal - 2018 commissioning	70%	67%	58%	48%

** Assumes continuation of the upfront 30% investment credit from Solar Energy Corp India.*

Source: (Buckley, 2014)

Data by Deutsche Bank shows a similar picture. The higher tariffs for wind and solar power today are due to the higher capital costs for upfront investments. However, the life cycle costs of different energy sources in India show that wind and solar PV actually already are on parity with conventional power sources.

Figure 20: Life cycle costs of conventional and renewable sources of energy in India, in INR per kWh



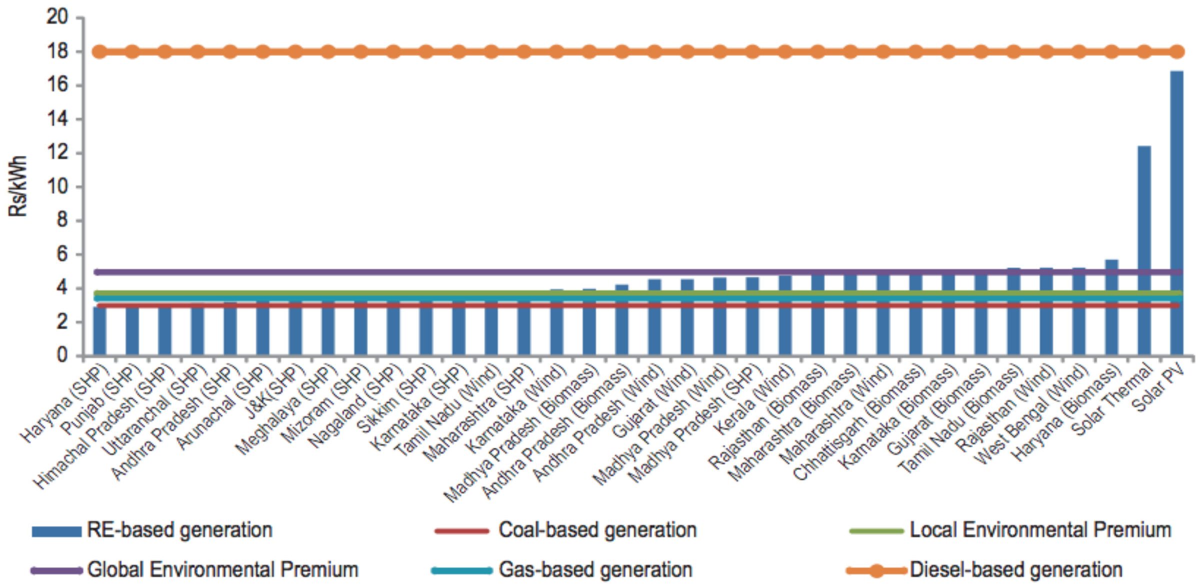
Source: (Puri, 2015). Based on Deutsche Bank estimates

The two trends of rising prices for coal power and increasing import dependence while prices for power generation from RE sources are falling have recently spurred a public debate in India. Former Minister of Power, EAS Sarma, questioned the strong position of coal in power generation and argued that coal is not a solution for the Indians that currently have no access to electricity and that the social costs of coal, in terms of public health and environmental damage, outweigh the benefits of coal power (Sarma, 2015).

Recent data confirm the downward trend in RE generation prices. In the first phase of the JNNSM, prices for PV fell to US$0.13/MW. In 2014, the prices offered by developers had reached US$0.09/MW (see figure below). Figures for 2015 are even lower, with bids in Madhya Pradesh and Telangana reaching between INR5 and 5.50 – or around US$0.08/MW – underscoring the very fast reduction of bid prices for solar power (Kumar, 2015; Mukul & Jai, 2015). Given this trend, solar power can soon be expected to be competitive even with existing coal-generated power. For those communities not already connected to the electricity grid, decentralised power generation from RE sources is already the less costly solution compared to centralised coal generation (Compare Sarma, 2015).

More importantly, the attractiveness of RE power does not 'just' originate from its contribution to the basic load in the electricity grid. RE power plants are also highly attractive to replace diesel generators as a source of power – whether off-grid or as back-up power. Given the frequent blackouts, many businesses use diesel generators as a source of power when the supply from the electricity grid is failing, which is a particularly low-hanging fruit from a RE perspective: The figure below shows the generation costs of RE power in comparison to coal and diesel. It shows that the power generation costs of diesel are far above those of different RE power sources at around INR18 per kWh.

Figure 21: Costs of power generation, by state and RE technology, in INR per kWh

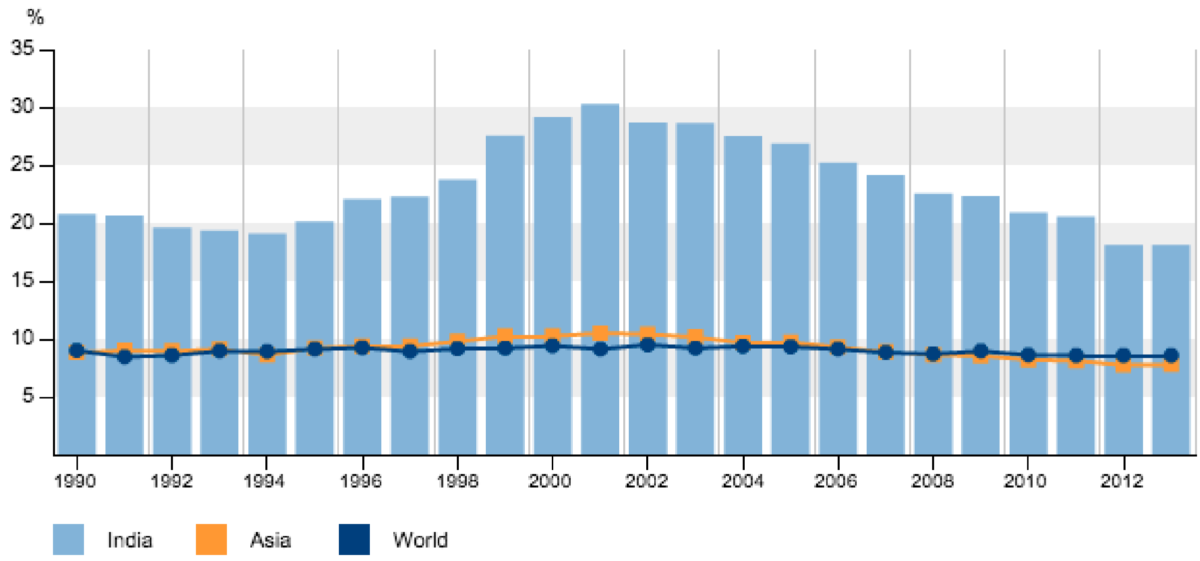


Source: (World Bank, 2010, p. 16)

2.3.3 Electricity infrastructure

The Power Grid Corporation of India manages the national electricity grid. Below the national level there are four regional grids, each comprising of a number of state grids. India's transmission infrastructure features a total of more than 300.000 km of transmission lines: 9432 km of ±500kV HVDC, 16823 km 765 kV, 134398 km of 400 kV and 148463 km of 220 kV lines (Central Electricity Authority, 2015). Distribution networks are nearly all owned and managed by State Electricity Boards, with a few local distribution grids that have been privatised.

Figure 22: T&D losses in India's electricity grid



Source: (World Energy Council, 2015)

The poor grid quality and prevalent electricity theft have resulted in a situation where losses from transmission and distribution (T&D) in India are more than twice the global and Asian average (see below), despite significant improvements since 2000. Still, in 2013, 18.1% of the electricity generated was lost. The insufficient growth in generation capacity and the high T&D losses combined further exacerbates the deficit between power demand and power generation, which leads to regular blackouts at peak power demand.

Despite the expansion of the grid, over 300 million Indians, or nearly a quarter of the population, lack proper access to the electricity grid (REN21, 2014, p. 136). More than 600 million people are estimated to lack access to modern energy services, and instead are using traditional biomass to cover their energy needs, with heavy damages for the environment. Two programmes are key in improving people's access to the electricity grid:

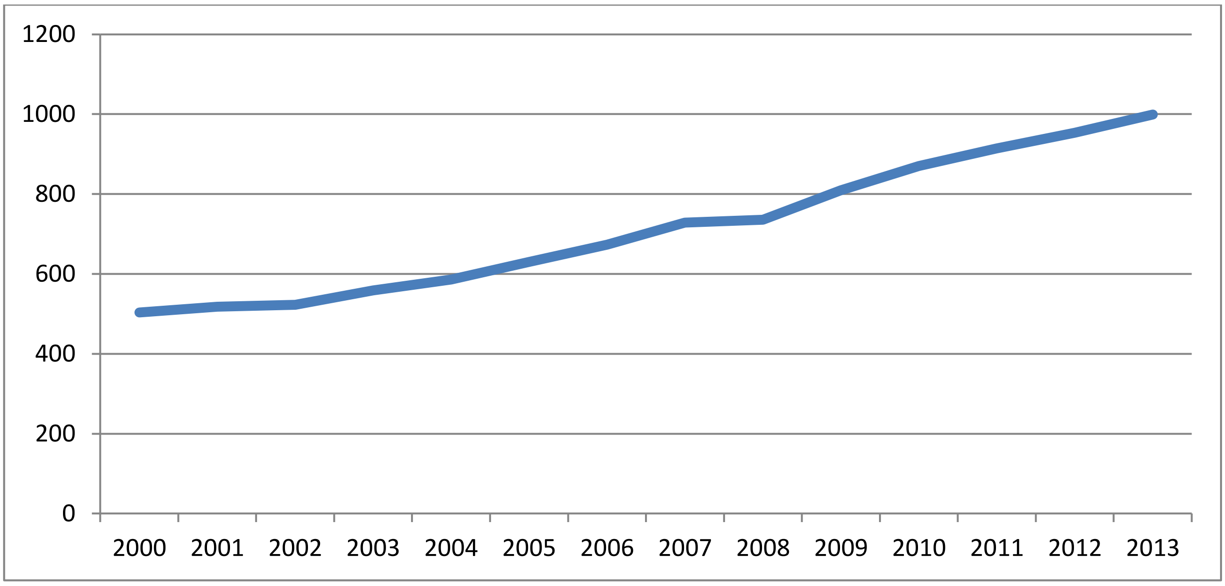
Rajiv Gandhi Grameen Vidyutikaran Yojana / Rajiv Gandhi Rural Electrification Scheme. The programme subsidises private infrastructure investments in the expansion of the electricity grid. When an investment is made, 9% of the costs are covered by the federal government, and 10% by the state government. Its volume accounts for 95% of the public budget for investments in rural electrification. The programme provides free a free cost-of-service connection to families below the poverty line. It has, however, not yet incorporated the promotion of solar energy in its efforts (Quitzow, 2015, p. 240).

Green Energy Corridor. The programme provides nearly US$8 bn for investments in transmission infrastructure for the integration of growing quantities of renewable electricity in eight of the states with the highest RE potentials: Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat, Maharashtra, Rajasthan, Himachal Pradesh and Jammu and Kashmir. The programme is managed by the Power Grid Corporation, CERC and MNRE, and their state-level counterparts (Power Grid Corporation of India, 2012; REN21, 2014, p. 82).

