GREAT
BRITAIN

August 2013

Business opportunities for UK companies in the Indian power sector

Transmission and distribution, smart grid, renewable energy and energy efficiency

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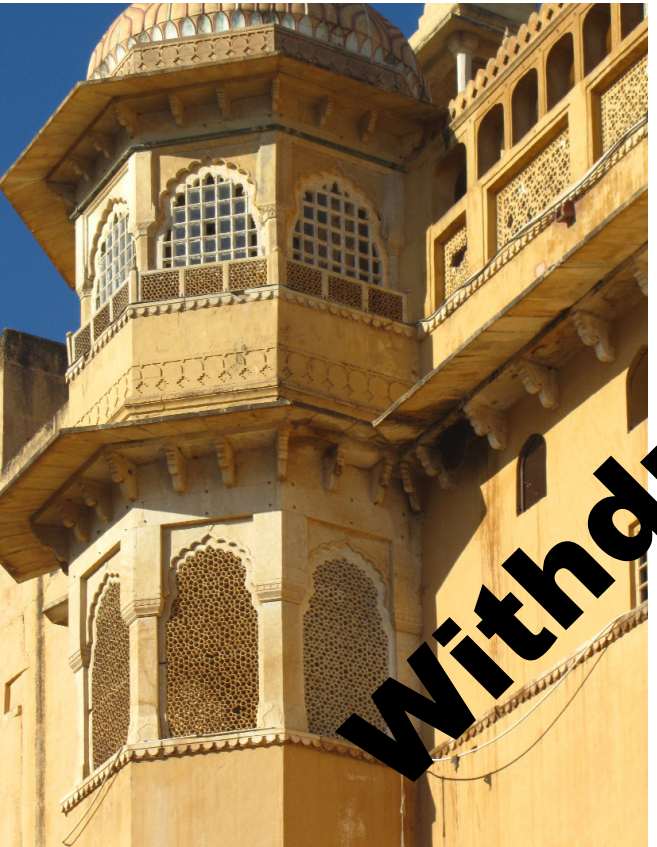
Introduction



India is a federal union comprising of 28 states and seven union territories. A land of diverse cultures and traditions, with 22 official languages and several unofficial dialects spread across a geographic area of 3.3 million sq. km, India is the world's seventh largest nation. As per the latest estimates, India has a population of approximately 1.2 billion.

India's economy is primarily driven by the five-year plans prepared by the Planning Commission of India. The first Five-Year Plan was for a period from FY 1951 to FY 1956. Currently, the 12th Five Year Plan (FY 2012 to FY 2017) is underway. As part of the planning process, the Indian states prepare their plans and get them approved by the Planning Commission.

The Indian economy is backed by a robust banking system, investment friendly policies, a young and skilled workforce, high urbanisation and significant untapped market potential.

Despite the current global slowdown, investors have shown renewed interest in the Indian economy, reflective of the FICCI Overall Business Confidence Index that rose to 62.4 in Q3 2012-13 from a much lower 61.8 reported in the Q2 survey. Also, the Indian corporate world is optimistic about the future, reflected in FICCI's Current Condition Index improving to 58.0 in Q3 2012-13 from 54.0 recorded during the Q2 survey.

All these factors have helped India become the second most favoured FDI destination across the world after China as indicated in the A.T. Kearney Foreign Direct Investment Confidence Index 2012.

What's in it for you?

India, quite remarkably, in the last two decades has emerged as a leading investment destination.

India has been continuously focussing on improving its infrastructure and services sectors. Primary among these is the Indian power sector which has seen a tremendous growth in investment, both on the government as well as the private fronts. The rising demand for investments in this sector also holds huge opportunities for foreign investments as well as for other foreign players trying to bring in technical knowhow combined with service delivery expertise.

This report showcases possible opportunities for UK companies in the Indian power sector, specifically in the trending segments within the sector--transmission and distribution, smart grid, renewable energy and energy efficiency. These segments are attracting the attention of policymakers as well as of investors to make the Indian power sector more sustainable in the future. This report also captures the performance of the economy, the power sector and its priority segments.

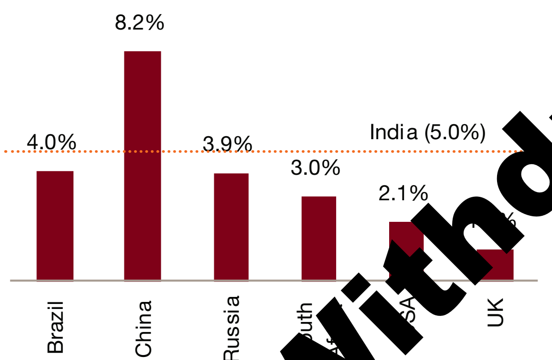
Indian economy: An overview

India's nominal GDP during 2012 was 1.2 tn GBP. It is therefore the world's third largest economy by purchasing power parity and the 10th largest by nominal GDP.

