Indo-German Energy Forum

RENEWABLE ENERGY IN INDIA 2013

An Overview

Indo-German Energy Forum Support Office

On behalf of
Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

Ministry of New and Renewable Energy
Government of India

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PREFACE

Renewable energy is becoming an increasingly important element of India's national energy mix. The huge potentials of the country in renewable energy are recognized as an additional important energy source which can contribute to the key policy objectives of the energy sector, given the ever increasing prices and the shortages in fossil fuel supplies. By diversifying the energy mix in a climate friendly way and by increasing the energy security at the same time, the main benefits of renewable energy for India become obvious. In addition, renewable energy allows for increased energy access to the Indian people, especially in the rural and remote areas, catering to their basic energy needs.

In the early 1980s, India became the world's first nation to have a "Ministry of New and Renewable Energy (MNRE)". Due to the heavy power shortage and the ever increasing prices of fossil fuels, the nation has taken up an ambitious target of augmenting the current energy supply with renewable sources. Notable achievements have already been made in this direction with a total of 29 GW of electricity generated from renewable sources, whose total potential has been estimated by MNRE to be around 245 GW. Today India has the world's 5th largest installed capacities of renewables, including small and large hydro, solar, wind and biomass.

Opportunities exist for both grid connected and off-grid applications in residential urban and rural areas, as well as in the agricultural, commercial and industrial sectors all across the country. The Indian government has come up with favourable policies to promote renewables, namely the Electricity Act in 2003, the National Electricity Policy in 2005, the National Tariff Policy in 2006, and the latest is the National Solar Mission in 2008. The institutional structure is well suited for this, with every Indian state having its own renewable energy development agency, apart from a federal level agency (IREDA) guided by the MNRE and Ministry of Power (MOP). Innovative financing mechanisms, including Generation Based Incentives (GBI) and the Renewable Purchase Obligations (RPO) make the renewable energy sector an interesting investment opportunity and contribute to the sustainable economic growth of the country.

There is hardly any doubt that India's renewable sector is ready to grow, and with a strong support from the government and an active participation from the private sector, the sector will boom in the coming future. The Indian government has, notably, linked the development of this sector to the nation's GDP growth, thereby opening up further avenues in the renewables sector.

Many governments all over the world acknowledge the contribution of renewables towards a green economy and a climate friendly energy supply. In Germany, the current energy transition, known as "Energiewende", is marked by a path towards an energy supply through high shares of renewable energy, increasing energy efficiency and lower emissions of GHG. This ambitious transition in the economy and the industry of the country requires broad understanding of the technical, economical as well as legal requirements of the energy sector in order to manage the change successfully.

The Indo-German Energy Forum (IGEF), which was established by the Indian Prime Minister Singh and the German Chancellor Merkel in April 2006 in an effort to deepen the Indo-German ties, provides an excellent platform for both countries to share experiences in the transition of the energy sector. The IGEF aims at promoting renewable energy as well as energy efficiency at both demand and supply sides. The forum focusses on exchange of knowledge, promoting private sector investments and putting in place an enabling environment to further develop the markets for renewable energy and energy efficiency in both India and Germany. The IGEF thus has a mandate to facilitate and to engage in strategic co-operation projects between the Indian and German governments as well as between the private sectors in both countries. This report has been prepared by the IGEF Support Office in an effort to give a brief overview of the current renewable energy scenario in India to the private sector companies willing to invest there.

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EXECUTIVE SUMMARY

India has been ranked by the IMF as the world's tenth largest economy and the third largest by purchasing power parity. The Indian economy has been growing at an annual average rate of around 8 percent, coupled with an increasing urbanisation and an ever increasing demand for energy. The Integrated Energy Policy of India, which is geared towards an annual GDP growth rate of 9 percent through 2031-32, estimates the increase in primary energy supplies to 4 to 5 times and the increase in electricity generation to 6 to 7 times from the 2003-04 levels. Despite a 52 GW capacity addition during the implementation of the nation's 11th Five Year Plan, there is a 12 GW shortage to electrify all the unelectrified rural areas inhabited by more than 300 million people. This has resulted in extreme pressures on the nation's energy resources, making India one of the largest importers and producers of coal. Similar is the story for oil and natural gas as well as for nuclear power.

The total potential for renewables in India, as per the Ministry of New and Renewable Energy (MNRE), is around 245 GW, while the current installed capacity is 29 GW. Only around 12% of the country's potential has been exploited so far. In the wake of power deficits and increasing costs of conventional sources of power, India's energy security is at a major issue for the government, especially to sustain long term economic growth of the country.

Moreover, with millions of rural Indian households without access to electricity, decentralized usage of renewables provides ample opportunities for the country to increase energy access and improve the standards of living of the citizens. The Government of India has, therefore, made considerable efforts towards the development of renewables.

The most prominent move in this regard has been the setting up of an independent ministry in the early 1980s to look into the development of renewables - a first of its kind in the world. Further, the target set by the National Action Plan on Climate Change (NAPCC) in 2008 to increase the share of renewable energy in the country's energy mix by up to 15 % by 2020, signalled the country's firm commitment towards a sustainable future.

Due to the shortage and the ever increasing prices of fossil fuels, the nation has taken up an ambitious target of augmenting the current energy supplies with renewable sources, making it the main stream in the near future, given the abundant availability of these resources. Today India has the world's 5th largest installed capacities of renewables. The high solar insolation in India for over 300 days a year, if tapped with PV modules with efficiency of about 10 percent, is enough to supply thousand times more energy than the domestic demand projected for 2015[1,2]. India has now the world's 5th largest installed wind capacity, with a detailed wind atlas already available for the whole country. India has 5th largest exploitable hydro-power resources in the world and is currently the world's 7th largest hydroelectric producer.

India already had a total installed capacity of 1.9 GW of solar power by August 2013, with plans of increasing the capacity by an additional 10 GW by 2017, totalling to 22 GW by 2022. This has been fuelled by regulatory frameworks and policies, including the National Solar Mission under the National Action Plan on Climate Change, which aims for 15% renewable energy by 2020. The MNRE has not only taken up a target of 10.5 GW of additional wind power generation capacity by 2012 (although 6 GW may be available for commercial use), but also revised the wind potential of India from resource 49 GW assessed at 50 m hub to 102 GW assessed at 80 m hub. Having a dominant and widespread agricultural economy, the potential for biogas is immense, especially in the rural areas which have abundant biomass and may opt for off-grid biogas electricity generation. This already has proven its potential to increase the energy access and the energy security in the country, with 4.4 million small scale biogas plants already established with further potential in urban residential and agro-based industrial sectors. As per the MNRE, the potential of Waste to Energy is about 1.7 GW from urban waste (1.5 from Municipality Solid Wastes and 0.225 GW from sewage) and about 1.3 GW from industrial waste, while IREDA claims that only 2 % of the total potential has been harnessed.

The Government of India has since continued to develop policy frameworks both at the federal and the state level to encourage the development

[1] Muneer, T.; Asif, M.; Munawwar, S. (2005)."Sustainable production of solar electricity with particular reference to the Indian economy". Renewable and Sustainable Energy Reviews9 (5): 444. doi:10.1016/j.rser.2004.03.004

[2] "Status of Solar Energy in INDIA – 2010". Retrieved 2011-03-01

of an energy market which is conducive to the growth of renewables. The government's policies provide different incentives to promote renewables, including Feed-In-Tariffs, capital subsidies and tax benefits. In addition, demand side mechanisms, such as Renewable Purchase Obligations (RPOs) and Renewable Energy Certificates (RECs) as well as provisions for grid connectivity and forecasting, have been instrumental in pushing forward the renewables sector.

Currently, some of the main challenges facing the renewables sector include the uncertainty in state government policies, delays in implementation of government programs and the slowing down of the Indian economy due to the global economic downturn. However, the fundamental parameters in favour of renewables – India's hunger for energy, the good availability of renewable resources and the falling cost of renewables – make India a very attractive market for renewable energy generation.

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GLOSSARY

AD	Accelerated Depreciation
AHEC	Alternate Hydro Energy Centre
BOOT	Build, Operate, Own and Transfer
BPGP	Biogas Power Generation Program
CHP	Combined Heat and Power
CSP	Concentrated Solar Power
DISCOM	Distribution Company
ERC	Energy Research Centre
FiT	Feed-in-Tariffs
GBI	Generation Based Incentive
IEX	Indian Energy Exchange
IGEN	Indo German Energy Program
JPNATC	Jai Prakash Narayan Apex Trauma Center
LBNL	Lawrence Berkley National Laboratory
NAPCC	National Action Plan for Climate Change
NBMMP	National Biogas and Manure Management
NGO	Non-Government Organisation
NSM	Jawaharlal Nehru National Solar Mission
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PSS	Payment Security Scheme
PV	Photovoltaic
PXIL	Power Exchange India Limited
RE	Renewable Energy
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligations
RVE	Remote Village Electrification Policy
SERC	State Electricity Regulatory Commission
SPO	Solar Purchase Obligation
VGF	Viability Gap Funding

INSTITUTIONS IN THE RENEWABLE ENERGY SECTOR

C-WET	Centre for Wind Energy Technology
CEA	Central Electricity Authority
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IREDA	The Indian Renewable Energy Development Agency
IEA	International Energy Agency
MNRE	Ministry of New and Renewable Energy
MOP	Ministry of Power
NOWA	National offshore Wind Energy Authority
NVVN	NTPC VidyutVyapar Nigam
SECI	Solar Energy Corporation of India

OVERVIEW

1.1 Status of renewable sources of power in India

India, with 1.2 billion inhabitants, is the second most populous country in the world. She also has a fast developing economy,with an average GDP Growth of 6.5% during 2011-12 and around 5.4% in the first half of 2013[3]. As a result of India's rapid economic growth, energy demand is also rising rapidly. However, India's energy supply is lagging behind the economic growth, creating a structural energy deficit. For power alone (around 2/3 of India's energy requirements - is in the form of electricity), the supply shortfall between April 2012 and March 2013 (FY 2012-13) was 8.7%, according to the Central Electricity Authority (CEA). The CEA projects the supply shortfall for 2013 (FY 2013-14) to be around 6.7% of the energy demand.The total demand for power is anticipated to be 1,048 billion kWh, while the supply would be 978 billion kWh, which would leave a deficit of 70 billion kWh[4]. At the same time, the costs of conventional sources of electricity are rising rapidly, with the value of oil imports being 3.5%[5] higher and the value of coal imports being 13.5%[6] higher in April 2013 than the value in the corresponding period last year.