2.4 Economic development

Growth in average per capita incomes in India has been tremendous between 2000 and 2013, nearly doubling in that time (see below) albeit starting from a very low level (by international comparison). The data underscores the large dynamic in terms of growth, but also that many of these people are gaining or will gain access to electricity in the near future, thereby increasing the demand for (low-cost) electricity.

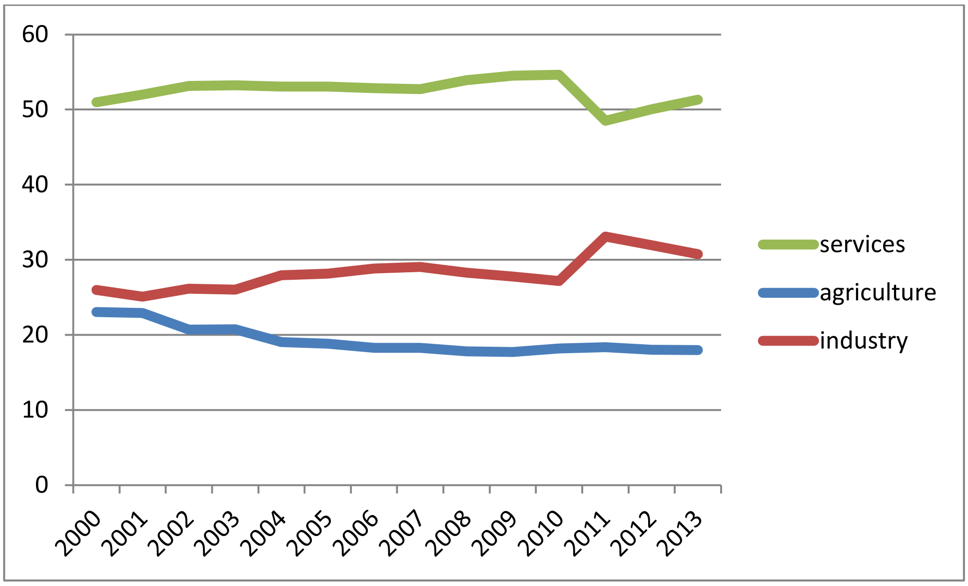
Figure 23: Adjusted net national income per capita in India, in constant 2005 US$, 2000-2013



Source: {WorldBank:2015wl}

The Indian economy still has a relatively large primary sector, accounting for 18% of GDP. Industry accounts for 31% of GDP, and the manufacturing sector for only 17.3%.

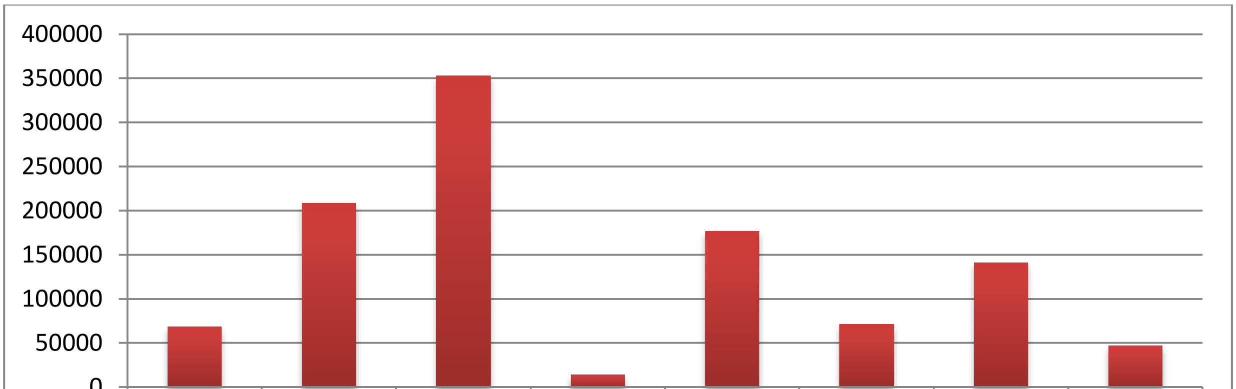
Figure 24: Structure of Indian GDP, by sector, in % of GDP



Source: (World Bank, 2015)

Industry is the main source of power usage, accounting for a third of domestically supplied power in 2011. The second source of power consumption is losses during the process of generation, transmission & distribution, accounting for 19%, followed by residential consumption (16%) and agriculture (13%). The remaining sectors are listed in the figure below.

Figure 25: Power consumption in India in 2011, in GWh



	Elec., CHP and heat plants	Losses	Industry	Transport (Rail)	Residential	Commercial and public services	Agriculture /Forestry	Non-specified
GWh	68362	208400	353058	14206	176749	71026	140960	46897

Source: Own depiction, based on (IEA, 2014)

2.5 Financial system

A broad range of financing institutions is active on the Indian market, ranging from commercial banks to national development banks and institutions that provide favourable lending conditions to private equity investors and international financing institutions. The large number and the considerable diversity of financing institutions together with the broad involvement of the private sector are major assets of the country. The figure below provides a snapshot of the range for the wind-financing sector.

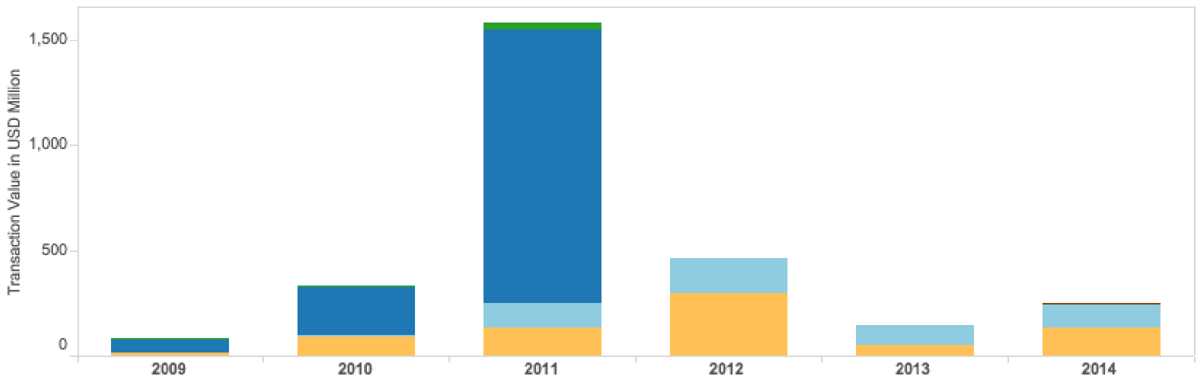
Figure 26: Key wind-financing institutions in India

Type of Investor	Examples
Commercial banks	Public Sector Banks: SBI, Canara Bank; Punjab National Bank (PNB) Private Sector Banks: IDBI, ICICI Bank and YES Bank Foreign Banks: Morgan Stanley Infrastructure Partners; Standard Chartered; HSBC
Non-Banking Financial Company (NBFC)	IDFC; IREDA; PFC
Private Equity investors	Morgan Stanley Infrastructure Partners; IDFC; MCap Fund; PTC India Financial Services Ltd (PFS); Goldman Sachs; UTI Capital, Ascent Capital Advisors India Pvt Ltd; VenturEast and Draper Fisher Jurvetson; FE Clean Energy; TVS Capital; Deutsche Investitions
Bilateral/Multilateral agencies	ADB; World Bank – IFC

Source: (Council on Energy, Environment and Water, 2014a, p. 6)

Since 2009, international financial institutions have provided nearly US$3 billion in finance for RE investments in the form of loans or equity. The major targets for international finance have been hydropower, wind and solar.

Figure 27: Renewable energy finance flows to Indian RE projects



Source: (IRENA, 2015)

3 Political strategies, actors and processes

The Indian state structure is federal. Energy and electricity matters are – with the exception of nuclear energy (at the national level) – part of the list of policy items for which states and the national government have shared responsibility. The taxation of electricity solely falls under the authority of the states.

This study focuses on policies and strategies at the national level as they guide the efforts in the states. With the establishment of the different ‘National Missions’, the national government has also taken a strong lead on these policy issues. However, states have a certain freedom in the way they implement their renewable energy, electricity and energy efficiency policies – as illustrated in section 4.4.3.

3.1 Overview

3.1.1 Framework laws

The 2001 Energy Conservation Act (ECA) and the 2003 Electricity Act provide the legal foundation for many of the implementing agencies (such as the Bureau of Energy Efficiency, or BEE) and the policy instruments (such as building codes and energy efficiency labels) created successively in the fields of renewable energy and energy efficiency. The Electricity Act is further important as it broke up the vertically integrated structure of the state-owned utilities at the national and state levels, and separated generation from transmission and distribution. The law also introduced the first renewable portfolio standards for electricity from renewable sources at the state level. Finally, the 2005 National Electricity Policy required distribution companies to increase their shares of electricity from renewable sources through renewable purchase obligations (RPOs).

The key strategy document in India is the National Action Plan on Climate Change (NAPCC) with its eight ‘national missions’.

3.1.2 National Action Plan on Climate Change

The National Action Plan on Climate Change (NAPCC) was adopted in the summer of 2008 as a ten-year strategy for India’s climate change and energy policy. It is implemented through ministerial implementation plans, which ministries develop and submit to the PM’s office as a follow-up to the strategy. The NAPCC acknowledges the complexity of climate change-related impacts and develops eight national ‘missions’ for India to address these challenges. The National Missions each have a lead ministry that is tasked with developing goals and implementing strategies, and to establish working groups that include different government ministries as well as civil society stakeholders (see 3.3.2). The specificity of the National Missions varies significantly, with some of them formulating measurable goals while others ‘only’ outline general directions to be specified in follow-up processes.

Table 2: National Missions under the National Action Plan on Climate Change and their respective key goals (by 2017)

Jawaharlal Nehru National Solar Mission (JNNSM)	• Significantly increase the share of solar energy in the total energy mix • Increase the domestic annual solar PV manufacturing capacity to 1000 MW • Install at least 1000 MW of CSP power generation capacity annually
National Mission for Enhanced Energy Efficiency (NMEEE)	• Electricity demand reductions of 10,000 MW by 2012 (against BAU)
National Mission for a Sustainable Habitat	• Establish energy efficiency as a core principle of urban planning
National Water Mission	• 20% improvement in the efficiency of water use
National Mission for Sustaining the Himalayan Ecosystem	• Conservation of diversity, forest cover and ecosystems in the Himalayas
National Mission for a Green India	• Afforestation of six million hectares of forest cover • Expand forest cover from 23% to 33% of the country's territory
National Mission for a Sustainable Agriculture	• Support adaptation to climate change in agriculture
National Mission on Strategic Knowledge for Climate Change	• Improve the understanding of climate science, impacts and challenges

Source: (Government of India, 2008)

The National Missions present eight individual strategies in themselves that are not necessarily clearly linked to one another. While the JNNSM and the NMEEE can be considered "clear and relatively focused, others (such as Water, Green India, Sustainable Agriculture) are still too general to provide a sufficient framework to give a direction to India's development and rather read like 'wish lists'" (Byrvan & Rajan, 2012, p. 8).