India's GDP (at 2004-05 prices) grew at an average annual rate of approximately 10% (quarter-on-quarter basis) till FY 2008-09 before the global economic slowdown. The robustness of the Indian economy, despite the persistent global slowdown, is reflected in its existing growth of 4.5% (quarter-on-quarter basis) in the third quarter of FY 2012-13 which is the lowest in the last 15 quarters.

The CSO of India has projected the national GDP to grow at a rate of 5% for FY 2012-13. This growth rate, while lower than past trends, is higher than the other leading nations such as South Africa, the US and the UK.

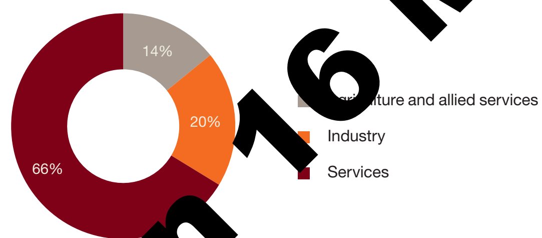
Estimated GDP growth rates for 2013



Source: IMF

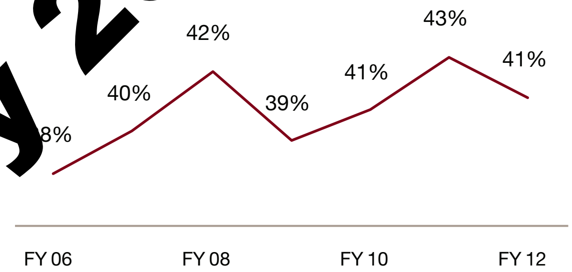
The services sector is a key driver to the Indian economy. According to the estimates of the CSO, it contributed around 66% to the economy. This highlights the potential India holds for firms engaged in the service industry in India. This, in particular for the power sector, means opportunities in areas such as project management, bid advisory, consulting etc.

Estimated GDP growth rates for 2013



Green shoots: India's GCF as a percentage of its GDP has remained stable around 40% despite the GDP growth slowing down.

India's GCF to GDP ratio at 2004-05 prices



Source: Central Statistical Office

To encourage capital formation in the manufacturing sector, the government has incentivised to acquire and install new plant and machinery. As discussed earlier, the Union Budget FY 2013-14 also proposes an additional deduction of 15% on the cost of such new plant and machinery where the investment exceeds 12 million GBP.

> *"One area that is at the top of our agenda and will require particular attention and effort at multiple levels across government is infrastructure. During the 12th Plan, we have set ourselves a target of realising nearly 1 trillion dollars of investment in infrastructure sectors. To do so, we will have to overcome the constraints that currently deter or slow down this investment."*
>
> Prime Minister Manmohan Singh at a meeting of the council of ministers in November 2012

Union Budget FY 2013-14: Highlights

Corporate tax: The basic corporate tax rate has remained unchanged at 40% for a foreign company operating in India. However, the Finance Minister has proposed an increase of 3% in surcharge for income beyond 1.2 million GBP. The proposed corporate tax structure is as follows:

Particulars	Proposed tax	
	Taxable income< 1.2 mn GBP	Taxable income> 1.20 mn GBP
Corporate tax	40%	40%
Surcharge	2%	5%
Education cess	3%	3%
Effective tax rate	40.02%	43.36%

Incentive for manufacturing sector: Companies engaged in the manufacturing or production sector, will be eligible to claim an additional deduction of 15% of the cost of new plant and machinery, provided the investment exceeds 12 million GBP and has been installed in the period 1 April 2013 to 31 March 2015. In case the threshold of 12 million GBP is not achieved in FY 2013-14, in order to be eligible, the minimum threshold would need to be achieved in FY 2014-15.

A lock-in period of five years has been p[illegible] for the transfer of such plant and machinery, during which the deduction availed would be taxable as business income. There is an exception to this rule in the case of the transfer of a plant as under an amalgamation or demerger.

A concessional tax rate of 15% on dividends received by an Indian company from specified foreign companies has been extended for one more year i.e. till FY 2013-14.