It addition to the costs and the supply challenges of the power generation sector, there are significant challenges associated with the reach, the capacity, the maintenance and the governance of the Indian power grid infrastructure. This resulted in a massive grid failure affecting around half of country in July 2012[7].

Renewables are increasingly playing an important role in improving India's power supply. They are additional sources of power that can help reduce the country's power deficit andcan be deployed de-centrally, improving India's energy security. Renewables are also increasingly becoming cost effective when compared to conventional power generation. The proliferation of renewables would reduce greenhouse gas emissions of the country and this sector could lead to the formation of a new industry, providing employment opportunities to several Indians.

India has a huge renewable energy potential. The Ministry of New and Renewable Energy (MNRE) of the Government of India has estimated the potential to be over 245 GW[8]. Notably, India has a vast solar potential(theoretically, 0.42% of India's Thardesert could generate enough power to meet the demand of the entire country).The MNRE has not only taken up a target of 10.5 GW of additional wind power generation capacity by 2012 (although 6 GW may be available for commercial use) but also revised the wind potential of India from resource 49 GW assessed at 50 m hub to 102 GW assessed at 80 m hub. However, given that the potential for sources such as offshore wind, geothermal and tidal energy has not been fully assessed yet, the MNRE estimate is still conservative on them. Some unofficial estimates indicate that the potential of tidal, offshore wind and geothermal energy is as large as 8,000 MW[9], 1,000 MW[10] and10, 600 MW[11], respectively.

In order to incentivize the installation of renewables in India, the Indian government (through the MNRE at the federal level), as well as the individual state governments (through state renewable energy development authorities), have launched various policy and fiscal measures, which have significantly boosted the growth of renewable energy in the country. The current installed capacity of renewable sources of energy (wind, solar, biomass and small hydro) in the country is around 29 GW, while the

[3] Source: Ministry of Finance; Report "Mid-Year economic analysis 2012-2013" accessed athttp://bit.ly/16cPyrl on June 12,2013
[4] Source: CEA ; Report "Power Scenario at a Glance", November 2012 accessed at http://bit.ly/1bvkaVm on June 12, 2013
[5] Source:Article by Commodity Online accessed at http://bit.ly/13ZKF2S on June 12, 2013
[6] Source: Article by Business Standard accessed athttp://bit.ly/1fBN0K9on October 16,2013
[7] Source: Article by The Hindu accessed at http://bit.ly/13BCitZ on June 12, 2013

[8] Source: Press Information Bureau release on May, 2013; "Contribution of Renewable Energy" accessed at http://bit.ly/13BOM4D on June 12, 2013
[9] Source: MNRE accessed athttp://bit.ly/1a3HH1Ron June 12,2013
[10] Source: Article published by 'Renewable Energy World' accessed athttp://bit.ly/15Wpe44on June 12, 2013
[11] Source: Article published by 'Indiapowersector.com' accessed athttp://bit.ly/1941Of0on June 12, 2013

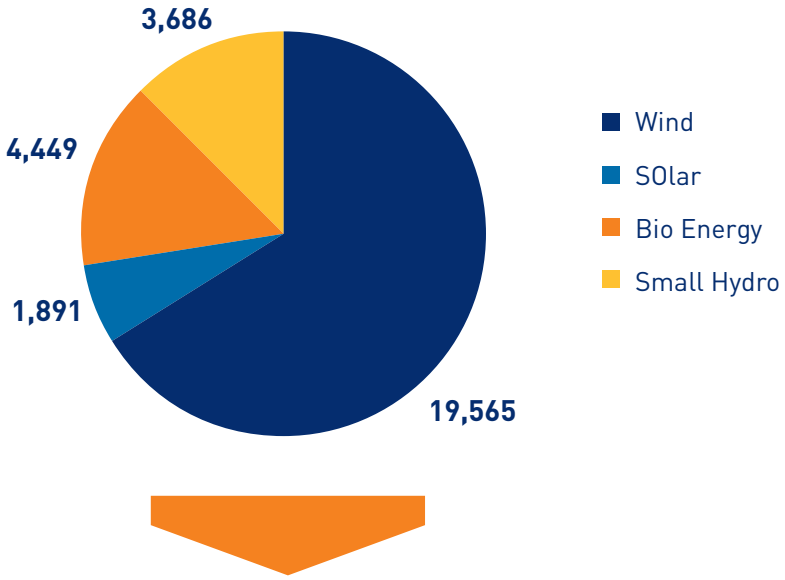
total potential of renewables in the country up to the year 2032 is projected to be 106 GW. The figures include both grid connected and off-grid projects. The source-wise breakup of the installed capacity and potential of renewables is given in the figures below.

India has adopted various types of renewable technologies in her energy mix. Wind has been the most dominant source, and will continue to havethe highest share as per the report 'World Energy Outlook' published by the International Energy Agency (IEA). Since 2010,

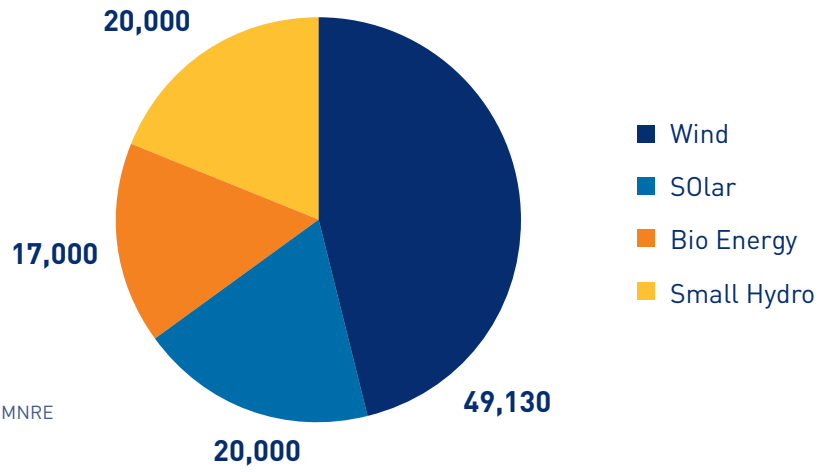
Solar PV has received a significant push from the government with the launch of a dedicated national solar policy, the "Jawaharlal Nehru National Solar Mission" (JNNSM)[12]. Bioenergy has also developed steadily with the help of government policies. Small hydro and concentrated solar power (CSP) has lagged behind, mainly due to issues such as long gestation periods in the case of small hydro and high installation costs in case of CSP. The following figure shows how different technologies have been adopted in India over a period of time.

Figure 1: Potential and current installed capacity of renewable sources of energy in India

Installed capacity of renewables in India (June 30, 2013 in MW)



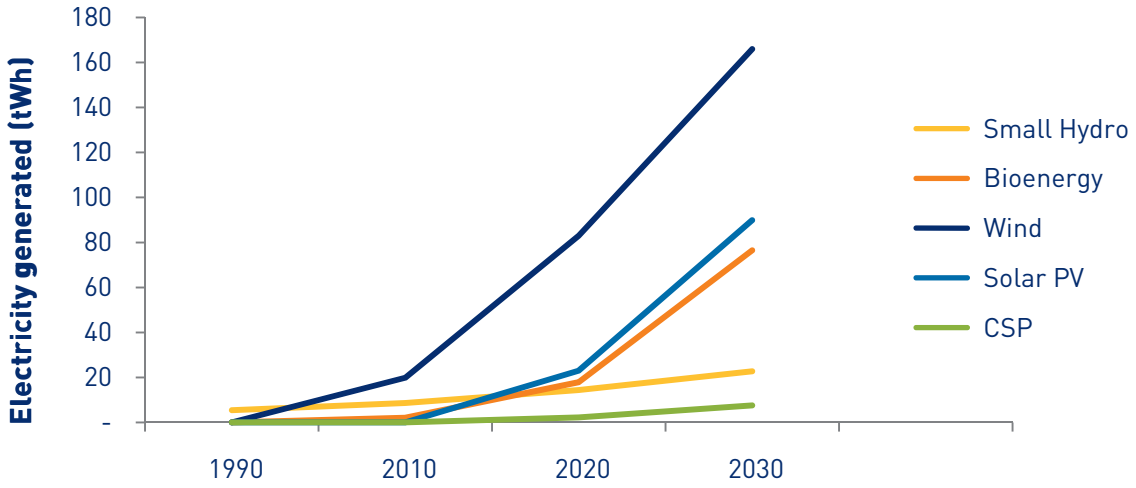
Potential of renewables in India upto 2032 (Jan 31st 2013 in MW)



Source: MNRE

[12] Details about the policy can be accessed at the Ministry of New and Renewable Energy website athttp://bit.ly/PjLscl

Figure 2 : Adoption of renewable technologies in India[13]



Source: IEA 2012 World Energy Outlook

1.2 Policy structure for renewable energy in India

The Government of India, through the MNRE, has introduced various incentives for adopting renewable energy sources. The MNRE considers wind, solar, biomass and small hydropower[14] to be renewable sources of energy. One of the key incentives offered to developers of renewable energy sources is the preferential or Feed-in-Tariffs (FiT). FiTs are special prices paid to the developer for generating power from renewable energy sources and can be fixed at the central or state government level. This tariff is higher than the price of electricity from conventional sources of electricity. Developers setting up power plants using renewable sources can avail of tax rebates and concessions[15] as well. One of the primary forms of tax concessions introduced is the Accelerated Depreciation (AD). AD allows power developers to decrease their tax burden. The Government of India allows developers of wind and solar plants to depreciate 80% of the asset value in the first year of commissioning a plant. The MNRE has also provided concessions on taxes paid on the import of raw materials and equipment required to establish renewable power generation units. For example, wind turbine manufacturers have to pay a concessional custom duty on import of certain critical components of the wind turbines. For renewable energy sources, such as wind, solar and biomass, several states have established their own incentives as well. At the federal level, all power producers are also allowed a corporate tax discount for a period of ten consecutive years out of first fifteen years of operation. This is termed as a ten-year tax holiday.