Also, the NAPCC has been criticised for too much focussing on the economic development goal of "high growth rates", rather than establishing a goal for long-term emissions reduction that could serve as a guideline for the Five-Year Plans (FYPs) (Government of India, 2008, p. 2; Pandve, 2009; Byrvan & Rajan, 2012, p. 9). Beyond outlining the eight missions, the NAPCC also contains rather specific "other initiatives", covering energy efficiency in power generation, the electricity grid, R&D as well as international cooperation.

The specific goals and action programmes of the two key missions – the JNNSM and the NMEEE – and the other activities will be discussed below in section 3.4.

3.2 Key governmental actors

Ministry of Power. The Ministry oversees India's electricity production and the development of the energy and electricity infrastructure. It further coordinates these efforts with the states' relevant entities as well as with private power producers. It is also the lead ministry for energy efficiency policies.

Ministry for New and Renewable Energy. The MNRE is the key ministry for renewable energy policies and is the lead ministry for the National Action Plan on Climate Change and the JNNSM (Quitzow, 2015).

Prime Minister's Office. The Prime Minister's Office is involved in all major energy policy decisions. Particularly under the government of Narendra Modi, the PM's Office has been very actively managing energy policy, for example in its push for more ambitious RE development goals (see below) (The Hindu, 2014).

PM's Council on Climate Change. The Council is involved in the broad strategic decisions on Indian RE and EE policies. It was established under the NAPCC and is tasked with reviewing the progress of the National Missions and to provide input on the development of renewable energy and energy efficiency policies.

3.3 The process of strategy development and implementation

3.3.1 Processes and capacities for strategy development in government

The National Missions were developed by broad steering committees that represent both major government ministries as well as civil society stakeholders. For example, the NMEEE's development was coordinated by various government ministries, the business community, NGOs and academia. A draft version was put on the BEE's website for review by the public. The comments led to a draft mission document that was finally reviewed by the relevant ministries and the Prime Minister's Office (Bureau of Energy Efficiency, 2009).

In contrast, the JNNSM was drafted by a core team within the MNRE. A 'second level of ownership' within the federal government lies with the affiliated Ministries for Science and Technology, Power, Commerce, Industry and Finance as well as with the Prime Minister's Office and the Planning Commission (Quitzow, 2015, p. 238).

3.3.2 (Vertical/horizontal) integration of interests in strategy development

The key approach for the strategic integration of different actors and interests in Indian politics is the country's process of developing the five-year plans (FYPs). The FYPs are coordinated among government agencies via a broad range of steering committees of the Planning Commission (26 in total for the 12th FYP, 2012-2017), each with its own working groups composed of representatives from various government ministries and of representatives from outside the government.

Table 3: Steering committees under the 12th FYP

Agriculture	Communication, Information Technology and Information	Culture	Development Policy
Environment and Forest	Financial Resources	Human Resource Development	Health and Family Welfare
Housing and Urban Development	Labour, Employment and Manpower	International Economics	Industry
Mineral	Multi-Level Planning	Power and Energy	Prospective Planning
Rural Development	Project Appraisal Management Division	Science and Technology	Socio-Economic Research
Social Justice and Social Welfare	Tourism	Transport	Voluntary
Women and Child Development		Water Resources	

Source: (Planning Commission, 2014)

The steering committees are not only constituted of representatives of different government ministries, but also of scientists and representatives of the business community. As an example, the table below shows the composition of the Steering Committee on Power.

Table 4: Membership in the Steering Committee on Power

Chairman	Secretary of the Ministry of Power	
Government members	Sr. Adviser (Energy), Planning Commission	Representative of Ministry of Petroleum & Natural Gas
	Chairperson, Central Electricity Authority	Representative of Ministry of Environment & Forest
	Representative of Ministry of New & Renewable Sources of Energy	Representative of Department of Science & Technology
	Representative of Department of Atomic Energy	Member (Planning), Central Electricity Authority – Member Secretary
	Representative of Ministry of Coal	
Public sector undertakings	National Thermal Power Corporation	Gujarat Urja Vikas Nigam Ltd.
	National Hydro Electric Power Corporation	Haryana Vidyut Prasaran Nigam
	Power Grid Corporation of India Ltd.	Karnataka Power Corporation Ltd.
	Power Finance Corporation	Maharashtra State Electricity Distribution Co. Ltd.
	Rural Electrification Corporation	Grid Corporation of Orissa Ltd.
	Nuclear Power Corporation of India Ltd.	
Private sector and non-official members	Shell India	Reliance Industries
	Reliance Infrastructure	Tata Power
	Girish Sant[7], Prayas Energy Group	Confederation of Indian Industry
	Federation of Indian Chambers of Commerce and Industry	

Source: Own depiction based on (Ministry of Power, 2012).

There are three major groups represented in the steering committees that foster the horizontal and vertical integration of policy and policy-related interests: 1) government representatives of nine ministries; 2) representatives of state-owned enterprises and 3) representatives of the private sector and civil society.

[7] http://www.prayaspune.org/peg/about-girish.html

Similarly, the Prime Minister's Council on Climate Change is made up of both government representatives and members of civil society tasked with reviewing the implementation of the NAPCC, the latter including individual academics as well as journalists. As an example, the membership in the first Council is listed here.

Table 5: Membership in the PM's first Council on Climate Change

Government	Minister of External Affairs	Finance Minister
	Minister of Environment & Forests	Minister of Agriculture
	Minister of Water Resources	Minister of Science & Technology
	Deputy Chairman, Planning Commission	Principal Scientific Advisor to PM
	Chairman, National Manufacturing Competitiveness Council	Chairman, Economic Advisory Council
	Chairman, Bureau of Energy Efficiency	Foreign Secretary
	Secretary, Environment & Forests	Principal Secretary to PM
Non-governmental members	Dr R. K. Pachauri (Chairperson), TERI	Dr Prodipto Ghosh
	Dr Nitin Desai	Dr Sunita Narain
	Shri Chandrashekhar Dasgupta, retired diplomat	Executive Editor, India Today
	Chairman, Investment Commission	Science Editor, The Hindu newspaper

Source: (Government of India, 2007)

3.3.3 Participation of non-governmental stakeholders

The integration of stakeholders is widely established; the quality of the participation and the influence of the stakeholders involved, however, vary considerably. The previous section already outlined a number of institutions and councils in which non-governmental stakeholders are involved. Other examples in this respect are:

Solar Research Council, *Industry Advisory Council*, *High Powered Task Force.* These names represent a number of councils that have been created to involve private actors in the JNNSM, foster knowledge exchange between and with them and built-up capacity in the sector. However, so far, they do not yet seem to play an important role in solar policy and there are no public documents available that would provide information on the work of these councils or, more generally, on the patterns of public-private cooperation in that specific issue area (Quitzow, 2015, p. 241).

3.3.4 Institutions and capacities for implementation

Central and State Electricity Regulatory Commissions (CERC). CERC is the main regulatory agency in India and its key task is the regulation of the electricity grid to ensure non-discriminatory access and to facilitate the development of and cooperation between the national, regional and state electricity grids for transmission and distribution.

Central Electricity Authority (CEA). As legislated by the Electricity Act (2003), the CEA is tasked with the preparation of the National Electricity Plan that guides the development of the electricity system. The CEA also advises government ministries on policy questions. It plays a particularly important role as the link between national and state electricity grids.

Bureau of Energy Efficiency (BEE). The Bureau implements energy efficiency policy based on the 2001 Energy Conservation Act. There are corresponding agencies in each state. The BEE developed a range of energy efficiency standards and works closely with energy intensive industries ("designate consumers") to reduce their energy consumption.

Beyond the regulatory agencies, many state-owned public companies (also called 'public sector undertakings') are in charge of implementing various aspects of energy policy. They are involved in decision-making processes and are often the implementation agencies of the central government ministries and agencies.

Power Grid Corporation of India. The Power Grid Corporation is a state-owned electric utility company that holds a monopoly on managing the national transmission grid. The company plays a key role in managing overall grid stability including the regional grids.

The *National Thermal Power Corporation (NTCP)*. The NTCP is the country's largest electricity producer accounting for more than a quarter of the electricity fed into the grid annually. Most of that production comes from coal-fired power plants.

Vidyut Vyapar Nigam Limited (NVVN). The NVVN is a subsidiary of NTCP tasked with the purchasing and sale of both conventional and non-conventional sources of electricity as well as with its import and export.

Rural Electrification Corporation. The Rural Electrification Corporation is tasked with implementing the expansion of the electricity grid as well as with the promotion of off-grid solutions to bring electricity to rural areas.

Solar Energy Corporation of India. The Corporation was set up in 2011 under the JNNSM and MNRE as a non-profit state-owned company tasked with the implementation of the JNNSM. It works on fostering R&D on solar power and manages the reverse bidding processes in solar PV auctions (Quitzow, 2015, p. 240).

Energy Efficiency Services Limited. The company operates under the Ministry of Power and implements a range of demand-side-oriented EE policies.

3.3.5 Monitoring and Evaluation

The Council on Climate Change is charged with annually reviewing each National Mission's progress towards achieving its goal for 2017 (Government of India, 2008, p. 8). The Mission's annual reports are available to the public.

Additionally, the JNNSM's phase I implementation was reviewed by the World Bank on behalf of the MNRE, which also included two public consultation measures with societal stakeholders (Quitzow, 2015, p. 240).

3.4 Goals and action programmes

3.4.1 Jawaharlal Nehru National Solar Mission

The JNNSM's core objective is to "establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible" (Ministry of New and Renewable Energy, 2010). Thus, it aims at fostering energy security by expanding and diversifying electricity sources and contributes to the country's climate policy goals by providing carbon free electricity. By working to establish the necessary conditions, the mission aims at accelerating the market for solar technologies. The document was launched in 2008 and formally adopted in 2010 and outlines solar capacity expansion goals in three stages:

Table 6: Phases and Goals of the JNNSM (as adopted in 2008)

Overall goals	• Grid parity of solar PV by 2022 • Parity with coal-based thermal power by 2030 • Expansion of off-grid solar applications in order to accelerate the electrification of the rural areas and to include those areas so far without access to electricity and heat • To create favourable conditions for domestic solar manufacturing capabilities and employment • To create pilot and demonstration projects to spur on domestic indigenous R&D and manufacturing • To develop an annual domestic manufacturing capacity of 2 GW of solar PV cells
Installed solar capacity in phase I (2010-2013)	• 1,000 MW capacity of grid-connected solar power (including rooftop PV) • 300 MW capacity of off-grid applications • 7 million square metres of solar-thermal collectors
Installed solar capacity in phase II (2013-2017)	• 4,000–10,000 MW capacity of grid-connected solar power (including rooftop PV) • 1,000 MW capacity of off-grid applications • 15 million square metres of solar-thermal collectors
Installed solar capacity in Phase 3 (2017-2022)	• 20,000 MW capacity of grid-connected solar power (including rooftop PV) • 2,000 MW from off-grid capacities • 20 million square metres of solar-thermal collectors • To deploy 20 million solar lighting systems in rural areas

Source: (Ministry of New and Renewable Energy, 2010)

In addition to the goals, the JNNSM outlines various *incentive schemes and policy instruments* to support the achievement of these goals, ranging from import duty exemptions on materials and equipment to low-interest rate loans for investors. These are underpinned by a Special Incentive Package for solar PV manufacturing companies as well as public investment in solar manufacturing technology parks (Ministry of New and Renewable Energy, 2010). For the supply side, the JNNSM neither outlines measureable targets nor a specific link to industrial development strategies – rather, it focuses on creating demand for market development. A key weakness of the JNNSM is seen in the MNRE lacking the capacity to pursue industrial policy goals by itself while at the same time not being proactive enough to involve industrial policy stakeholders to a degree that would be necessary to combine both solar energy and industry policy goals (Quitzow, 2015, p. 238& 240).