Incentive for power sector: The sunset clause for commencing eligible activity for claiming profit linked incentive by power companies has been extended by one year i.e. upto 31 March 2014.

Increase in tax rates for royalties and FTS: The domestic tax rate for royalties and FTS is proposed to be increased to 25% (plus applicable surcharge and cess) from 10% (plus applicable surcharge and cess). This is subject to reduced rates, if any, as per the relevant tax treaty provisions.

Tax withholding provisions: TDS rate on interest payments reduced from 20 on 5% to funds invested by a foreign company in long-term infrastructure bonds issued by an Indian company.

> *"[illegible]t the Finance Minister had in mind was first to get government finances in order. If investors believe that the government has its finances in order, in some sense that gives the best environment both for investments as well as savings to take place and clearly as a country, we need more investment and more savings again, as he said in the speech."*
>
> Raghuram Rajan, Chief Economic Advisor on the Union Budget 2013

Foreign investments in India

The Indian rupee is fully convertible on current account and convertible only partially on capital account with limits on foreign investments and FDI.

Foreign Exchange Management Act: Foreign investments in India are governed by the Foreign Exchange Management Act, 1999. The RBI issues notifications regarding norms, rules and regulations pertaining to FEMA.

Foreign equity investment in India: Foreign equity in Indian companies is subject to sectoral equity caps specified under India's FDI policy. The FDI policy allows for foreign investments either under the automatic route where no approval is required to be taken from the government or the RBI (automatic route) or the approval route where the FIPB under the Department of Economic Affairs, Ministry of Finance, serves as a single window for issuing clearances to investors.

Department of Industrial Policy and Promotion: The DIPP, under the aegis of the Ministry of Commerce and Industry, is responsible for ensuring and monitoring industrial development and investment in the country.

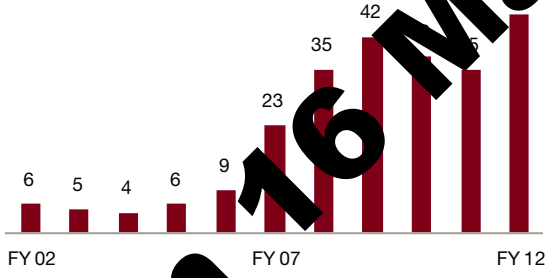
Investment in India by FIIs, NRIs, PIOs[1]: FIIs, NRIs and PIOs can invest in the primary and secondary capital markets to acquire shares and debentures of Indian companies through the portfolio investment scheme.

The ceiling for investments by FIIs, NRIs and PIOs is governed by notification issued by the RBI. Currently, the ceiling for overall investment for FIIs is 24% of the paid-up capital of the Indian company and 10% for NRIs and PIOs. The limit is 20% of the paid-up capital in the case of public sector banks, including the State Bank of India.

Investment through FDI in India: The government of India understands the importance of FDI and has liberalised FDI norms over the years.

FDI inflow in India has witnessed a steep increase over the past decade. India registered a negative growth in FDI primarily on account of the global downturn in FY 2009-10 and FY 2010-11 but the situation has improved in FY 2011-12.

FDI in India million USD*



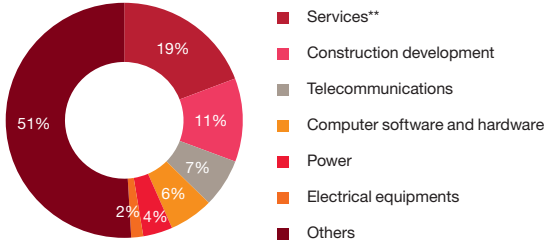
Source: Dept. of Industrial Policy and Promotion

**1 USD = 0.62[illegible] GBP*

FDI equity inflows to India are highly fragmented across 13 sectors and are a function of sectoral FDI caps and sector performance. The power sector has attracted 4% of the cumulative FDI equity inflows since April 2000.

In addition to this, electrical equipment further contribute cumulative FDI inflows of 2% to the pie.

FDI equity inflows*: Apr 2000 – Mar 2013



Source: Dept.of Industrial Policy and Promotion

**Refer to later sections on FDI in power sector*

*** Services sector includes financial, banking, insurance, non-financial / business, outsourcing, R&D, courier, tech. testing and analysis*

1. Refer http://www.pwc.in/en_IN/[illegible]/publications-2012/Destination_India_2012.pdf for help on setting up business in India. This publication focusses on tax policy, tax incentives, exchange control and the FDI policy. The publication is compiled by PwC's inbound investment advisory specialists in India, drawing on their extensive knowledge and experience of typical issues faced by first-time investors in the country.