1.3 Renewable Purchase Obligations

The government of India, through its commitments in the National Action Plan for Climate Change (NAPCC), has introduced Renewable Purchase Obligations (RPO). The RPO mechanism is a demand side measure which requires some designated "obligated entities" to include a specified share of renewable power in their overall power mix. Power Distribution Companies (DISCOMs), both private and public as well as the open access consumers and the captive consumers, are obligated entities.

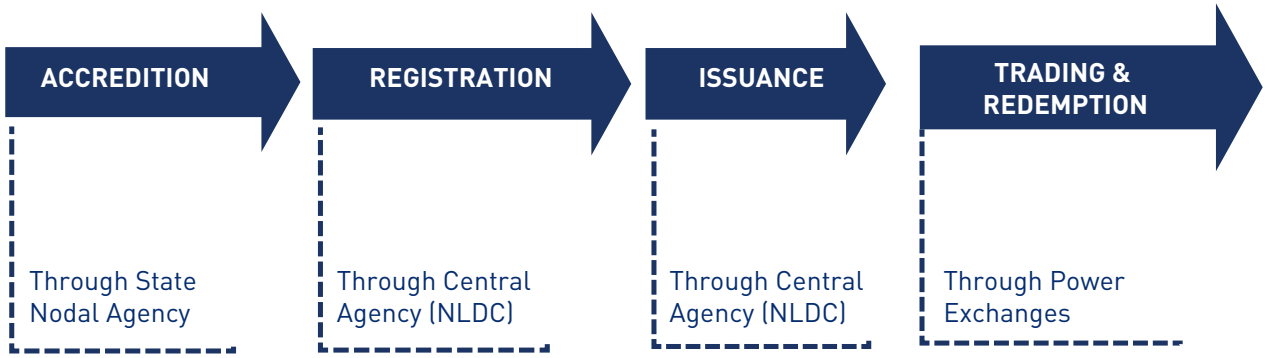
Obligated entities can meet their RPOs by two methods: They can set up their own renewable energy (RE) power plant or, in the case of DISCOMs, they can buy the power directly from a RE plant by

[13] As the figure for small hydro was not available, it has been roughly assumed to be around 7.5% of that of "Total Hydro"; Figures for 2020 and 2030 are projections made by the IEA.
[14] Hydro power installations of capacity less than 25 MW each.
[15] Information about processes of project development accessed from Solarguidelines.in at http://bit.ly/1dLtojr on June 12,2013

signing a Power Purchase Agreement (PPA) with the developer of the plant. Alternatively they can buy Renewable Energy Certificates (REC) from RE generators. A REC is issued to a developer who generates 1MWh of renewable power from a plant that has been registered with the central or state power load dispatch centre. An REC can then be purchased by an obligated entity on the Indian Energy Exchange (IEX) or the Power Exchange India Limited (PXIL) for a bid amount within the predefined floor (lower limit) and the forbearance (upper limit) price limit. RECs are of two types: Solar RECs and Non-Solar RECs. For Solar RECs, the current floor price is INR 9,300 (EUR 143) per MWh and the forbearance price is INR 13,400 (EUR 206) per MWh. For Non-solar RECs the current floor price is INR 1,500 (EUR 23) per MWh and the forbearance price is INR 3,300 (EUR 51) per MWh[16]. The framework for the REC mechanism is given in the figure below.

As per the NAPCC, India aims to source 15% of her power from renewable sources by 2020 through RPO obligations. The RPO has a solar carve out of 3%, which implies that 3% of the power has to be sourced from solar in particular. Like solar, the RPO does not have a carve - out for wind, bio energy or small hydropower at a central level as of now.

Figure 3: REC mechanism framework



Source: Renewable Energy Certificate Registry

[16] Source: CERC; "Monthly Report of Short Term Transactions of Energy in India", March 2013 accessed at http://bit.ly/17GKvm9 on June 12, 2013

WIND POWER

2.1 Installed capacity

India, with a total of 19,565 MW as of June 30, 2013[17], has the fifth largest installed capacity of wind power in the world. She is just behind China, USA, Germany and Spain. For comparison, as of June 2013, Germany had an installed capacity of (32,422 MW) for wind power[18]. The targeted capacity addition in India for the period between April 2012 and March 2013 was 2,500 MW. The total capacity added during FY2012-2013 was around 1,700 MW[19].

was an early mover in the industry with installations dating back to the late 1990's. Many of these are now at the end of their commissioning period and are now being repowered as well. Andhra Pradesh, which had an installed capacity of just 435 MW by the end of 2012, was the state with the highest growth in installations of around 18% in the first half of 2013. This may be attributed to the high Feed-in-Tariff (FIT) of INR 4.7 (EUR 0.07) per KWh and the wind carve-out in its RPO of 5% in the state.

Table 1: State wise installed capacity and growth rate of wind in India

WIND: State wise installed capacity (up to June 30th 2013)			
State	**Installed capacity as of December 31st 2012 (MW)**	**Installed capacity as of June 30th 2013 (MW)**	**Growth (%)**
Tamil Nadu	7,153	7,196	1%
Gujarat	3,093	3,250	5%
Maharashtra	2,976	3,294	10%
Karnataka	2,113	2,170	3%
Rajasthan	2,355	2,717	15%
Madhya Pradesh	386	386	0%
Andhra Pradesh	435	514	18%
Kerala	35	35.1	0%
Others	4	4.3	8%
Total	**18,550**	**19,565**	**5%**

Source: MNRE

Table 1[20] gives the state-wise, cumulative capacity installations at the end of 2012 till June 2013 as well as the semi-annual growth rate. Tamil Nadu is the southern Indian state with the highest installed capacity (7,196 MW) until June 2013, and had 8% capacity addition between 2011 and 2012. The growth can be attributed to the fact that the state

2.2 Policy framework

States such as Andhra Pradesh, Maharashtra, Rajasthan, Madhya Pradesh, Kerala and Gujarat have updated their policies for wind as of March 2013. The new wind specific RPO requirements specified by the State Electricity Regulatory Boards (SERC) of various states demonstrate this. Gujarat, Rajasthan and Karnataka have an RPO requirement of 7-9% just from wind power by 2015. Tamil Nadu,

[17] Source:MNRE accessed at http://bit.ly/14woYJX on June 12, 2013
[18] Source: BWE German Wind Energy Association accessed at http://bit.ly/13BDQ8P on June 12, 2013
[19] Source: http://bit.ly/15WqKDm
[20] Source: Ministry of New and Renewable Energy; Annual Report 2012-2013 accessed at http://bit.ly/18wOgvG on July 15, 2013

Gujarat and Andhra Pradesh have also issued modified tariff during the year. Most states in the country allow the "open access" mechanism[21]. Open access allows consumers to buy power from any generator in the country. In selling this power, in addition to the generation cost, the developer has to take into account various charges for using the established transmission and distribution grid. Open access charges include wheeling charges, transmission charges, point-of-connection charges, state load dispatch (SLDC) charges and regional load dispatch charges (RLDC) charges.

The wheeling charges[22] have been reduced for wind. In Haryana and Punjab, for instance, charges are 2% of power transmitted. The buy-back tariff (FIT) is as high as INR 5.96 (EUR 0.08)/KWh in Punjab and as low as INR 3.51 (EUR 0.05)/KWh in Tamil Nadu. Table 2[23] gives the policies specified by every state as of December 31, 2012.

Table 2 Part A: State specific policies for wind (December 31, 2012)[24]

State	Wheeling and transmission charges	RPO			
		12-13	13-14	14-15	15-16
Andhra Pradesh	As per regulations and terms and conditions approved by the Commission	5%			
Haryana	2% of energy transmitted	2.75%	4%	N/A	N/A
Karnataka	5% of energy transmitted	7-10%			
West Bengal	1/3 of the wheeling charges calculated as per tariff order under tariff regulations or cost of 7.5% of the energy fed into the grid irrespective of wheeling, whichever is higher. Transmission charges will be 2/3 of the rate of such charges applicable for open access customers for long term and short term open access	Captive and open access consumers: 5%			
Madhya Pradesh	2% of energy transmitted + transmission charges as per the Commission	4%	N/A	N/A	N/A
Maharashtra	As per open access regulations	4%	5.50%	7%	N/A
Rajhastan	Transmission charges applicable to RES power stations to be half of the transmission charges, specified by the Commission for open access consumers	8%	9%	9%	9%
Tamil Nadu	5% energy in case of consumption of HV/EHV (high voltage/extra high voltage) and 7.5% in case of LV (Low voltage)	N/A	N/A	N/A	N/A
Gujarat	For 66kV and above: Transmission charges and 4.4% for transmission losses For below 66kV:Transmission charge and 10% transmission losses and wheeling charges	9%			
Kerala	5% of energy transmitted	17%	N/A	N/A	N/A
Punjab	2% of energy transmitted	3% from 2010 with an annual increase of 10% of 3% per year up to a maximum of RPO of 10%			
Odisha	On actual basis	2.37%	3.37%	3.81%	N/A

Source: MNRE

[21] Definition of "Open Access" in the Electricity Act, 2003: The non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission.