3.4.2 Revision and up-scaling of the JNNSM's goals

In July 2015, the government of Prime Minister Modi decided to completely revise the targets of the JNNSM in the middle of phase II and scale them up enormously. For solar PV capacity, the goal of the second phase of the JNNSM (ending in 2017) was increased to 15,750 MW (from a previous 9,000 MW) (Hall, 2014). The overall capacity development goal of installing 20 GW of grid-connected solar power until 2022 was increased five-fold to 100 GW: 4 GW are already installed. The remainder is to come from two sources: 40 GW from rooftop installations on public, commercial, industrial and residential buildings; and 57 GW from medium to large-scale solar power plants. An overview of the state's commitments to reach the shared solar PV goal can be found in the annex in Figure 33.

Table 7: 'Scaled-up' goals of the JNNSM (2015), targets for annual additions and total installed capacity by 2022, in MW

Category	Annual addition targets							
	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Rooftop solar PV	200	4,800	5,000	6,000	7,000	8,000	9,000	40,000
Ground-mounted solar power	1,800	7,200	10,000	10,000	10,000	9,500	8,500	57,000
Total	2,000	12,000	15,000	16,000	17,000	17,500	17,500	97,000

Source: (MNRE, 2015b).

The resolution containing the new scaled-up goals, while mentioning new funds, does not provide for new implementation measures. It refers to the possibility that the in-between goals might be revised to ensure a "smooth implementation" and that MNRE "may issue a detailed Action Plan" (MNRE, 2015b).

Beyond the revised goals for 2022, media reports in September 2015 suggested that the cabinet could adopt new goals for 2030 for RE development to reach 350 GW of installed capacity from renewable energy sources (equivalent to 40% of the total electricity supply), with 250 GW coming from solar sources and 100 GW from wind power (Mittal, 2015b).

3.4.3 National Wind Energy Mission

After the turmoil in the policy landscape for wind power with the withdrawal of two main support instruments and their reintroduction after investments dropped severely, it is expected that the Modi government will soon outline a comprehensive strategy for the wind sector in the form of a National Wind Energy Mission (Mittal, 2014). Available information suggests that the approach could be different to the JNNSM in that it will most likely not have a bidding scheme and will instead allow wind-rich states to implement their own incentive schemes, while the national level itself will focus on systemic questions such as grid expansion (Council on Energy, Environment and Water, 2014a, p. 5).

In 2014, the MNRE held a round of consultations in collaboration with IREDA and the Shakti Sustainable Energy Foundation and Centre for Study of Science, Technology and Policy that "was attended by more than 150 stakeholders from industry, government and research" (Choudhury, 2014). While the Wind Energy Mission is still under development, goals for wind power development in the next two FYPs until 2022 have been communicated to the press. Some have mentioned a combined 100GW to be installed from both onshore and offshore wind power until 2022 (e.g. Choudhury, 2014). More likely is a lower goal of 60 GW until 2022 as the commitments by the states at the RE-Invest Conference suggest. An overview of the state's commitments to reach the shared wind power development goals can be found in the annex in Figure 33. These still appear very ambitious, especially when putting them into perspective: Until 2014, well into the 12th FYP, the total installed wind power capacity was about 22.5 GW with additions of 2.3 GW in 2014. Thus, the new 60 GW goal would require tripling installed capacity within eight years.

3.4.4 National Mission for Enhanced Energy Efficiency (NMEEE)

The NAPCC outlined four policy initiatives for EE that are spelled out by the NMEEE (Government of India, 2009):

- To establish a market-based mechanism to enhance the cost effectiveness of improvements in energy efficiency ("Perform, Achieve and Trade");
- To accelerate the shift to energy efficient appliances (Market Transformation for Energy Efficiency);
- To finance demand side mechanisms for EE (Financing of Energy Efficiency);
- To develop fiscal policy instruments that foster EE (Framework for Energy Efficient Economic Development).

By 2015, these measures are expected to result in (Bureau of Energy Efficiency, 2009):

- annual fuel savings in excess of 23 million toe;
- cumulative avoided electricity capacity additions of 19,000 MW;
- CO_2 emission reductions of 98 million tons per year.

The activities under the NMEEE are implemented by a publically owned company (Energy Efficiency Services Limited) established as an energy services company and resource centre for other actors – e.g. by offering various consultancy services on access to international carbon finance and the Clean Development Mechanism, demand-side energy management practices as well as training and capacity-building (IEA, 2015, p. 114).

3.4.5 12th Five-Year Plan (2012-2017)

The Five-Year Plans (FYPs) serve as key planning documents to ensure consistency across government departments and provide guidance for national policy. RE and EE policy targets of the FYPs build on the NAPCC and its national missions and formulate goals to specify and guide their implementation. The following table gives an overview of the goals related to RE and EE in the current FYP. Of course, the revision of RE capacity development goals in the summer of 2015 also affects the current 12th FYP and its RE-related goals.

Table 8: RE and EE policy goals under the 12th Five-Year Plan 2012-2017

Primary commercial energy production from RE	20 Mtoe/3.12% share in commercial energy production	2020
Total capacity additions from RE	30 GW	2017
Total capacity additions from wind	15 GW	2017
Total capacity additions from solar	10 GW	2017
Total grid-connected capacity added from solar	20 GW	2022
Total off-grid capacity added from solar	2 GW	2022
Solar thermal collector area	20 million m^2	2022
Solar home lighting systems in rural areas	20 million units	2022
Total energy efficiency savings	Equivalent to 11 GW ‘avoided capacity’	2017

Source: (Planning Commission, 2013)

4 Specific policy measures in India

4.1 Human qualifications and technological know-how

- *Jawaharlal Nehru National Solar Mission*. The JNNSM features a major programme to advance research and development of solar power, covering both basic and applied research with the aim of improving existing processes and technologies, developing demonstration projects and mobilising public-private partnerships for developing an R&D infrastructure and supporting start-ups. The JNNSM also addresses human resource issues, as India expects to need 60,000 to 200,000 qualified people just in the PV sector by 2020 (Ministry of New and Renewable Energy, 2010).
- *Development of Solar Energy courses*. The network of Indian Institutes of Technology and Engineering Colleges is developing specific training programmes with financial assistance from the government.
- *Fellowship Programme for Study Abroad*. A government programme funds scholarships for 100 students to study at world-class universities abroad, with the goal of transferring knowledge back to India.
- *National Centre for Photovoltaic Research and Education (NCPRE) at the Indian Institute of Technology in Mumbai*. The NCPRE was established in 2010 to become one of the globally leading research institutes in PV research. NCPRE also offers a range of PhD and Master's level courses.[8]
- *MNRE's Human Development Programme.* The MNRE has started 10 pilot training programmes organised by the National Institute for Solar Energy and state-level renewable energy agencies. The programme will develop course materials in collaboration with local industry representatives to identify the respective skill needs (Ministry of New and Renewable Energy, 2015a).
- *MNRE National Institutes*. There are a number of autonomous research institutions that exist under the MNRE and that work on developing new RE technologies and training programmes. Each focuses on one type of RE: Along with the National Institute on Solar Energy and the National Institute on Wind Energy, the Sardar Swaran Singh National Institute of Renewable Energy focuses on biofuels and biomass, while the Alternate Hydro Energy Centre works on small-scale hydroelectricity.
- *National Skill Development Corporation (NSDC).* In addition to the MNRE, there are other ministries involved in providing training programmes for employment in RE and EE. The Ministry of Skill Development & Entrepreneurship finances the National Skill Development Corporation (as a publically owned enterprise) in order to develop vocational institutions and ensure the quality of the training these institutions offer. Through its partner organisations, the NSDC works on training in a wide range of sectors, including energy efficiency and renewable energy.[9] In January 2015, the NSDC started the process of setting up a skills council on "Green Technology" to accompany the development and quality assurance of training programmes for professions in the field.

[8] See **http://www.ncpre.iitb.ac.in/**

[9] See **http://nscsindia.org/NSCSTrainingPartners.aspx**

So far, the standards for the qualification of workers, e.g. solar panel technicians, are covered by the skills council for the electronics industry.10

- *Market Development and Promotion of Solar Concentrator-based Process Heat Applications*. The programme by the MNRE and UNDP provides funding for at least 30 demonstration and 60 replication projects on solar-based heat generation between 2012 and 2017. It also supports the training of 300 representatives of manufacturers, installers and developers. The budget of nearly $24 million is provided by GEF, MNRE, industry and other financial institutions (Epp, 2011).

4.2 Access to capital

4.2.1 Renewable energy

- *Clean Energy Fund*. The Fund provides capital to the IREDA, which is used to provide below-market rate loans for investments in RE power generation of up to 50% of the project costs. Non-recourse financing through IREDA has supported 55% of all wind projects in 2011 (Council on Energy, Environment and Water, 2014a, p. 6).
- *International Carbon Finance*. International sources of carbon finance, such as the UNFCCC's CDM or the Green Climate Fund, provide access to international sources of finance for RE and EE investments. Beyond their contribution to financing the expansion of RE/EE as such, they have also spurred on the transfer of technology, e.g. of high-capacity wind turbines, to India (Council on Energy, Environment and Water, 2014a). The first Indian bank to receive accreditation from the Green Climate Fund, and thus gain access to its funds, was the National Bank for Agriculture and Rural Development in the summer of 2015. Others are expected to follow.11
- *Required lending to the RE sector.* The Reserve Bank of India (the country's central bank) has classified renewable energy as one of its priority sectors, with direct consequences for commercial banks, both domestic and foreign.12 These are required to lend 40% of their net credit to the priority sectors identified by the central bank.

4.2.2 Energy efficiency

- *Light a Billion Lives.* The financing approach underwent a transformation since 2007, moving from grant-based financing to a more flexible approach that is suitable for scaling up the energy efficient lighting solutions throughout the market (see below). Key to the programme's success is acknowledging the rural poor's very limited buying capacity by introducing a fee-based payment option that is attractive even to the poorest.