India-UK trade relations

India's political relations with the UK are managed through a High Commission in London and two consulates in Birmingham and Edinburgh. The UK in turn, has a High Commission in New Delhi and five deputy High Commissions in Mumbai, Chennai, Kolkata, Bangalore and Hyderabad. UKTI, a UK government department that helps UK based companies to succeed in the global economy, also maintains trade offices across India.

India-UK Joint Economic Trade Committee: India does not have any specific free trade agreement with the UK or the European Union at the moment.

However, to strengthen trade relations, India and the UK constituted the JETCO in January 2005. The latest JETCO meeting was held in April 2012 where several projects were identified in the field of advance manufacturing and engineering sector:

- Collaboration between BAE systems and Mahindra and Mahindra
- Joint venture between Hindustan Aeronautics Limited and Rolls Royce
- Collaboration between Bhushan Power and Steel and CDE Asia Limited

India-EU bilateral trade and investment agreement

India and the EU, of which the UK is a member, are in advanced stages of discussion on a bilateral trade and investment agreement

"We want to make progress on the very rapid progress on the India Free Trade Agreement. I think there is a window of opportunity if all sides can now look at what extra they can bring to completing a deal that would do as much as anything to help growth both here in India and in the European Union."

Prime Minister David Cameron during his India Visit in February 2013

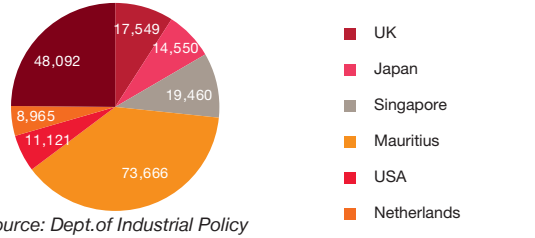
"We are well on course to double trade with India by 2015 and I hope this is further encouragement to UK companies to trade, invest and build their presence in India."

Foreign and Commonwealth Office Minister Hugo Swire on signing an agreement between the BG Group and the Gujarat State Petroleum Corporation Limited for long-term sale of LNG in March 2013

Trade with the UK

The UK features in the list of top nations with FDI equity inflows in India. It has contributed around 9% of the cumulative FDI equity inflows in India for the period from April 2000 to February 2011.

FDI equity inflows: Apr 2000 – Mar 2013 (mn USD)



Source: Dept.of Industrial Policy and Promotion

The Indian power sector

Structural set-up

Power is a 'concurrent subject' in India. This means it is governed by both the central and state governments. The industry structure is defined by the Electricity Act (EA), 2003, wherein the central government makes policies and plans for the overall sector, while respective state governments make policies and plans for the development of the power sector in their respective states.

The defined electricity regulatory framework gives the responsibilities for regulating generation, transmission utilities owned by the central government and carrying out inter-state operations to the CERC and that of regulating generation, transmission and distribution utilities owned by state government or UT (or operating within the state UT) and carrying out intra-state operations to state or joint electricity regulatory commissions.

All policy measures introduced at the central and state levels have given sufficient impetus for the development of the sector evident by the increasing per capita consumption.

	Policy	Regulator	Generation	Transmission	System Operation	Distribution	Trading
CENTRAL/ INTER STATE	MoP (GoI), MNRE (GoI), IREDA, BEE	Central ERC	CPSUs (NTPC, NHPC, etc.)	PGCIL (CTU)	POSOCO (NLDC & RLDCs)	-	Power exchanges, Traders
STATE /INTRA STATE	Power Dept. of State Govt. & UTs, SREDA	State ERCs & Joint ERCs	State GenCos	State TransCos (STUs)	SLDCs	State Discoms	Discoms
PRIIVATE OWNED (Semi/ Fully)	-	-	UMPPs, IPPs & CPPs	IPTCs (Inter & intra state licensees)	POSOCO (NLDC & RLDCs)	Pvt. Discoms, Distribution Franchisees	Discoms, Open Access consumers
			G, T & D Planning and Monitoring by CEA				

Statutes governing the Indian power sector

Electricity Act, 2003: Envisages promoting competition with multiple player market for improving quality of service to consumers through liberalisation of the generation regime, reorganisation of the electricity boards, creation of independent regulators, freedom for building dedicated transmission lines, enabling the provision of more than one distribution licensee in the area, etc.