[22] Wheeling charges are the charges for using the grid for transporting electric power over the transmission lines

[23] Source: Ministry of New and Renewable Energy; Annual Report 2012-2013 accessed at http://bit.ly/18wOgvG on June 12, 2013

[24] Banking and Open access is allowed by all of these states

Table 2 Part B: State specific policies for wind (December 31, 2012) [25]

State	Buy back			
Andhra Pradesh	INR 4.70 (EUR 0.072)/unit			
Haryana	N/A			
Karnataka	INR 3.70 (EUR 0.05)/unit fixed for 10 years			
West Bengal	To be decided on a case to case basis with a cap of INR 4.87 (EUR0 0.74)/unit fixed for 10 years	Captive and open access consumers: 5%		
Madhya Pradesh	INR 5.92 (EUR 0.09)/unit for 25 years		N/A	N/A
Maharashtra	Particular	Wind zone 1	Wind Zone 2	Wind Zone 3
	Net levelized tariff for 2013-2014	INR 5.81	INR 5.05	INR 4.31
	Net levelized tariff adjusted after additional depreciation (if availed)	INR 5.46	INR 4.74	INR 4.05
Rajasthan	INR 5.18(EUR 0.08) and INR 4.89 (EUR 0.07) (higher AD)/unit for Jaisalmer, Barmar and Jodhpur and INR 5.44 (EUR 0.08) and INR 5.13(EUR 0.07) (higher AD)/unit for other districts	9%		
Tamil Nadu	INR 3.51 (EUR 0.05)/unit levelized for windmills commissioned after 31.07.2012	17%	N/A	N/A
Gujarat	INR 4.15 (EUR 0.06)/unit			
Kerala	INR 4.47 (EUR 0.05)/unit for 13 years with effect from 01.01.2013	2.37%	3.37%	3.81%
Punjab	INR 5.96(EUR 0.09)/unit			
Odisha	INR5.31 (EUR 0.08)/unit			

Source: MNRE

The Government of India initiated the "Wind Power Program" in 1984. It was designed to drive the commercialization of wind power in the country, support demonstration of wind power projects and promote research and development in this field. It aims to support the implementation of projects and to create awareness among the general public. The MNRE undertakes reforms regarding its incentives and schemes for wind power in the country under this program.

Currently the MNRE provides several incentives to the wind industry in India. The Indian Renewable Energy Development Agency (IREDA), under the MNRE, provides loans to wind project developers. In addition, developers have the benefit of a ten-year tax holiday for income generated from wind power projects[26]. This is the discount on corporate tax available to all power producers. Wind turbine manufacturers in India are also exempted from paying a excise duty on their production. Developers importing wind electric generators can also avail of import duty concessions.

The main driver for the wind market in the past, however, has been Accelerated Depreciation (AD). This allowed a depreciation of 80% of the cost of the installation in the first year, thus reducing the taxable income for the owner of the plant by an amount equivalent to 80% of the plant's cost. Of all the installations in wind, after the introduction of the AD scheme, 70% of the developers availed of it.

[25] Banking and Open access is allowed by all of these states

[26] More details on incentives for wind power generation can be accessed athttp://bit.ly/1gJvN0von June 12, 2013

As an alternative to the AD scheme, there was also a Generation Based Incentive (GBI) given to the project developers. The GBI scheme only applied to Independent Power Producers (IPP) and captive consumers while excluding all third party sale of power. This gave the project developer an incentive of INR 0.50 (EUR 0.01) per KWh of electricity fed into the grid. The incentive could be availed for a minimum of four years and a maximum of ten years, with an overall cap of INR 6.2m (EUR 95,384) per MW. The total disbursement of the incentive in a year, during the first four years could not exceed INR 1.5m (EUR 23,076) per MW. The scheme was limited to a capacity of 4,000 MW, which was to be registered with IREDA, until March 31, 2012. The GBI and AD schemes were operated in parallel in a mutually exclusive manner. The GBI scheme was discontinued on March 31, 2012, after 1,500MW had been registered under it, while the AD scheme was discontinued from April 2012.

2.3 New policy developments

Earlier this year, the finance minister, while presenting the union budget of 2013-2014, allotted INR 8 billion (EUR 123million) to the MNRE to support the GBI incentive for wind[27]. Finally, in August 2013 the Union Cabinet approved the reintroduction of the GBI. A GBI of INR 0.50 (EUR 0.01)/KWh can be availed by wind power producers for a minimum of four years and a maximum of ten years, with an overall cap of INR 10m (EUR 153,846) per MW. The benefit of this incentive is applicable retrospectively for all projects launched after April 1, 2012. The total disbursement of the incentive in a year, during the first four years cannot exceed INR 2.5 million (EUR 23,076) per MW. The scheme has been designed to continue for a target of 15,000 MW during the period from 2012 to 2017. The projects have to be registered with IREDA, under this scheme.

India has so far tapped into its onshore wind potential only. It has not yet explored its offshore wind potential. The offshore wind speed is considerably higher than that the onshore wind speed and, as a result, the Capacity Utilization Factor (CUF) of offshore wind turbines is comparably higher. The MNRE established the Offshore Wind Steering Committee in August 2012 under the chairmanship of Mr. G.B. Pradhan, the then Secretary of the MNRE. The committee members consist of the various stakeholders in the wind industry in India, including ministry members, organizations and developers. The committee released a draft of the National Offshore Wind Energy Policy in May 2013. A national consultation on draft offshore policy was held in August 2013. The draft calls for the appointment of a National Offshore Wind Energy Authority (NOWA). NOWA, supported by the MNRE, will act as the nodal agency to enter into contracts with the project developers and to coordinate with other agencies for clearances. The MNRE would act as a nodal ministry and overlook the overall development of offshore wind energy in India. According to the draft, a tax holiday for the first ten years of offshore wind power generation may be available to the power producer. Concession in customs duty and exemption in excise duty may be available to the manufacturers of the offshore wind turbines. Further, exemption of service taxes for services such as conducting of Renewable Energy Resource Assessment / Environmental Impact Assessment / Oceanographic Study by third parties, utilization of survey vessels and installation vessels may be provided for. The government may also call for proposals for the development of offshore wind energy projects in specific areas. Such projects may be exempted from paying the fee for leasing the seabed area blocks and after a specified period, the ownership of the projects will be transferred to the government[28].

2.4 Challenges and opportunities

Approximately 1,380 MW of wind power in India was installed before 2002. Since these wind farms are now reaching the end of their commissioning period, they will require repowering in order to remain productive. At the same time, repowering offers a great opportunity to increase the generation (installed capacity, CUF) from the best sites. Repowering has constrains of land ownership and the signing of new PPAs by utilities. Spanish wind turbine manufacturer Gamesa has already repowered two wind farms in the state of Tamil Nadu. The improvement in productivity is given in Table 3.

[27] Source: Article by The Economic Times accessed at http://bit.ly/19pOwfs on June 12, 2013

[28] Source: Draft of "The National Offshore Wind Energy Policy" May 2013, accessed at http://bit.ly/11vlu5e on June 12, 2013

Table 3: Comparison: old and repowered wind farm in Coimbatore, Tamil Nadu

Parameter	Before repowering	After repowering
Installed Capacity	8 MW	8.5 MW
Annual generation	10.4 GWh	22 GWh
Plant load factor (PLF)	14.70%	29.50%

Source: The Hindu Business Line

Currently wind power accounts for 8.7% of the installed power capacity in India, but it only contributes 1.6% to the power generated[29]. While it naturally has a lower plant load factor (PLF) than fossil fuel, nuclear or hydropower plants, the Indian PLF for wind has been particularly low by international standards because of its modest wind regimes. In northern European countries, the PLF for on shore wind power is generally 25% to 30%. Repowering old wind farms can increase the PLF from 15% to as much as 30%, thereby making wind a much more important power source. However, many wind power companies whose plants are approaching the end of their commissioning period are unwilling to repower their plants in the absence of government subsidies and long-term policy frameworks. By providing this visibility and support, the MNRE could incentivize the repowering of old wind farms.

The installed capacity for wind is currently much higher than the amount of energy produced from the installations that is being transmitted through the national grid. This is due to limitations of the grid infrastructure in the country. For the power generated from the total installed capacity of wind in the country to be optimally evacuated or transmitted, the grid has to be stable and accessible so that it is available for the steady transmission of power at all times. Further, the augmentation of grid is also needed to accommodate new and additional capacities. In order to address this issue, the MNRE has released a report on "Green Energy Corridors". This report identifies the infrastructure required for the efficient evacuation and transmission of renewable energy, including wind[30]. The MNRE has also sought Germany's cooperation to bring advanced grid integration technology to India. A Joint Declaration of Intent for soft credit of INR 71 billion (EUR 1 billion) and technical cooperation for the development of Green Energy Corridors was signed between the two countries during the visit of the Indian Prime Minister, Dr. Manmohan Singh, to Germany on April 11, 2013[31].