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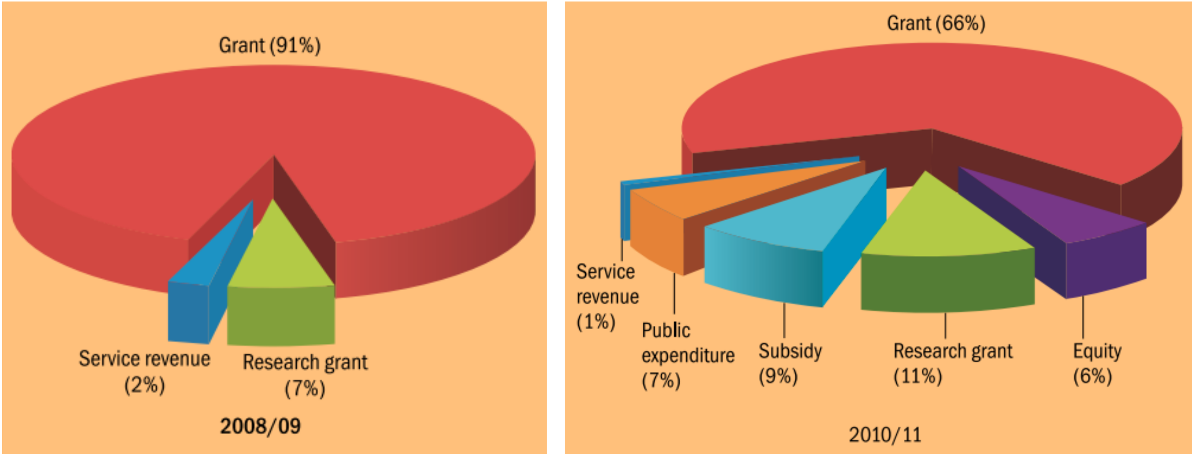
[10] For example, see the occupational standards for the training of solar panel installation technicians: **http://nscsindia.org/App_Documents/QPs/Solar_Solar_Panel_Installation_Technician.pdf**

[11] See **https://www.nabard.org/News-Files/NABARD_accredited_as_the_first_National_Implementing_Entity.pdf**

[12] See **https://rbi.org.in/Scripts/NotificationUser.aspx?Id=9688&Mode=0**

Figure 28: Diversification of funding sources of Light a Billion Lives over time (2008/2009–2010/2011



Source: (Light a Billion Lives, 2013)

- *IREDA Financing Schemes.* IREDA provides financing to promote, develop and extend financial assistance for renewable energy and energy efficiency/conservation projects. It offers a wide range of funding instruments from direct project financing, equipment finance, business development finance, loans for manufacturing facilities of energy efficiency equipment, and loans to local banks for on-lending (Institute of Industrial Productivity, 2015). IREDA's funding is provided for by both the national government as well as by a range of bilateral and multilateral funding institutions, such as the KfW (the German development bank), AFD (the French development bank), Nordic Investment Bank, European Investment Bank, Japan International Cooperation Agency, World Bank, Asian Development Bank and other international financial institutions (Institute of Industrial Productivity, 2015).
- *Loans for small and medium-sized enterprises in EE.* Another approach to financing EE investments is through loans for small and medium-sized companies working in the sector.13 The Small Industries Development Bank (SIDBI) provides such financial products to a range of businesses working on energy efficiency, such as small and medium-sized businesses, energy services companies or manufacturers of energy-saving equipment. These lines of finance are also supported by international sources, such as the KfW or the Japanese International Cooperation Agency.

4.3 Level playing field & formation of fair prices

- *Coal tax/Clean Energy Cess.* India's Clean Energy Fund is financed through a tax on coal, peat and lignite as an approach to levelling the playing field. The tax was initially adopted in 2010 and doubled in 2014, raising about one billion US$ annually (Institute of Industrial Productivity, 2015; Singh, 2015).

[13] For an example, see http://www.sidbi.com/sites/default/files/SIDBI_Flyer_Financing%20EE%20Projects.pdf

4.4 Support measures to foster demand

4.4.1 Renewable energy

4.4.1.1. Renewable Purchase Obligations and Trading of Renewable Electricity Certificates

- *Renewable Purchase Obligations.* The Indian federal government has defined a minimum share (Renewable Purchase Obligations, RPO) for electricity from renewable sources to be held by power distribution companies as well as companies producing their own electricity. RPOs were introduced with the 2003 Electricity Act and have a long-term goal of reaching 15% by 2020 for all renewables combined (Council on Energy, Environment and Water, 2014a). Their specific implementation in each state is governed by the State Electricity Regulatory Commissions (MNRE, 2015a). The RPO for solar power to be bought will rise from 0.25% in phase I of the JNNSM to 3% by phase III in 2022. In May 2015, the Ministry of Power issued a proposal for the revision of RPOs, which has not yet been adopted by the cabinet. It suggests increasing the RPOs for solar power from 3% to 8% by March 2019. The effectiveness of the RPOs was in question for a while, as they were not properly enforced, which had reduced investor confidence for some time. A landmark ruling in May 2015 by the Indian Supreme Court upholding the standpoint of the regulatory authorities that those companies under RPOs can be forced to either meet their obligations or to pay a fine when failing to do so is expected to greatly enforce the implementation of RPOs (Puri, 2015, p. 29). The table below provides an example of the progression for solar and non-solar renewable RPOs in the state of Jharkhand:

Table 9: Minimum Renewable Purchase Obligations in % of electricity produced

Year	Solar	Non-solar RE sources	Total
2010-11	0.25%	1.75%	2.00%
2011-12	0.50%	2.50%	3.00%
2012-13	1.0%	3.0%	4.00%

Source: (Jharkhand State Electricity Regulatory Commission, 2010)

- *Renewable Electricity Certificates.* Renewable Electricity Certificates (REC) allow the trading of such Purchase Obligations between states. A voluntary trading platform for such RECs has been set up by CERC who is also in charge of its regulation, which further includes the determination of a minimum price.14 This represents the difference between the average price for electricity from conventional sources (Annual Pooled Purchase Cost) and “the highest difference between the project viability cost for solar PV or thermal projects” in each fiscal year (Davies, 2011).

[14] The platform can be found at https://www.recregistryindia.nic.in/

4.4.1.2. Feed-in tariffs for renewable sources of electricity

- *Feed-in tariffs for RE.* The Central Electricity Regulatory Commission (CERC) issued a national regulation on feed-in tariffs in 2009, after many states had already introduced feed-in tariffs of their own accord. The regulation does not require the states to introduce feed-in tariffs, but provides a model that these can copy. It does not contain technology-specific rates, but defines a methodology for determining the tariff for each technology that ought to be reviewed annually, considering the following criteria: a) return on equity, b) interest on loan capital, c) depreciation, d) interest on working capital and e) operation and maintenance expenses. The duration of the FIT is determined by technology, ranging from 20 years for biomass to 25 for wind and solar to 35 years for small hydro projects (CERC, 2009).

4.4.1.3. Demand-side support instruments for wind power

The wind market in India has gone through some turmoil because of the changing policy landscape (the temporary abolition of the GBI and AD) and uncertainty about the fate of the RPOs that led to an enormous drop in investments in the FY 2012/2013. The reinstatement of the GBI has led to an uptick in wind power investments and overachievement of the capacity development goals in 2014 (Ministry of New and Renewable Energy, 2015b). It must be noted that a company can only use either the AD or GBI.

- *Accelerated Depreciation (AD).* The policy was in place from 2002 to 2012 and reinstated in 2014. It allows a project developer to deduct up to 80% of his investment costs in the first year. The rate was changed to only 35% in 2012, which led to a massive drop in investments (Council on Energy, Environment and Water, 2014a).
- *Generation-Based Incentive (GBI).* The GBI was introduced in 2009 and - similarly to the AD – expired in 2012. It pays out half a rupee (US$0.01) per kWh of electricity for a period of 4 to 10 years – with a maximum cap of around US$170,000 per MW (Council on Energy, Environment and Water, 2014a, p. 4; REN21, 2014, p. 82).
- *Further financial incentives.* Other incentives include income tax exemptions on wind power earnings for 10 years, exemptions from excise duties, customs exemptions for RE equipment, an allowable 100% of foreign direct investments in energy projects and tax incentives for research and development activities.

4.4.1.4. Allocation of solar power capacity under the JNNSM

- *Accelerated Depreciation and Generation-Based Incentives for solar power.* The BGI and AD policy instruments are also available to solar power developers (MNRE, 2011b). However, the main policy instrument under the JNNSM is a reverse bidding system. NVVN manages the bids under the JNNSM and awards them. Successful bidders sign 25-year power purchase agreements with NVVN according to the guidelines set by CERC. Each MW of solar power procured by NVVN will be matched with the equivalent grid capacity by the Ministry of Power and NTCP (Burnwal, 2011).
- *Reverse bidding solar power auctions.* The allocation of the 1,000 MW of solar power capacity allocated under the first phase of the JNNSM was done as part of a reverse bidding scheme. PV was bid on in two stages – 150 MW and 350 MW – and the 500 MW of solar thermal capacity was auctioned in one step. The process allocates capacity to those developers that offer capacity at the lowest price, which leads to a rapid drop in prices. Some states have copied the instrument. An overview of bidding results from phase I and the first batch of phase II can be found in section 8.3.

4.4.1.5. Solar PV domestic content requirement

- *Domestic content requirements for solar PV & CSP.* The implementation of the reverse bidding auctions allows for domestic content requirements to be attached to the bids. In phase I of the JNNSM, it required monocrystalline silicon PV cells to originate in India. The requirement has been criticised for being ineffective and mostly resulting in a distortion of the market towards thin-film technologies. For phase II of the JNNSM, the local content requirement will be defined in a technology-neutral way (see Council on Energy, Environment and Water & National Resources Defense Council,, 2014, p. 16). For CSP allocations, the domestic content must be at least 30% of the bid value. Phase II of the JNNSM will – in its first auction – have equally sized PV batches of 375 MW with one requiring domestic content and one not requiring any domestic content (Headway Solar, 2014).

4.4.1.6. Support for solar thermal water installations

- *Rebate programme for SWH*. The subsidy scheme finances 30% of the price of a solar water heating system. It was designed in a way in which the seller pre-financed the subsidy and later got reimbursed by MNRE. However, MNRE had been late in repaying the companies for several years, which eventually resulted in the total abolition of the instrument in late 2014.[15] However, it was concluded that overall, the instrument had been successful in significantly bringing down prices for SWH systems and that these would henceforth be able to create a market for themselves, even without subsidies (Epp, 2014). After an initial slump in the demand due to higher prices, the market started to recover in 2014 as manufacturers began offering discounts (REN21, 2015, p. 202).

4.4.1.7. Support for off-grid RE

- The *Remote Village Electrification Programme* provides financial assistance for the purchase of off-grid solutions for electricity production as well as energy efficient lighting. It covers small-scale hydro, biomass, biogas, biofuels, wind or PV systems as well as home and street lighting systems (MNRE, 2011a).

4.4.2 Energy efficiency

4.4.2.1. Energy efficient buildings

- *Energy Conservation Building Code*. The national building code was launched in 2007. It is not mandatory for states and implementation has been varied.[16] The code sets minimum EE standards for commercial buildings, provides guidelines for residential buildings, and promotes the use of ESCOs to reduce energy consumption (Bureau of Energy Efficiency, 2014).