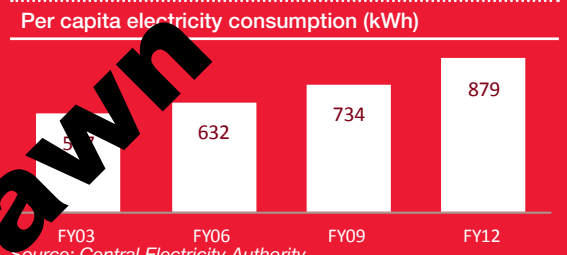
National Electricity Policy, 2005: Aims at providing electricity supply to all areas and protecting consumer interests, keeping in view availability of resources, technology, economics of generation and energy security issues.

National Tariff Policy, 2006: Ensures availability of affordable electricity to all consumers while ensuring financial viability of investments in the sector through the promotion of a competitive and efficient industry operating within a transparent, consistent and predictable regulatory regime.

Sector outlook

Although a lot has been achieved over the past few years, the Indian power sector still has a long way to go. This coupled with a favourable policy environment, has opened up huge avenues for investments in the sector.

- **25%** (approximately 0.3 billion) of Indi[illegible] population with no electricity acc[illegible]s p[illegible]orld Bank estimates for 2010
- **8.7%** energy deficit (amounting [illegible]905 MUs) and **9.0%** peak demand deficit (a[illegible]ounting to 12.16 GW) during FY [illegible]13
- **The per capita e[illegible]ctri[illegible]nsumption is still less than 1/4th [illegible]obal average**



Source: Central Electricity Authority

2[illegible]% AT&C losses, much higher than the [illegible]overnment target of 15%

100% FDI under automatic route for power sector

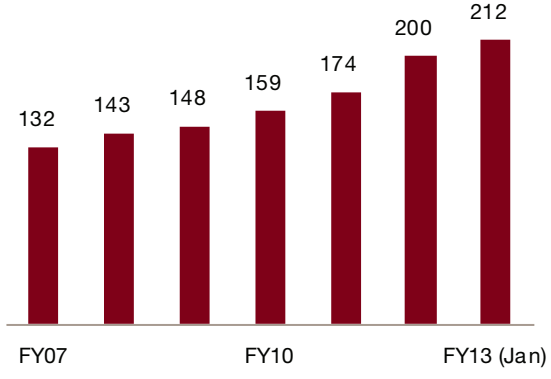
- No requirement of a licence for the generation sector
- Tariff based international competitive bidding for generation and transmission projects
- Financial restructuring scheme by government of India for distribution utilities with provisions of investment support for performance improvement
- Returns on equity: CERC allows RoE of 15.5% (pre tax) to central generating stations and inter-state transmission licensees. Most SERCs also allow distribution utilities RoE of 15.5% to 16% during tariff determination. Regulator determined RoE does not apply to projects awarded under competitive routes.

Power generation

India's generation capacity has almost doubled in the last decade to 212 GW in January 2013, placing it as the world's fifth largest power market in terms of installed generation capacity.

One of the key reasons for significant capacity additions in recent years is the increasing private investments in power generation.

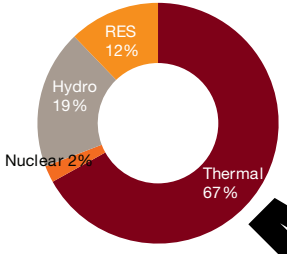
Generation capacity (GW)



Source: Central Electricity Authority

An emerging trend in India's generation mix is th rising share of power generated through renewa energy sources.

Existing generation mix

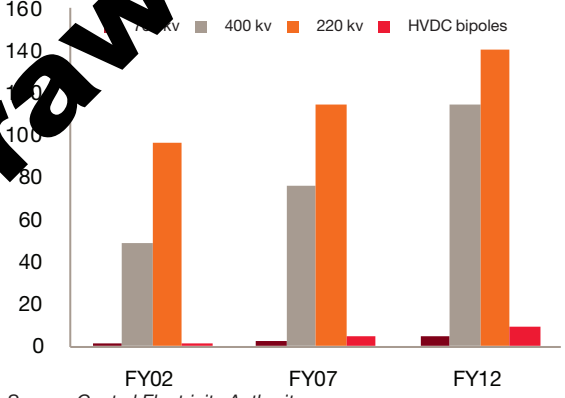


Source: Central Electricity Authority

Transmission

The inter-regional trans ission capacity has doubled over the last five years and currently stands at 27.8 GW with over 257.3 thousand circuit kms of transmission line

Transmissio ('000 ckm)