The potential for wind might be significantly higher than previously estimated. In its India Wind Atlas[32], after analysing data from 1948 to 2010, the Indian Centre for Wind Energy Technology (C-WET) has estimated that the wind potential at 50 m hub height is 49 GW and at 80 m hub height is 103 GW. A recent study by the Lawrence Berkley National Laboratory (LBNL)[33] has reassessed this potential and reached the conclusion that the wind potential in India at 80m hub height, with a minimum capacity utilization factor (CUF) of 25%, is actually as high as 543 GW. This potential was arrived by considering only high quality wind sites in Tamil Nadu, Maharashtra, Andhra Pradesh, Karnataka and Gujarat. It, however, does not include the potential of offshore wind in India. With its vast coastline, the country would be an ideal candidate for offshore wind installations. The 400 GW difference in estimate can be attributed primarily to the fact that C-WET estimates the land availability to be 2% all over India, excluding the Himalayan states, north-eastern states and Andaman and Nicobar Islands. The LBNL study on the other hand considers GIS data while considering terrain, wind speed and land availability in every state in India before reaching its estimate. The study, however, did not account for the appetite for investment in different parts of the country.

[29] Source: CEA report accessed athttp://bit.ly/194da2Fandhttp://bit.ly/14wvYGy
[30] Source: Press Information Bureau release on August 14, 2012; "Connection of wind power to grids" accessed at http://bit.ly/13BOM4D on June 12, 2013.
[31] Source: Press Information Bureau release on April 16, 2013; "India seeks Germany's cooperation to bring grid integration technology to India" accessed at http://bit.ly/13BZyI9 andhttp://bit.ly/172lC5hon June 12, 2013
[32] Source: Center for Wind Energy Technology and Riso DTU National Laboratory for Technology, 2010. Indian Wind Atlas accessed at http://bit.ly/1a3T6ic on June 12, 2013
[33] Source: Lawrence Berkley National Laboratory; Report "Reassessing Wind Potential Estimates for India: Economic and Policy Implications" March 2012, accessed at http://1.usa.gov/1a3TUUf on June 12, 2013

SOLAR POWER

3.1 Installed capacity

Grid connected solar power, until the end of 2010, when the installed capacity was still less than 50 MW, had played a relatively insignificant role as compared to other renewable sources of energy in India, such as wind. Since then, however, the solar power industry has grown rapidly. Installed capacity for solar power reached 1.2 GW by the end of 2012[34] and more than 1.9 GW by the end of July 2013[35]. Grid connected photovoltaic (PV) contributed around 1,850 MW to this capacity and off grid photovoltaic amounted to 130 MW. Germany, by comparison, had an installed capacity of 34,558 MW by July 2013[36].

Gujarat was the first to release a state specific solar policy back in 2009. In 2010, the MNRE launched the Jawaharlal Nehru National Solar Mission (NSM) with an aim to add 20GW of solar installations in India by 2022. Following the launch of the NSM, several states such as Karnataka, Gujarat, Rajasthan, Madhya Pradesh and Uttar Pradesh published state specific solar policies, driven by RPOs. The growth in installations since 2010 can primarily be attributed to allocations under the NSM, Gujarat Solar Policy, Karnataka Solar Policy and direct allocations by states such as Madhya Pradesh and Maharashtra. Details about the states policies are given in the section 'New Policy Developments'.

As of June 30, 2013, India had 131.86 MW of off-grid solar systems (PV) with a capacity of more than 1 kW each[37]. The MNRE formulated the Remote Village Electrification Policy (RVE). In this scheme, the government entities received a 90% capital subsidy and the non-government organizations (NGO), individuals and private companies received a 30% capital subsidy to set-up off-grid solar PV systems. As of April 2012, the RVE policy has been discontinued since it had reached the end of its pre decided term. The MNRE has indicated that a new policy centred on off-grid installations will be released during phase two of the NSM.As part of the first phase of the NSM, central government also provided support in the form of the 30% subsidy through the MNRE on the PV system cost or a low cost loan at 5% interest, repayable within five years. This support was also applicable only up to March 31st 2013 as part of the first phase, and there is no clarity yet on whether it will continue in the second phase.

The state wise segregation of grid-connected solar power plants in India up till July 31st 2013 is given in the table 4.

Table 4: State wise segregation of commissioned grid connected solar power projects (July 31st2013)[38]

States	Commissioned	
	CSP (MW)	PV (MW)
Andhra Pradesh		63
Chhattisgarh		4
Gujarat		851
Haryana	3	8
Jharkhand		32
Karnataka		24
Madhya Pradesh		45
Maharashtra		172
Odisha		13
Punjab		12
Rajasthan	53	567
Tamil Nadu		21
Uttar Pradesh		17
Uttarakhand		5
West Bengal		2
Andaman & Nicobar		5
Delhi		3
Lakshadweep		1
Total	**1,900**	

Source: MNRE

[34] Source: IEA; "PVPS Report, A Snapshot of Global PV 1992-2012"
[35] Source: MNRE; MNRE Achievements accessed at http://bit.ly/14woYJX in July, 2013
[36] Source: FraunhoferInstitue of Solar Energy Systems accessed at http://bit.ly/ZBPMSR in July, 2013
[37] Source: MNRE
[38] Source: BRIDGE TO INDIA; PROJECT DATABASE

3.2 Policy Framework

The NSM is playing a central role in moving towards 3% of solar in the power mix in India by 2022. The NSM is spread over three phases. Phase One, executed in two batches, aimed to allocate 500 MW of PV and CSP projects each. The allocations for Phase One Batch Two were completed in December 2011. Out of the total projects allocated under Phase One of the NSM, 476 MW of projects have been commissioned. The target of Phase One has however been achieved with projects completed under the state-driven policies. Phase Two, scheduled to start in the latter half of 2013 and conclude by 2017, has a target of 9 GW. Phase Three is scheduled to begin in the second half of 2017 and conclude by 2022, and has a target of 10 GW, which the highest amongst all the phases. The phases were designed such that the government can take advantage of the falling prices for solar power. The majority of the projects are to be allocated in the last phase when the cost of solar are expected to be near grid parity. The government expects that part of the NSM's target will be fulfilled by supporting projects through direct incentives (either by FiTs or by Viability Gap Funding). The other part is to be achieved through RPO requirements across the states.

The most successful state level policy so far has been the Gujarat Solar Policy of 2009. Under this policy, 850 MW of solar PV has been installed in the state, representing 57% of the total installations in India. Gujarat offers a fixed FiT as opposed to the NSM, which allocated projects on a reverse bidding basis for Phase One. As per the method of reverse bidding, the developer quoting the lowest FiT for 25 years was awarded the project.

3.3 New policy developments

The first draft of guidelines for Phase Two of the NSM was published in the December 2012. The allocations for the first batch of Phase Two are expected to take place in the second half of 2013. The second phase aims to add 9,000 MW, of which 3,000 MW would be added through reverse bidding. Phase Two of the NSM shall be spaced out over the duration of the 12th Five Year Plan (2012-2017). According to the draft guidelines for Phase Two of the NSM, the MNRE had planned to allocate 800 MW through a bundling of power mechanism (as in Phase One of the NSM), and 750 MW through a Viability Gap Funding (VGF) mechanism. As per the bundling of power mechanism, the nodal agency (NVVN in case of the Phase One) 'bundled' the solar power bought from solar power plants with power from conventional sources, which had not been allocated to states by the Ministry of Power (MoP), in the ratio of 1:4. The bundled power was then sold at a unitary rate. The objective of this mechanism was to bring down the difference between the average cost and the sale price of solar power.

However, as there is only a limited amount of unallocated power available and all the states in India demand access to it, the Ministry of Power (MoP) has been unwilling to provide any more unallocated power for the NSM. Consequently, the MNRE has now decided to go ahead only with the allocations for 750 MW based on VGF.

Under this mechanism, a standard tariff will be provided by the power distribution companies. This would typically be higher than their standard price of procurement as this would allow them to also meet their RPOs. The developers would be required to bid for the upfront funding required to make their projects viable at the given tariff. The minimum project capacity for single bid is to be 10 MW and the maximum capacity is to be 50 MW. Projects are to be allocated in multiples of 10 MW. According to the draft, a fixed tariff INR 5.45 (EUR 0.08) per kWh will be awarded to projects not availing accelerated depreciation, while a fixed tariff of INR 4.95(EUR 0.07) per kWh will be awarded to projects availing accelerated depreciation. Over and above this, the VGF will be provided with an upper limit of 30% of the project cost or INR 25 million per MW. The exact quantum of VGF will be determined by a reverse bidding mechanism.

Phase One of the NSM had the NTPC VidyutVyapar Nigam (NVVN) as the nodal agency. The Indian Renewable Energy Development Agency (IREDA) was the entity chosen to provide capital subsidies for solar projects in Phase One of the NSM. The MNRE has now set up the Solar Energy Corporation of India (SECI) as the nodal agency for Phase Two of the NSM. The SECI shall be taking over the roles of the NVVN and IREDA under the NSM, and shall also invest directly into solar projects.

The nodal agency for Phase One of the NSM, the NVVN, was under the administration of the Ministry of Power. The SECI will be directly operated under the MNRE. The SECI also has a larger fund dedicated to solar power projects as compared to the NVVN. NVVN had a fund of INR 4,850m (EUR 74.78m) for its Payment Security Scheme (PSS). The SECI is starting with an initial fund of INR 20 billion (EUR 307m)[39]. Thus the SECI shall have a larger fund to back its PSS. This aims to remove a key concern of both Indian and international developers regarding payment security.

The Karnataka Solar Policy aims to allocate 350MW of solar by 2016 through competitive bidding. The Karnataka Electricity Regulatory Commission has already allocated 60 MW of solar PV projects under the policy. The lowest successful bid was for INR 7.94 (EUR 0.12) per kWh. The state has also waived all wheeling charges for solar projects[40]. The state recently opened bids for another 130 MW where the lowest successful bid was INR 5.51 (EUR 0.084) per kWh.