[15] The reason for the delayed payments was that the revenues from the coal tax could not be used for the programme.

[16] One group of states simply issued the code (Rajasthan, Odisha, Uttrakhand, Punjab, Karnataka, Andhra Pradesh and UT of Puducherry), another amended the ECBC regulations to their needs (Uttar Pradesh, Kerala, Chhattisgarh, Gujarat, Bihar, Tamil Nadu, Haryana, Maharashtra, West Bengal) and others are still in the process of amending it (Himachal Pradesh, Assam, Tripura, Mizoram, Jharkhand, Goa, Madhya Pradesh).

- *Voluntary building labels*. A vast range of voluntary good practice energy efficiency labels for buildings exist in India, covering different types of buildings, originating from a variety of entities.[17]

4.4.2.2. Energy efficient consumer goods and lighting

- *Energy efficiency labels.* The 2006 BEE *Star Label* is a label for consumer goods to identify energy efficient appliances. For a few product categories – such as refrigerators, lamps, air conditioning and distribution transformers – it is mandatory to get certification, while the label is voluntary for other products.
- The 2009 *Bachat Lamp Yojana* Programme is organised by BEE and provides for the exchange of efficient CFL light bulbs for incandescent bulbs. The exchange is being financed by carbon credits under the UNFCCC's clean development mechanism (UNFCCC, 2013). The energy savings from the project alone result in emission savings of over 600,000 tons of CO2 every year.
- *Lighting Asia*. The programme promotes off-grid lighting by creating a market for CFL and LED lighting in solar home systems (SHS) and Pico-PV small-scale lighting. The programme tests lighting systems against its *Global Lighting Quality Standards scheme*[18]*,* ensures their compliance and awards best practice products.19 It aims to provide lighting for 2 million people by the end of 2015. Capital for the programme is provided by the IFC (REN21, 2014, p. 140). The programme is modelled on a similar campaign that was implemented in Africa.
- *Light a Billion Lives*. The programme was set up by TERI and aims to provide training for micro-entrepreneurs who create their own businesses, providing energy-efficient lighting in the form of solar-powered lamps to customers in local villages – either paid for through a daily usage fee or via a loan finance model (TERI, 2015).

4.4.2.3. Mandatory EE measures for energy-intensive industries

Under the Energy Conservation Act (ECA), the national government, represented by the BEE, can require energy-intensive companies representing about 60% of India's primary energy consumption (so called 'designated consumers', such as producers of aluminium; fertilisers; iron/steel; cement; pulp/paper; chloralkali products; textiles; chemicals) to:

- undergo energy audits,
- designate and appoint energy managers,
- report annually to BEE about EE improvements,
- use energy efficient building standards,
- organise training measures (Government of India, 2001).

[17] These are: Bureau of Energy Efficiency (BEE) Star Rating for Buildings, Green Rating for Integrated Habitat Assessment (GRIHA), IGBC Green Factory Building Rating System, IGBC Green Homes Rating System, IGBC Green SEZ Rating System, IGBC Green Township Rating System, LEED India for Core & Shell and LEED India for New Construction.

[18] For the standards, see https://www.lightingglobal.org/activities/qa/standards/

[19] For examples of products receiving awards, see https://www.lightingglobal.org/activities/qa/outstanding-product-awards/2012-outstanding-product-awards-competition/

4.4.2.4. Perform, Achieve, Trade (PAT) Scheme

The 2010 amendment of the Energy Conservation Act (ECA) introduced a market-based trading scheme: the so-called “Perform, Achieve and Trade” (PAT). It is being implemented under the NMEEE and the NAPCC. PAT established a trading scheme for energy efficiency certificates and mandates the ECA’s ‘designated consumers’ to take part in it. PAT’s first phase between 2012 and 2015 focuses on 478 facilities of ‘designated consumers’. The energy savings obligations for the first phase are plant-specific and determined by BEE using a methodology that takes historic emissions into account and puts higher savings expectations on less efficient plants, averaging a savings target of 4.8% by 2015 (Institute of Industrial Productivity,, 2015). The second round will broaden the base of ‘regulated industries’ to include “refineries, chemicals, petrochemicals, automobile manufacturing, sugar and glass” (Planning Commission, 2013, p. 157).

4.4.3 State and municipal level policies on RE

Many of the policies adopted at the national level are either voluntary for states to follow or serve as models upon which states can implement their own policies. Generally, there is little coordination or a common forum between the national level and the states in which the use of policy instruments is discussed, let alone coordinated, to foster consistency. There is a huge range of state-level policies that generally complement national policies – although in some cases they contradict them. For example:

- Several states complemented the national RPO with their state RPOs that go beyond the national goals; some have in addition introduced their own feed-in tariffs for renewables, such as (REN21, 2014):
  - 2003 Maharashtra
  - 2004 Andhra Pradesh and Madhya Pradesh
  - 2005 Karnataka, Uttaranchal, and Uttar Pradesh
  - 2006 Kerala
  - 2008 Chhattisgarh, Gujarat, Haryana, Punjab, Rajasthan, Tamil Nadu, W.Bengal

  Gujarat is currently even ignoring calls from the national government to reduce the rates in its FIT scheme (REN21, 2014, p. 79).

- Twenty five states have introduced net metering schemes as financial incentives for households to install rooftop PV (Puri, 2015, p. 31).

Beyond the states, cities are also involved in climate, RE and EE policy-making. 36 cities have developed green city plans in response to the National Solar Cities Programme. Some cities have amended their building codes to require the installation of rooftop PV systems or to mandate the use of solar-water heating (REN21, 2014, p. 193).

5 Outlook on India's development in RE and EE

5.1 Market development

- The expansion goals for RE/EE under the National Missions and the FYPs, the generally rising competitiveness of power and heat produced from renewables (with grid parity for PV expected by 2017/18) and the overall upward trend in investments suggest a further strong growth of related markets in India. Data on the most recent capacity auctions shows that there is not only significantly more capacity being offered by companies than called for by the government, but also that the prices offered for solar PV are significantly lower already than predicted earlier and are likely to reach full price parity with new coal power very soon (Buckley, 2014; e.g. Kumar, 2015; Mukul & Jai, 2015; Puri, 2015).

The up-scaled goals for wind and solar power generation under the JNNSM and the NWEN are highly ambitious and will reinvigorate the market. In early 2015, Prime Minister Modi held an "RE-Invest Conference" at which a large number of foreign and domestic energy companies signed memoranda of understanding with the Government of India with investment commitments that amount to US$35 billion. Commitments by private companies to expand power generation capacity from renewable sources amount to about 210GW, and commitments by Indian public sector companies add up to nearly 9GW.20 166GW of new capacity are expected from solar, 45GW from wind and about 4GW from other RE sources (Puri, 2015, pp. 67-69). Further, private sector companies pledged to create annual manufacturing capacities of more than 36 GW in wind and 5 GW in solar (see below).

Figure 29: Other renewables commitments at RE-Invest Summit, February 2015, creation of manufacturing capacities

S. No.	Company	Capacity (MW)	Solar	Wind	Others
	Private Sector - Manufacturing				
1	Suzlon Energy Ltd.	11,000		11,000	
2	Gamesa	7,500		7,500	
3	Inox	5,000		5,000	
4	Regen	4,450		4,450	
5	Wind World (India) Pvt. Ltd.	4,500		4,500	
6	Vikram Solar	2,300	2,300		
7	Waree Energies Ltd.	2,000	2,000		
8	RRB Energy Limited	2,000		2,000	
9	Kenersys India Pvt. Ltd.	1,000		1,000	
10	Leitwind Shriram Manufacturing Ltd.	900		900	
11	Emmvee Photovoltaic Power Pvt. Ltd.	750	750		
12	BGR Power Limited	150			
	Total	**41,550**	**5,050**	**36,350**	**0**

Source: (Puri, 2015, p. 70)

[20] Over 300 private and nearly 40 public companies made such commitments. These can be found online under https://web.archive.org/web/20150626181431/http://re-invest.in/Document/orginal/Green_Energy_Commitments.pdf

The new goals and commitments made in 2015 essentially revise all existing goals. It is likely that this vastly higher level of ambition will drive investments, employment and domestic economic growth in RE. However, how these goals are to be reached is – so far – largely unclear. Questions like how the historically inadequate electricity infrastructure is expected to integrate much higher levels of renewable power or how the – so far – “grossly inadequate” solar manufacturing capacity is to expand fast enough to meet the projected annual demand also remain unclear (Puri, 2015, p. 38 & 80). Therefore, these commitments should be seen as pledges – and should not be interpreted as a strategy.

The demand for investments in energy efficiency is likely to grow strongly with the expansion of the PAT scheme to other industries. The market for energy efficient buildings and the effects of the green buildings code will play a major role in determining India’s long-term energy efficiency performance, as it is estimated that 70% of India’s building stock by 2030 have yet to be constructed (REN21, 2014, p. 84).

5.2 Estimated employment effects

A number of estimates evaluate future employment potential from RE and EE in India. The high variation between these estimates is essentially due to a lack of official data to base them on. A number of these also represent examples of ‘wishful thinking’:

- A study by the Confederation of Indian Industry and MNRE estimated more than one million jobs to be created from RE by 2020. The table presents the projected employment figures for the different renewable energy technologies at three different stages (2010, 2015 and 2020) and for two different scenarios (moderate and high). The data indicates that the employment effects are likely to be highest in solar energy applications and various forms of modern bioenergy.

Table 10: Estimated current and future employment in the RE sector in India[21]

Sector	Estimated current employment (in 2010)	Estimated future employment			
		2015		2020	
		Scenario I (moderate)	Scenario II (high)	Scenario I (moderate)	Scenario II (high)
Wind	42,000	44,000	80,000	46,000	160,000
PV on-grid	40,000	39,000[22]		152,000[23]	
PV off-grid	72,000	140,000		225,000	
	41,000	123,000		270,000	

[21] The estimates are called into question by other observers (Council on Energy, Environment and Water & National Resources Defense Council, 2014).

[22] Employment for 2017 estimated based on JNNSM targets

[23] Employment for 2022 estimated based on JNNSM targets

Solar thermal					
Biomass on-grid	35,000	47,000	62,000	60,000	100,000
Biomass gasifier	22,500	30,000	39,000	38,000	63,000
Biogas	85,000	150,000	196,000	240,000	395,000
Small hy-dro	12,500	16,000	20,000	20,000	30,000
Total	350,000	589,000	699,000	1,051,000	1,395,000

Source: (Confederation of Indian Industry & MNRE, 2010)

- Bridge to India produces comparable figures for the solar sector – estimating up to 675,000 jobs by 2024 (Bridge to India & TATA Solar Power, 2014).
- The Global Wind Energy Council estimates an employment potential for the wind sector of 98,000 by 2020 (Council on Energy, Environment and Water, 2014b).

The data do not include projections about employment created from energy efficiency.

5.3 Trade-offs: competing policy goals

One key problem of the JNNSM is that it pursues two policy goals that are in contradiction with each other: the provision of cheap solar electricity on the one hand, while at the same time fostering domestic manufacturing and employment on the other. Thus, a stronger focus on a more differentiated, technology-sensitive market development, which takes into account the degree of maturity of each technology as well as India's degree of readiness in this respect, could be advisable. The introduction of technology-specific auctions is a clear step in this direction. Similarly, others have called for specific policies in order to address those policy goals the current design of the JNNSM does not address (sufficiently), such as enhancing manufacturing capabilities and training skilled workers (Council on Energy, Environment and Water, National Resources Defense Council, 2014, p. 17).

6 Conclusion: Key features of the Indian approach, explanatory limitations of the study and open questions for future research

This concluding section aims at boiling down some key features of the strategy and policies employed in India, in an effort to identify the specific strengths and weaknesses of this approach. At the same time, remaining data and knowledge gaps shall be highlighted in order to mark the limitations of the study and point out areas for future research.

6.1 Key features of the Indian strategies and policies on RE and EE

In this first section a number of key features of the strategic approach and the policies used by the Indian government will be highlighted. Many of them are related to the National Missions before Prime Minister Modi came into office. Despite the major policy changes started by his government, these findings are overall still valid, as they pertain largely to the challenges of effectively implementing government strategies and policies.

6.1.1 Strategic approach to RE and EE

- The NAPCC as well as the JNNSM and NMEEE are relatively general strategy documents that provide a more or less specific direction for national development. While they contain some measurable goals, they also do not really indicate specific implementation measures. The other National Missions under the NAPCC are similarly are phrased in such a general way that they leave many aspects of the strategy unclear and hard to monitor and evaluate. This especially concerns the responsibilities of the different actors, the specific targets to be reached, the financial resources to be mobilised or the specific policy measures to be taken.
- The drastic upward revision of the official RE goals by the Modi government in the middle of the JNNSM has created a lot of questions – with few of them answered – about how to reach the enormous intended increase in the capacity development goals. So far, it is still unclear how 'realistic' these goals are, given the observable development trend of power generation capacity from renewables to date.
- India still lacks a long-term vision that goes beyond the medium-term scope of the NAPCC or the FYPs. The Planning Commission's "India Energy Security Scenarios 2047" provide a long-term view, but do not represent a comprehensive energy strategy as they solely focus on the topic of energy security. The country's international commitments to climate change mitigation given at the Paris Conference of the United Nations Framework Convention on Climate Change might serve as a framework for a long-term approach to energy sector planning.
- Next to the government (at national and state levels), state-owned enterprises, private businesses and civil society representatives are involved in the development, reviewing and monitoring of strategies – through the Council on Climate Change, the steering groups under the FYP or for the National Missions. There is, however, little evidence in the consulted sources of how effective the integration of such a multitude of actors has really been in guiding strategy development.

- The JNNSM focuses on fostering the demand side and the creation of a domestic market for solar power at the lowest price. It is still not really linked to other relevant policy strategies and/or instruments, such as those dealing with industrial development and/or employment creation. Linking this demand-side approach to supply-side measures holds a lot of potential to increase both the Indian share of employment and the value created by this demand.

6.1.2 Policy instruments for RE and EE

- The JNNSM has been relatively effective in fostering demand for PV, but has been less successful with regard to its industrial and employment policy goals, mainly due to the lack of coordinated action on promoting domestic manufacturing and skill development. The few existing initiatives regarding skill development focus on university skills, but not on those parts of the value chain where most jobs are. Similarly, the local content requirements intended to support Indian production have been criticised for being ineffective and for merely distorting the market.
- The unfolding and impact of the wind energy policy also underscores the need for a consistent and reliable policy framework. Sudden changes (such as the abolition of the GBI and AD) and the lack of enforcement of the RPOs weakened investor confidence, which resulted in the recent sudden slump in wind power investments.
- The side-by-side existence of a multitude of national and state policies, regulations and administrative procedures is a significant hurdle for investors. The JNNSM or the national government do not provide transparency or a service to support investors in that endeavour. A project by GIZ aiming to enhance transparency on PV regulations via a web-based tool has made a first step in this direction.[24]
- While the National Missions and the related policy documents put much emphasis on industrial and employment policy goals, there is little follow-up to these espoused goals in terms of actual policy development and implementation.
- The 2015 revision of policy goals, the new level of ambition to actually enforce policies (e.g. with regard to RPOs) and the numerous new commitments made by the national and state governments as well as by publically-owned and private companies will give a boost to local RE markets. However, so far it is unclear how such a drastic acceleration of the RE deployment can be implemented in practice.

6.2 Explanatory limitations of the study

The central limitation of the study is to know the exact outcome which the recent major overhaul and upward revision of the previous RE (and EE) goals by the Modi government will have. What makes it hard to form an opinion about how realistic these goals are is that there is – beyond the rhetorical commitments made by various actors – little information on what additional resources and instruments will be mobilised by the national or state governments. Interviews with local experts have emphasised how hard it is – even for them – to keep track of the vast landscape of (financial and regulatory) policy measures and institutions for fostering the development of RE and EE that exist in the country.

[24] See **http://www.eclareon.eu/en/solar-guidelines**

One key problem so far, which has, for instance, limited the effectiveness of the JNNSM, is that there is no central platform for the exchange of information on RE and EE policies – which could either provide guidance for investors or serve as a forum for policymakers to share good practices. A key challenge for implementing the RE and EE investment commitments made in 2015 will therefore be to provide more transparency on existing policies and better coordinate policy measures, especially in infrastructure development.

In addition to the limitations which result from the repeated changes in strategy as well as from a more general lack of transparency, a number of other limitations need to be highlighted regarding the reliability and quality of data that is available:

- *Quality and reliability of available data.* Especially with regard to the estimates of employment effects from RE and EE, the assumptions of the available models vary and produce a broad range of results. The recent complete overhaul of RE goals further adds to this insecurity about the reliability of estimates.
- *Lack of data on small-scale and distributed energy.* Nearly half of the solar power capacity envisioned for 2022 (40 GW) are to originate from rooftop solar, but there is no specific data available for small-scale solar power. The data available through IRENA is based on capacity from utility-scale RE installations.
- Break-down of investment data. The data available on RE investments worldwide (e.g. by FS-UNEP Collaborating Centre, 2014) presents aggregated data and overall numbers. It does not break down investments by federal state (despite the known significant differences between them) or analyses the actors providing financing (e.g. with regard to the relative importance of public vs. private banks).

6.3 Open questions for future research

The recent drastic revision of the official policy goals has added more questions to the already existing list of questions regarding the development and implementation of RE and EE policies in India until now. Given the complexity of the subject, the list is by no means complete – it rather aims at pointing out some particularly crucial questions.

- How can the coordination between the national government and the state governments be improved, especially in the most relevant fields of policy such as for energy, employment, research, infrastructure, industrial and trade development?
- What is the scope of and potential for decentralised power generation, especially from solar power? How can the goal to install 40 GW of capacity in rooftop PV be reached? What additional policy measures will be pursued?
- What role do decentralised power sources, particularly solar PV, play in the policy schemes to foster rural electrification? What is the market potential (in terms of value added and employment) of such small-scale PV solutions?
- How can the expansion of the electricity grid be accelerated to provide the necessary capacity to transmit and distribute the RE capacity envisioned for 2022? Through what approaches will the expansion of the various regional power grids be coordinated (e.g. if there will be a power grid expansion strategy)?
- Given the current focus of RE policy on demand creation: What approaches can be devised which link the demand-side to supply-side instruments in order to foster employment creation, or to build up technological capacities in businesses in order to foster their competitiveness?

- Will RE industrial policy retain its current focus on developing the domestic market through protectionist measures? Or will there be a more open trade policy towards technology imports to accelerate the build-up of domestic technological capacities?
- What has been the impact of the participation of representatives of non-governmental organisations, state government- and publically owned companies in the advisory councils on RE and EE? Is there evidence that their participation has had a significant impact on strategy development? Or has the strategic approach which is guiding India's energy policy at the time of writing basically been shaped in a top-down approach driven by the Prime Minister's Office?

7 Literature

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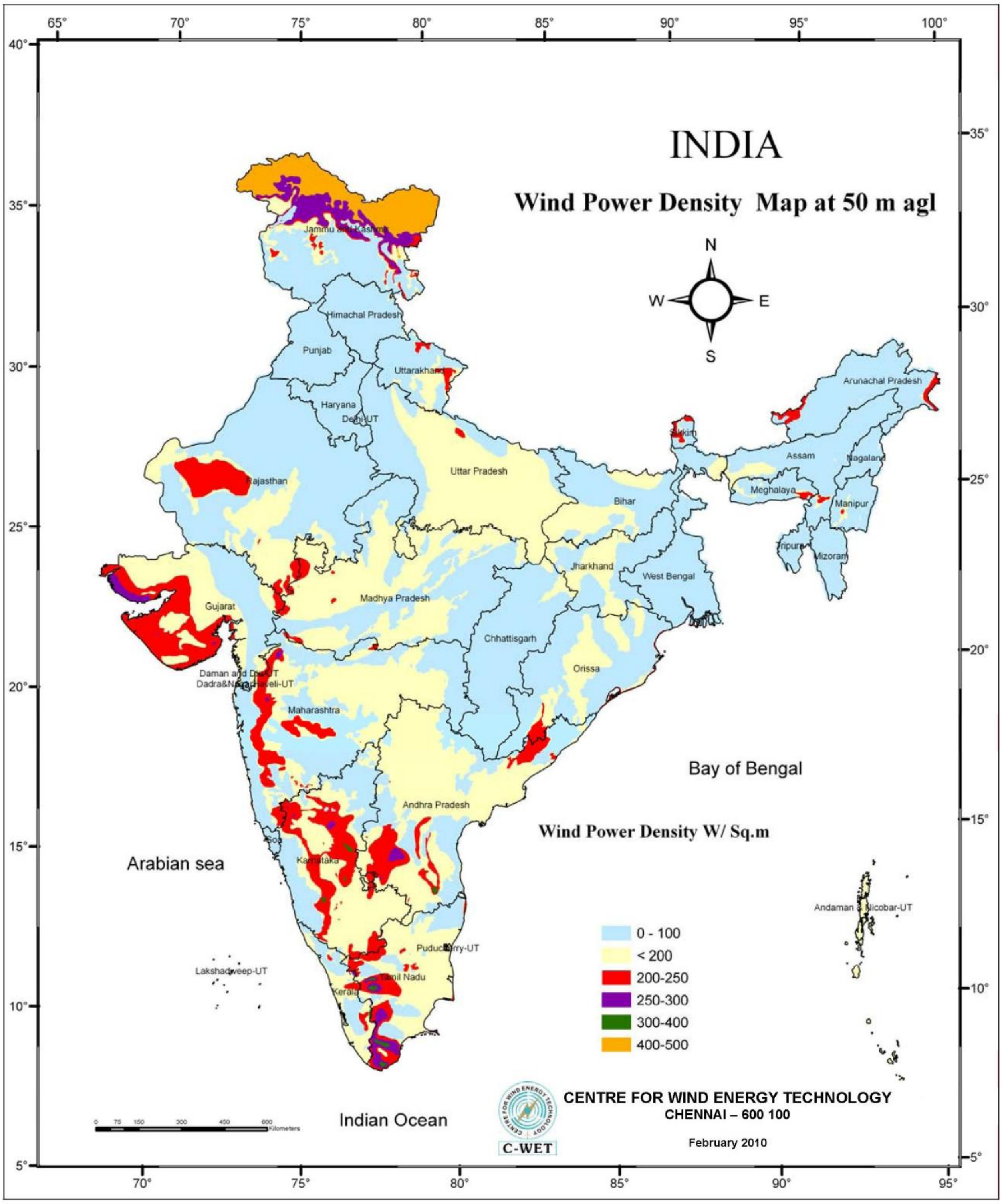
8 Annex