The states of Odisha and Madhya Pradesh have so far allocated 25 MW and 225 MW of solar power projects respectively. Madhya Pradesh has announced a capacity addition of 800 MW over the next four years under the Madhya Pradesh Solar Policy and is planning to set up four solar parks of 200 MW each. A capacity of 225 MW had been allocated in Madhya Pradesh in the second quarter of 2012. As per the deadlines, five projects with capacities up to 25 MW each had to be commissioned by June 2013 and a 105 MW project would be commissioned by June 2014. However, as of September 2013, only the 105 MW project has been commissioned ahead of schedule.

The state of Uttar Pradesh (U.P.) released its solar policy in early 2013. The Uttar Pradesh Solar Power Policy aims to allocate 500 MW of solar power in the state by 2017. The state announced the bidding process for 200 MW of solar PV capacity however it has finalized a capacity of 130 MW. The minimum capacity of a project was 5 MW and maximum was 50 MW with multiples of 5 MW. A key differentiator of this policy is that the PPA is only for 10 years. The policy has a clause that allows only developers with prior experience to bid for projects[41].

In November 2012, Rajasthan invited bids for 100 MW of solar projects under the reverse bidding process. The lowest bid was INR 6.45 (EUR 0.1) per kWh. The state expected all the developers to meet the lowest bid in order to get the allocation. However only seven companies were allocated projects totalling 75 MW at this tariff.

The Andhra Pradesh state solar policy was released in September 2012. Andhra Pradesh invited bids for 1,000 MW of projects. The lowest price offered was INR 6.49 (EUR 0.1) per kWh. The projects were to be allocated based on the lowest bids offered at each interconnection location i.e. electrical substation. However, in a sudden change in policy after the allocation process, the state decided to only offer the lowest tariff across the entire state. After the change in the allocation process only 34 developers, who plan to install 350 MW in the state accepted this low tariff. Further, with the state's probable division, a capacity of less than 150 MW has been finalized up till now.

The Tamil Nadu Solar Policy was announced in October 2012. The policy has a target of 3 GW of solar power installation in the state by 2015. The policy aims to achieve this capacity addition by 350MW of rooftop installations, 1,500 MW of utility-scale projects and 1,150 MW of projects under the REC mechanism. In case of 50 MW of rooftop installations, Tamil Nadu will provide a Generation Based Incentive (GBI) for rooftop solar power through net metering. The remaining 300 MW under the rooftop installations is expected to come from government buildings and other government schemes for rural and urban lighting. For a target of 1,500 MW of utility scale projects till 2015, the policy targets an installation of 1,000 MW from the fulfilment of Solar Purchase Obligations (SPO). The SPO obligates certain commercial and industrial power consumers to meet a percentage of their electricity requirement through solar. These entities[42] have been mandated to purchase 3% of their electricity requirement through solar till December 2013 and 6% of the same from 2014 onwards. The remaining 500 MW of utility scale projects are expected to come up using a GBI based on a reverse bidding process. The remaining 1,150MW of the policy target is expected to come up using the existing REC mechanism. For utility scale

[39] Source: BRIDGE TO INDIA; INDIA SOLAR COMPASS, July 2012
[40] Source: BRIDGE TO INDIA; INDIA SOLAR COMPASS, July 2012
[41] Source: Uttar Pradesh Solar Policy 2013 accessed at http://bit.ly/11J4xbJ on June 12, 2013

[42] SPO obligated entities include HT consumers, who receive power from the grid at a constantly maintained high voltage level, of more than 11kV, transmitted through high tension lines.

projects, Tamil Nadu announced bids for 1000 MW in December 2012 and received proposals for 690 MW in March 2013.

The southern Indian state of Kerala has published a draft solar policy on February 27, 2013. The policy targets installations of 500 MW by 2017 and of 1,500 MW by 2030. Kerala's new policy is unique in its large focus on distributed power generation. To facilitate these installations, the government has proposed a GBI/FIT instead of a capital subsidy. Other incentives include no open access charges, no wheeling and T&D (Transmission and Distribution) charges for captive consumers and the exemption of electricity duty.

Punjab released a renewable energy policy in December 2012 that covers solar, wind, biomass and small-hydropower. Punjab has set a target of 1,000 MW of solar power generation by 2022. As part of phase one of the policy, the state announced a bidding process for 300 MW solar PV capacity allocations. A total of 50 MW was to be allotted for newly incorporated or existing companies with no prior experience of setting up and operating solar projects. The minimum capacity of a project has been set at 1 MW and the maximum capacity at 4 MW. In addition, a total of 250 MW was to be allotted to experienced companies that have installed and commissioned at least one project with a capacity of 5MW or higher and which is in operation for at least one year before the last date of submission of an e-bid anywhere in the world. The minimum capacity of the project can be 5 MW and the maximum capacity allowed for a single developer is 30 MW.

The benchmark tariffs for the bidding process were fixed at INR 8.75 (EUR 0.13) per kWh for companies not availing accelerated depreciation and INR 7.87 (EUR 0.12) per kWh for companies availing accelerated depreciation.

The Chhattisgarh solar policy was released on November 20, 2012. It aims to achieve a targeted solar power generation capacity between 500 MW to 1,000 MW by March 2017. This will be achieved through three routes: grid connected projects for captive use, through the REC mechanism and by electricity sale to DISCOM to fulfil the RPO obligation. Power generation is envisaged to be incentivized using interest subsidy, fixed capital investment subsidy, exemption from electricity and stamp duty. Details on these incentives and the state's plan or methodology to provide such incentives have not been provided yet.

The solar specific REC mechanism was introduced by the MNRE in 2010. RECs are issued to a registered power plant, producing solar power and selling the power without a preferential FiT. REC trading takes place on the energy exchanges of India (IEX and PXIL) on the last Wednesday of every month, within a specific time window.

The first solar REC was issued on May 24, 2012 to M&B Switchgears[43]. The five solar RECs traded at the time were bought at INR 13,000 (EUR 200) per REC. One REC is equivalent to 1 MWh of grid-connected electricity produced from solar. Table 5 gives the number of solar RECs traded since March 2013, in both the IEX and PXIL. It also shows the price the solar RECs were traded at, in the IEX (representative of 95% of traded volumes in June and July).

Table 5: Solar RECs: traded volumes and prices (1 REC = 1 MWh)

Solar REC	May 2013	June 2013	July 2013
Volume Traded	3,183	1,479	2,029
Price (INR)	11,490	9,300	9,300
Price (EUR)	177	143	143
Floor Price (INR)	9,300	9,300	9,300
Floor Price (EUR)	143	143	143
Forbearance price (INR)	13,400	13,400	13,400
Forbearance price (EUR)	206	206	206

Source: India Energy Exchange and Power Exchange India Limited

[43] The company's name has been changed to 'Ujaas Energy'

3.4 Challenges and opportunities

The primary challenge for developers in the solar industry remains the financing of their projects. Initially, the banks were hesitant about investing into solar projects since they were wary about the payment security offered by the power distribution companies and other public PPA partners. Subsequently their hesitancy increased when several developers were penalized under the NSM from not following commissioning deadlines. Further, many projects in India, especially from the older batch of the NSM are not performing as expected. This is partially because they were one of the first power plants to be commissioned in the country and had limited experience. However, even in case of relatively newer projects, there is a lot of variation in performance. Since India is a highly price sensitive market and many developers opt for cheaper equipment, trading for quality in the long run. Hence, performance is still a concern for financing institutions that have invested in such projects. Project developers need to maintain the quality of projects to ensure performance. Availability of performance data for previously executed plants is going to be a key for developers to seek future investments into their projects.

There was also uncertainty about on-ground irradiation levels of individual sites, and hence the expected power generation and financial viability of solar projects. To address this problem, the MNRE and the C-WET in association with GIZ has set up 51 measuring stations across the country. This has been done as part of the SolMap[44] Project under the IGEN program of the GIZ. However, banks are still reluctant to lend on a non-recourse basis as they are awaiting the actual generation data of installed plants.

Another challenge is the degree of uncertainty in the enforcement of solar RPOs and the consequent pricing of RECs. The RPOs are regulated at a state level, and most states do not, as yet, have a policy framework in place to enforce their solar RPOs. In order to ensure that India achieves 3% of solar in her power mix by 2022, the states have to have a more stringent penalty structure in place. Any penalty, in order to be effective to drive RPO compliance, has to be higher than the forbearance price of solar RECs.

The REC mechanism was introduced in 2010, but only started trading in May 2012. This was partially due to the fact that states did not impose RPO obligations more stringently on the obligated entities. The other reason for the slow start of the solar REC mechanism is that the floor and the forbearance prices are fixed only till 2017, beyond which there is no visibility regarding the pricing of the solar REC. This makes it difficult for developers to obtain long term financing in order to set up solar power plants that intend to register, to receive RECs.

The NSM framework included a Domestic Content Requirement (DCR). The DCR specified that developers could use only domestically produced PV cells and modules that used the Crystalline Silicon (CSi) technology, for projects under the NSM. Only modules using thin-film technology could be imported from international sources. Of all equipment used in a CSP plant, 30% had to be domestically manufactured. These guidelines were formulated with the intention of strengthening the domestic manufacturing industry in India. So far, the domestic content requirement only had a limited effect, as developers opted for the cheaper thin film technology rather than the more expensive domestic CSi cells and modules. As a result, Indian module manufacturers were pushing for the DCR to include the thin film technology along with CSi cells and modules for Phase Two of the NSM. On the other hand, project developers and international lobbyists were vying for a market open to international competition. Another way of supporting the Indian manufacturing industries without harming international trade relations would be to offer capital and tax incentives for producing solar modules in India. International competition would ensure that the Indian manufacturers strive to manufacture modules of competitive international standards, while the incentive would ensure that the prices of Indian modules could compete with the low prices of the international modules. In a recent revision of guidelines, the MNRE has stated that it will retain the DCR for 375 MW of the 750MW that is to be allocated during the first batch of second phase of the NSM.

[44] Source: GIZ Solmap website accessed athttp://bit.ly/18YHgYjon June 12,2013

BIO ENERGY

4.1 Installed capacity

Bio energy can be categorized into biomass, bio fuels and biogas. In India, a total of 4,449 MW has been installed under bio energy, both in grid connected and off-grid capacities. Table 6[45] gives the details of the installations under the different categories of bio energy up to June 2013.

Table 6: Installations under bio energy (as on June 30, 2013)

Type	Grid connected	Capacity installed (MW)
Biomass Power	On-grid	1,265
Bagasse Cogeneration	On-grid	2,337
Waste to Power (urban)	On-grid	96
	Off-grid	116
Biomass (non-bagasse) cogeneration	Off-grid	475
Biomass gasifiers (rural)	Off-grid	17
Biomass gasifiers (industrial)	Off-grid	143
Total		**4,449**

Source: MNRE achievements

4.2 Policy framework

The MNRE has incentivized non-bagasse cogeneration in India since 2005. "Cogeneration" refers to the production of both heat and electricity and is also called "combined heat and power" (CHP). "Bagasse" is the residue of crushed sugar cane from sugar mills. "Non- bagasse" includes by-products from all other industries, such as pulp and textiles. This sector has seen installations of 88 MW in the year FY 2012-2013. The cumulative capacity as on June 30, 2013 was 475 MW. The MNRE offers financial incentives in the form of an 80% AD in the first year of commissioning a biomass plant and concessions on the customs for imported equipment. Biomass developers can also avail a ten-year tax holiday on the power sale while the manufacturers of equipment pay a reduced excise duty.

The MNRE has also introduced a GBI scheme for biomass at a federal level. It is also looking to increase the operating period[46] of a bagasse cogeneration project from 180-220 days to 300 days a year with an intention of increasing the time allowed to a developer to obtain financing and setting up the plant infrastructure[47].

In 2012, under the Biomass Cogeneration program, the MNRE initiated a scheme for providing the federal government financial assistance for boiler up-gradation for cogeneration projects in cooperative sugar mills. Sugar mills with a total capacity of 36 MW were provided financial assistance in Maharashtra. These plants are expected to be commissioned later in 2013[48]. Further, federal government financial assistance is also being provided to bagasse cogeneration projects taken up through the Build, Own, Operate and Transfer (BOOT) model in cooperative sector sugar mills. The MNRE has supported BOOT projects in Maharashtra and Tamil Nadu. Two such projects in Maharashtra, with a total capacity of 80 MW have received assistance from the Ministry. Out of this, one model cogeneration project was commissioned this year and is exporting 22 MW to the grid. BOOT projects in 12 cooperative public sector sugars mills in Tamil Nadu of aggregate capacity of 183 MW are under implementation. The Ministry plans to extend this effort in the cooperative/public sector sugar mills in the states of Karnataka, Andhra Pradesh, Gujarat and Uttar Pradesh during the next two to three years.

[45] Source:MNRE Achievements accessed at http://bit.ly/14woYJX on June 12, 2013

[46] Operating period is the span of time between the signing of the PPA and the commissioning of the plant

[47] Source: Ministry of New and Renewable Energy; Annual Report 2012-2013 accessed at http://bit.ly/18wOgvG on June 12, 2013

[48] Ibid

Another program under implementation is the Biogas Power Generation Program (BPGP) launched in 2005-2006. The program aims to promote the biomass based power generation, especially in small capacities (3kW to 250 kW). Power for such a small capacity can be generated from animal waste, forest waste, agro/food processing industries and kitchen waste. 191 projects in 16 states with a capacity of 6 MW have been under construction. 3MW of these have been commissioned.

Further, as early as 1981, the MNRE implemented the National Biogas and Manure Management Program (NBMMP) to promote installations of family size biogas plants in rural households. The estimated potential for this sector is twelve million units. The program was reformed and extended during the 11th five-year plan (November 2009 to April 2012). Under this program, special incentives were provided to this sector, consisting of a fixed assistance of INR 16,700 (EUR 257) per unit for North-eastern states and INR 10,000 (EUR 154) per unit for other states. After these incentives were provided, by January 31, 2013, around 478,458 biogas plants have been set up all over India. The state wise break up of this is given below in Table 7[49].

Table 7: State/ UT: Break up of number of family type biogas plants installed under National Biogas and Manure Management Programme (NBMMP) during 2009-10 to 2012-13 (up to January 2013)

State/ Union Territories	Installations (plants)			
	2009-10	2010-11	2011-12	2012-13
Andhra Pradesh	13,699	16,275	15,346	10,488
Arunachal Pradesh	162	175	150	14
Assam	10,450	6,732	6,581	4,335
Bihar	200	350	3,285	-
Goa	31	18	65	21
Gujarat	10,556	6,105	2,631	2,482
Haryana	1,422	1,386	1,819	929
Himachal Pradesh	245	445	426	243
Jammu & Kashmir	155	114	136	193
Karnataka	10,323	14,464	12,363	8,778
Kerala	4,085	3,941	3,483	2,047
Madhya Pradesh	15,114	16,742	12,415	6,584
Maharashtra	11,235	21,456	22,220	9,262
Manipur	-	-	-	-
Meghalaya	825	1,275	1,390	170
Mizoram	50	100	100	461
Nagaland	605	1,171	1325	396
Orissa	5,296	6,050	7,186	2,828
Punjab	7,250	23,700	14,173	6,735
Rajasthan	176	275	498	73
Sikkim	555	358	635	136

[49] Source: Press Information Bureau release on March 2013; "Financial Assistance for Household Size Biogas plants" accessed at http://bit.ly/13BOM4D on June 12, 2013

State/ Union Territories	Installations (plants)			
	2009-10	2010-11	2011-12	2012-13
Tamil Nadu	1,740	1,493	1531	391
Tripura	47	89	117	68
Uttar Pradesh	3,252	4,603	4,759	1,282
West Bengal	16,748	17,000	19,986	7,135
Delhi	-	1	1	-
Pondicherry	5	-	-	-
Chhattisgarh	3,433	3,832	4,779	1,254
Jharkhand	1,030	913	750	150
Uttarakhand	1,225	2,082	2,114	687
TOTAL :	**119,914**	**151,138**	**140,264**	**67,142**

Source: MNRE

4.3 New policy developments

The MNRE is currently framing the policy for the National Bio-Energy Mission. The policy is to be implemented in two phases, the first between 2012 and 2017 (12th plan period) and the second between 2017 and 2022 (13th plan period). Phase One is targeting an additional 3,000 MW of installed capacity. The MNRE has allocated INR 34 billion (EUR 523 million) for the various incentives under this policy. It estimates that 150 million tons of raw material (agricultural, animal and human waste) is available in India, but the transportation of raw material and its supply at an industrial level is still a challenge.

In 2011, the MNRE made recommendations to the states on policies to incentivize biomass power[50]. Every state was asked to formulate an exclusive biomass policy to promote the growth of the sector. The first recommendation was to revise current tariffs and introduce a variable tariff component. The states were to do this by including a weighted average cost of the biomass resource used in every state. This is due to the fact that one of the challenges faced by the biomass industry is the availability and the transportation of raw materials needed for a biomass plant. If the tariff for biomass power includes a factor that accounts for the transport of biomass to the location of the plant, then this challenge can be addressed. Secondly, the states were advised to remove their control periods for biomass power producers. Every state fixes the tariff for the purchase of power from a renewable energy source for a certain length of time, typically one year. If the control period was to be removed and the tariff stabilized for a longer period of time, then developers would have a better planning security. It was also recommended that a wasteland development program be introduced, through which dedicated bio energy plantations could be incentivized to set up on land, which is unfit for farming through public private partnerships or through contract farming. As on June 2013, 17 states have in place policies promoting the development of Biomass power. However, only two states,Rajasthan and Madhya Pradesh, have exclusive policies for Biomass power that were announced in 2010 and 2011, respectively.

Under the National Policy of Biofuels, more than 3,000 biodiesel manufacturing plants, with a collective capacity of 3,470 tones per day, have been set up by private companies in several states as of May 2012. The state-wise break up of these plants is given in Table 8 below[51]. Currently, research on Jatropha plants for bio-diesel is being carried out collectively by the Ministry of Agriculture, Science and Technology, and the Ministry of New and Renewable Energy.

[50] Source: Ministry of New and Renewable Energy; Annual Report 2012-2013 accessed at http://bit.ly/18w0gvG on June 12, 2013

[51] Source: Press Information Bureau release on May 2012; "Production of Bio Diesel" accessed at http://bit.ly/13BOM4D on June 12, 2013

Table 8: State wise: bio diesel plants[52]

State	Installed capacity
Andhra Pradesh	2,510
Chhattisgarh	13
Gujarat	60
Haryana	30
Maharashtra	210
Uttarakhand	50
West Bengal	500
Total	3,373

Source: MNRE

The "Removal of Barriers to Biomass Power Generation in India" scheme was formulated by the MNRE and was officially started on July 5, 2012. It aims to identify the obstructions that are currently hampering the accelerated adoption of biomass power technologies in India and to explore the feasibility of large-scale commercialization of biomass power, through increased access to financing. The Indian soya major, Ruchi Soya, has set up a 1 MW gasification plant in Washim, Maharashtra as a Model Investment Project (MIP). It produces edible oil, and shall be using all the by-products from its crushing plant, that cannot be used as animal feed, to convert into bio fuel. The plant will be built by the Indian company,Thermax, using technology developed by the Energy Research Centre (ERC) and the Dutch company, Dahlman. The system has a conversion efficiency of more than 95% as opposed to a conversion efficiency of 80% to 85% of current technologies. Other MIPs demonstrating the operation of cogeneration from sugar mills, gasification and stronger fuel linkages for biomass combustion were set up in during 2012 and 2013.