8.1 Wind map of India

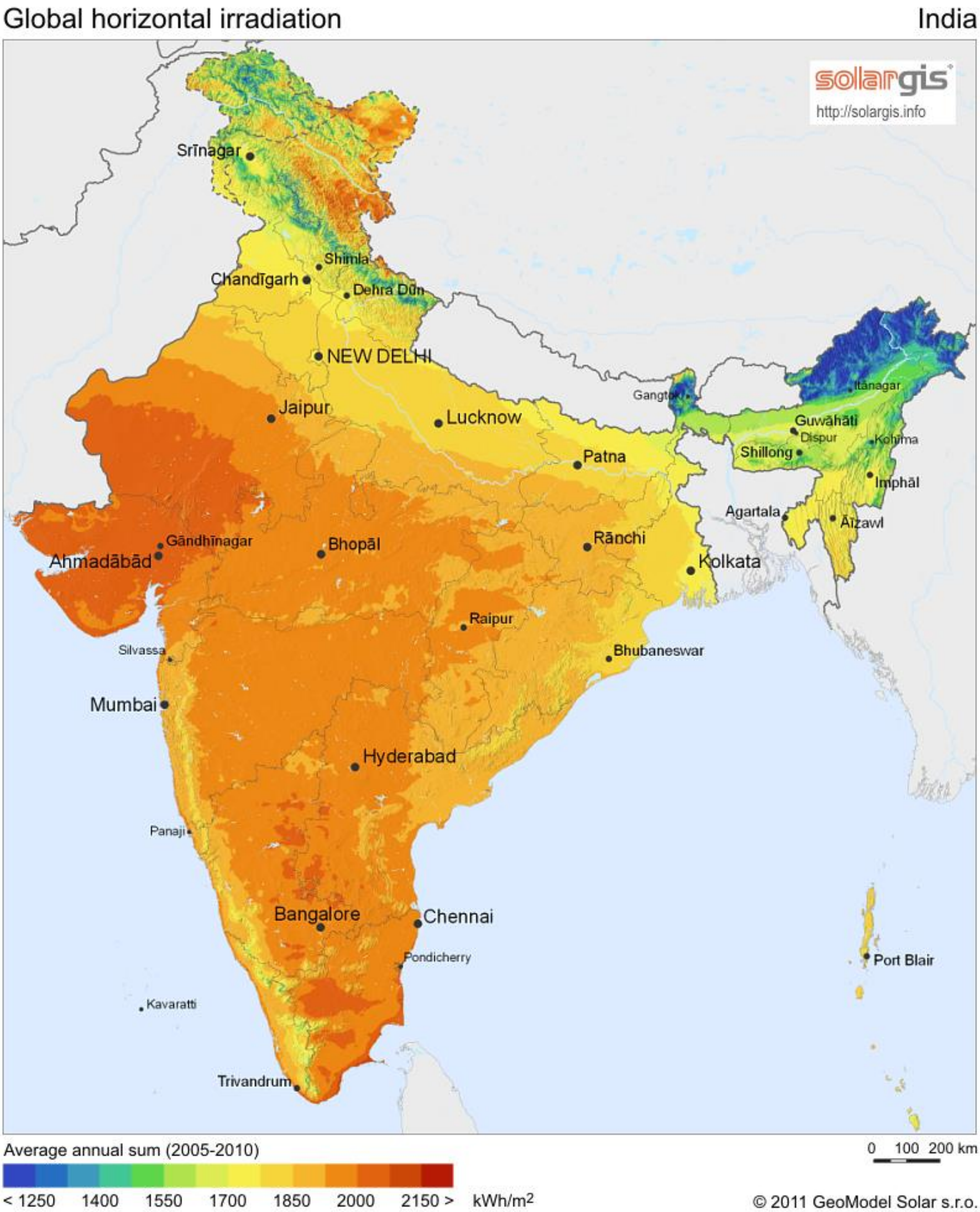
Figure 30: Wind map of India



Source: (Centre for Wind Energy Technology Chennai, 2010)

8.2 Solar irradiation map of India

Figure 31: Global horizontal irradiation in India (2011)



Source: (Solargis, 2011)

8.3 Results from JNNSM allocations in phase I & II

Figure 32: Results from JNNSM allocations in phase I & II

	NSM Phase I Batch I	NSM Phase I Batch II	NSM Phase II Batch I
Managed by	NVVN	NVVN	SECI
Capacity allocation	PV: 150 MW (PPA signed only for 140MW)[1] CSP: 470 MW	PV: 350 MW (PPA signed only for 340 MW)[1] CSP: Nil	PV: 750 MW[2] CSP: Nil
Minimum and maximum project capacity	PV: Min: 5 MW, Max: 5 MW. CSP: Min: 5MW, Max:100 MW (Max. of 3 project locations)[3]	Min: 5 MW, Max: 20 MW[3]	Min: 10 MW, Max: 50 MW[2]
Domestic content requirement (DCR)	PV: For projects based on c-Si technology, the modules must have been manufactured in India CSP: 30% domestic content mandatory[1]	For Projects based on c-Si technology, the modules must have been manufactured in India[1]	Separate bids for 375 MW capacity under DCR category and remaining 375 MW under open category[2]
Policy mechanism	Preferential feed-in tariff[3]	Preferential feed-in tariff[3]	Funding support by the govt. (VGF) to make project viable at INR 5.45/kWh tariff (INR 4.75/kWh for projects claiming accelerated depreciation)[2]
Allocation method	Reverse bidding on benchmark tariff (per kWh): PV: INR 17.91/kWh, CSP: INR 15.31/kWh[1]	Reverse bidding on benchmark tariff (per kWh): INR 15.39/kWh[1]	Reverse bidding for viability gap funding demand. Maximum VGF: INR 25 million/MW[2]
Required bank guarantee	INR 5 million/MW[3]	INR 5 million/MW[3]	INR 1 million/MW[1]
Required net worth of the bidder	INR 30 million/MW (up to 20 MW), INR 20 million addition/MW (>20 MW)[3]	INR 30 million/MW (up to 20 MW), INR 20 million addition/MW (>20 MW)[3]	INR 20 million/MW (up to 20 MW). INR 10 million addition/MW (>20 MW)[2]

Commissioning time period	PV: 12 months, CSP: 28 months[3]	13 months[3]	13 months[2]
Project allocation	Dec' 2010[4]	Dec' 2011[4]	Feb' 2014[2]
No. of bids submitted	PV: 343, CSP: 55	PV: 183	PV: 122
Total capacity of the bids submitted	PV: 1715 MW	PV: 1890 MW	PV: 2170 MW[2]
No. of projects selected	PV: 30, CSP: 8[1]	PV: 26[1]	PV: 47[2]
Maximum capacity by a bidder	PV: 5 MW, CSP: 100 MW[3]	50 MW[3]	100 MW[2]
Range of the winning bids	PV: INR 10.95/kWh - 12.76/kWh, CSP: INR 10.49/kWh - 12.24/kWh[1]	PV: INR 7.49kWh - 9.44/kWh[1]	DCR: INR 13.5 million/MW - INR 24.56 million/MW. Open: INR 1.7 million/MW - INR 13.5 million/MW[2]
Weighted average of the winning bids	PV: INR 12.16/kWh , CSP: 11.48/kWh[1]	PV: INR 8.77 / KWh[1]	DCR: INR 20.19 million/MW, Open: INR 10.67 million/MW[2]
Projects commissioned	PV: 140 MW, CSP: 50 MW[1]	PV: 330 MW[1]	Yet to be commissioned
Photovoltaic technology breakdown	Thin film: 55%[4], rest: polycrystalline	Thin film: 75%[4], rest: polycrystalline	
Total investment for the projects	PV: INR 15.4 billion (INR 110 million/MW), CSP: INR 56.4 billion (INR 120 million/MW)[4]	PV: INR 34 billion (INR 100 million/MW)[4]	
Prominent project developers	PV: All project developers allocated 5 MW, CSP: Rajasthan sun technique energy pvt. ltd, KVK energy ventures private limited - each 100 MW	PV: Welspun Solar - 50MW, Azure Power - 35MW, Green Infra Solar: 35MW	PV: Azure power - 100 MW, Acme - 60 MW, Waaree energies Pvt. Ltd - 50 MW, Today homes and infrastructure Pvt. Ltd- 50 MW

8.4 Revision of RE goals in 2015 – commitments by Indian states

Figure 33: Commitments to achieve 100GW solar and 175GW RE target from solar, wind, small hydro power and biomass, by state

Sates/UTs	Solar	Wind	SHP	Biomass
Delhi	2,762			
Haryana	4,142		25	209
Himachal Pradesh	776		1,500	
Jammu & Kashmir	1,155		150	
Punjab	4,772		50	244
Rajasthan	5,762	8,600		
Uttar Pradesh	10,697		25	3,499
Uttrakhand	900		700	197
Chandigarh	153			
Northern Region	**31,120**	**8,600**	**2,450**	**4,149**
Goa	358			
Gujarat	8,020	8,800	25	288
Chhattisgarh	1,783		25	
Madhya Pradesh	5,675	6,200	25	118
Maharashtra	11,926	7,600	50	2,469
D. & N. Haveli	449			
Daman & Diu	199			
Western Region	**28,410**	**22,600**	**125**	**2,875**
Andhra Pradesh	9,834	8,100		543
Telangana	-	2,000		
Karnataka	5,697	6,200	1,500	1,420
Kerala	1,870		100	
Tamil Nadu	8,884	11,900	75	649
Puducherry	246			
Southern Region	**26,531**	**28,200**	**1,675**	**2,612**
Bihar	2,493		25	244
Jharkhand	1,995		10	
Orissa	2,377			
West Bengal	5,336		50	
Sikkim	36		50	
Eastern Region	**12,237**	**0**	**135**	**244**
Assam	663		25	
Manipur / Meghalaya	266		50	
Nagaland	61		15	
Tripura	105			
Arunachal Pradesh	39		500	
Mizoram	72		25	
North Eastern Region	**1,205**		**615**	
Andaman & Nicobar Islands	27			
Lakshadweep	4			
Other (New States)		600		120
All India	**99,533**	**60,000**	**5,000**	**10,000**

Source: Deutsche Bank, MNRE

Source: (Puri, 2015, p. 65)