4.4 Challenges and opportunities

In the biomass sector, the availability of waste in large quantities, which can be transported to a plant at an acceptable cost, is proving to be the primary obstacle faced by the project developers.

A key obstacle to the accelerated deployment of biogas in India is the lack of technology standardization. There is no proven, single module gasifier or gas cleaning system for a capacity of more than 1MW. The megawatt scale systems are also not standardized. Further, there is no single project, which can serve to demonstrate the generation of grid quality power through biomass gasification.

There is not enough operating experience available on tri-generation also to enable regulators to determine separate tariffs for power generated through tri-generation. Through tri-generation, heat, electricity and cooling are simultaneously generated from a single source of raw material. The Bureau of Energy Efficiency, under the Indian Ministry of Power and also GIZ under the German government have, on June 5, 2012, commissioned a pilot tri-generation project. The project is situated in the Jai Prakash Narayan Apex Trauma Centre (JPNATC), New Delhi. The project uses natural gas to provide electricity, heating and cooling to the JPNATC. The maintenance and operation of the tri-generation system will be handled by pre-trained hospital staff.

Biofuels, such as bio-diesel and bio-ethanol are not yet available in sufficient quantities to meet the blending targets of the National Policy of Biofuels (2009).

[52] Information related to Bio diesel plants installed after May 2012 is not available yet

SMALL HYDRO POWER

5.1 Installed capacity

Hydro projects in India, which are under 25 MW in capacity, are classified as "small hydropower" and considered as a "renewable" energy source. Table 9[53] gives the total cumulative installed capacity for grid connected small hydropower plants and off-grid micro hydro plants (up to 100 kWh) in India up to June 30, 2013[54].

Table 9: Small hydro Installed capacity (June 30, 2013)

Type	Grid Connected	Capacity Installed
Small Hydro Power	On-grid	3,686 MW
Water mills/Micro hydro	Off-grid	2,131 plants

Source: MNRE achievements

Table 10[55] gives the state wise numbers for the small-hydro projects that have been constructed

Table 10: State wise projects and capacity additions for small hydro as on December 31,2012

State	Projects Installed		Projects under Implementation	
	Nos.	Capacity (MW)	Nos.	Capacity (MW)
Andhra Pradesh	66	218	15	35
Arunachal Pradesh	143	102	65	31
Assam	5	31	4	15
Bihar	29	71	5	18
Chhattisgarh	8	27	5	140
Goa	1	0.1	-	-
Gujarat	5	16	-	
Haryana	7	70	2	3
Himachal Pradesh	142	537	47	183
J&K	35	131	9	35
Jharkhand	6	4	8	35
Karnataka	132	915	41	322
Kerala	25	158	11	53
Madhya Pradesh	11	86	3	5
Maharashtra	47	295	20	81
Manipur	8	5	3	3
Meghalaya	4	31	3	2
Mizoram	18	36	1	1

[53] Source: MNRE Achievements accessed at http://bit.ly/14woYJX on June 12, 2013

[54] Source: Ministry of New and Renewable Energy; Annual Report 2012-2013 accessed at http://bit.ly/18wOgvG on June 12, 2013 at

[55] Ibid

State	Projects Installed		Projects under Implementation	
	Nos.	Capacity (MW)	Nos.	Capacity (MW)
Nagaland	10	29	4	4
Orissa	9	64	4	4
Punjab	46	155	12	21
Rajasthan	10	24	-	-
Sikkim	17	52	1	0.2
Tamil Nadu	21	123	a	21
Tripura	3	16	-	-
Uttar Pradesh	9	25	-	-
Uttarakhand	98	171	47	178
West Bengal	23	98	17	84
A&N Islands[56]	1	5	-	-
TOTAL	**939**	**3,495**	**327**	**1,274**

Source: MNRE

or are under construction as of December 31, 2012. The state wise break up for June 2013 is not available from the MNRE as yet. [56]

5.2 Policy framework

The MNRE, through its"Small Hydro Program" (2009), incentivized the installations of hydro power plants. Table 11 gives an overview of the various incentives.

The MNRE has subsidized the cost incurred for renovation of the plants, investigation of sites and creation of project reports for all the states. However, only North-Eastern states and other mountainous regions can avail of a financial subsidy[57]. For other states, only the investigation of a site and the preparation of a project report are subsidized, in association with the Alternate Hydro Energy Center (AHEC).

The North-Eastern states are less developed, and have a more difficult terrain prone to earthquakes. They also have a high potential for hydropower, especially small hydro plants. The difficulties posed for installations in these states and their potential have resulted in the MNRE offering higher subsidies and prioritizing installations there.

Other than the MNRE, several states with a high potential for hydro such as Andhra Pradesh, Uttar Pradesh, Karnataka, Uttaranchal, Maharashtra and Himachal Pradesh have formulated state specific incentives. These include preferential tariffs, lower wheeling charges, banking concessions, accelerated depreciation and tax exemptions[58] for installations of hydro power plants. Table 11 gives an overview of the various incentives.

[56] A&N Islands– Andaman and Nicobar Islands
[57] Source: BRIDGE TO INDIA

[58] Source: MNRE

Table 11: Small Hydro Programme: incentives[59]

	Program	Incentives
1	Subsidy for capital for hydropower plants up to 3MW in the Northeastern States	Up to INR 30 Million (EUR 429,000) per MW or 50% of project costs (the lower value apples)
2	Subsidy for capital for hydropower plants up to 100MW in the mountainous regions, the Northeastern States and islands, by public and NGO players	INR 15,000 (EUR 214) per kW
3	Interest subsidy for hydropower plants up to 3MW in the mountainous regions, the Northeastern States and islands	5% interest subsidy up to a total capital of INR 11.2 Million (EUR160,000) per MW
4	Interest subsidy for hydropower plants up to 3MW in other regions	Possible: Negotiations in individual cases
5	Subsidy for renovation, modernizing and upgrading hydropower plants up to 3MW	75% of the incoming costs up to INR 20 Million (EUR 286,000) per MW
6	Subsidy of the detailed survey and investigation	100% of incoming costs up to INR 150,000 (EUR 2,143) per location
7	Subsidy of the detailed project report	50% of incoming costs up to INR 100,000 (EUR 1,429) per report

Source: BRIDGE TO INDIA market analysis; MNRE

5.3 New policy developments

The MNRE has signed an MOU with the Alternate Hydro Energy Centre (AHEC), IIT Roorkee for research to enable the development and construction of small hydropower plants on a contractual basis. The AHEC provides technical support and helps to ensure that no upstream plant is hampering the potential of a new plant built downstream from it. Small hydro projects have a long gestation period of seven years and involve considerable capital investment (a case similar to large hydro installations)[60]. Also they are river-based systems that run the risk of becoming inefficient or redundant if the flow of the river changes. This makes it imperative to carry out feasibility studies before choosing a site. The MNRE has set up the framework of testing for feasibility of a plant before it is set up, so as to ensure the efficient working of the plant after commissioning.

5.4 Challenges and opportunities

The main challenges faced by small hydropower developers are related to ecology and infrastructure.

The primary challenge is that the rivers and their tributaries may change course. This will result in lower CUFs. In the worst case, a fully operational plant may become idle. The feasibility of a project has to be explored very stringently in order to minimize this risk. Changes in the courses of rivers have to be monitored and their impact on a new plant has to be analysed before installing a plant.

Another challenge faced by small, stand-alone plants (e.g. micro hydro projects up to 100 kW) is that they can only supply power to the area around it. The developer cannot sell the surplus power produced by the plant through the national grid. This is mainly due to the poor grid infrastructure and the lack of grid connectivity in rural and remote areas. This may lead to a lower utilization rate for the plant. Revenue collection in remote rural areas is also a challenge.

[59] Summary of incentivescan also be accessed at http://bit.ly/11gGu0v
[60] Source: IEA; Report "Renewable Power Essentials: Hydropower" 2010, accessed at http://bit.ly/13ZgRDm on June 12, 2013

Indo-German Energy Forum

Background and Objectives

To enhance and deepen the cooperation between India and Germany in the energy sector, the German Chancellor Dr. Angela Merkel and the Indian Prime Minister Dr. Manmohan Singh established the Indo-German Energy Forum (IGEF) at the Hannover Fair in April 2006.

The main objectives of the IGEF are

- to rehabilitate and modernise thermal power plants
- to encourage the use of clean energy sources
- to disseminate climate-friendly technologies on the energy supply and demand side.

The dialogue focuses on exchanging knowledge, promoting private sector activities and putting in place an enabling environment to further develop the markets for efficient thermal power plant technologies, energy efficiency and renewable energies in India and Germany.

Partners, Institutional Structure and Projects

The high level steering committee of the IGEF, also called the "Forum", takes place annually and provides a platform for high-level policy makers and representatives from industry, associations, financial institutions and research organizations from both India and Germany. On a working level, thematic sub groups have been created which convene meetings on a regular basis:

- Efficiency Enhancement in Fossil Fuel Based Power Plants
- Renewable Energies
- Demand-Side Energy Efficiency and Low Carbon Growth Strategies.

Within the sub groups, several task forces have been set up to devise and implement specific cooperation projects, such as the harmonisation of tender documents for the rehabilitation and modernization of thermal power plant, the Excellence Enhancement Centre for the Indian power sector or the development of an energy performance assessment tool for residential buildings. Additional task forces concerning further topics may be created at the initiative of representatives of the relevant government agencies, private sector and other experts. The Indo-German Energy Symposium provides energy experts from India and Germany a platform for technical exchange and has given further momentum to the bilateral dialogue. The Symposium takes place on a biannual basis and covers aspects of financing, project development, best practices as well as innovative technologies and policy issues.

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