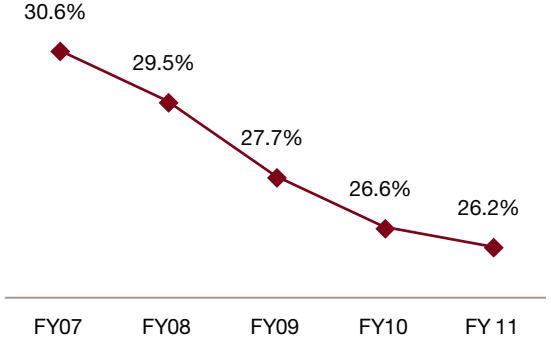
Source: Central Electricity Authority

The n work is supported by substations with a capac 9.7 GW HVDC and 399,801 MVA.

Distribution

The distribution wire business and retail supply are a single business. The Indian distribution sector has over 4.5 million circuit km lines owned by more than 60 distribution and retail supply utilities catering to over 200 million consumers. The critical indicator for assessing the performance of power distribution, AT&C loss, has improved over the past five years but there are significant improvement opportunities.

AT&C losses: India



Source: Central Electricity Authority

The Indian Planning Commission formulates a consolidated sector development plan for a five-year period. The recently concluded 11th Five Year Plan ended in FY 2012.

11th Five Year Plan (2007-2012)

The 11th Plan period witnessed record generation capacity addition during a plan period, at 55 GW. Additionally, life extension activities on 18 units aggregating 1.9 GW and R&M activities on 69 units aggregating to 17.4 GW were completed during the plan period. There has also been increased focus for efficient and clean technologies for the development of coal-based power plants. The share of renewable energy sources was 12% at the end of the 11th Five Year Plan period.

The aggregate inter-regional transmission capacity was increased by 69,926 ckm of transmission lines, 150,362 MVA of AC substations and 1.75 GW capacity of high-voltage, direct current (HVDC) substations.

The 11th Five Year Plan period also achieved 93% rural electrification.

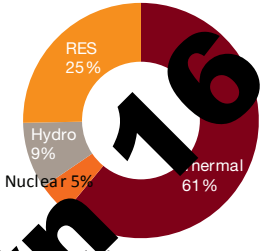
Despite making progress in infrastructure development, power distribution remains the weakest link of the sector faced with severe difficulties including poor financial health and hi AT&C losses.

Various energy efficiency measures adopted, during the 11th Five Year Plan, under different schemes of the BEE and the MoP resulted in approximate savings in avoided power capacity of 11 GW.

12th Five Year Plan (2012-2017)

The proposed 12th Five Year Plan has set an amb s generation capacity addition target of 118 GW.

12th Five Year Plan capacity addition



Source: Planni Commission

Of the pl 72.3 GW thermal capacity addition during t 2th Five Year Plan, 18 GW had been c sioned as on 27 June, 2013[2] constituting ar n 25% of the planned capacity addition. However, the hydro capacity addition has been uggish with only 633 MW[3] being commissioned as on 31 May, 2013 against the 12th Five Year Plan target of 10.9 GW. With fuel uncertainty challenges being faced by thermal projects and R&R issues concerning hydro projects, in addition to the changing economic scenario, the pace of development is expected to slow down in the short-term.

The pro ed eneration capacity additions are ex d to e supplemented with approximately 10 ,4 m of transmission lines, 270,000 MVA of AC nsformer capacity and 12.7 GW of HVDC systems as per the 12th Five Year Plan estimates.

Transmission capacity addition planned during 12th ve Year Plan

Voltage	Sub-stn. capacity	Lines (ckm)
HVDC	12,750 MW	7,440
765 kV	149,000 MVA	27,000
400 kV	45,000 MVA	38,000
220 kV	76,000 MVA	35,000

Source: Central Electricity Authority

Given the fact that the previous two plan periods had largely met the capacity addition targets for transmission lines and sub-stations, it is highly probable that the targets set in the 12th Five Year Plan will also be met.

Past Plans' performance (Transmission lines, ckm)

Plan	Target	Achievement
10th Plan	41,342	46,138
11th Plan	88,515	70,286

Source: CEA, Planning Commission

The plan also envisages the introduction of new technologies and higher voltage systems in power transmission such as the Aurangabad–Wardha 400 kV double circuit line established for evacuating power from the Mundra UMPP, part of which is planned and designed to be later converted into a 1,200 kV single circuit line.

2. Refer http://cea.nic.in/reports/p oad_status.pdf for details
3. Refer http://cea.nic.in/repo ecommission_12plan.pdf for details

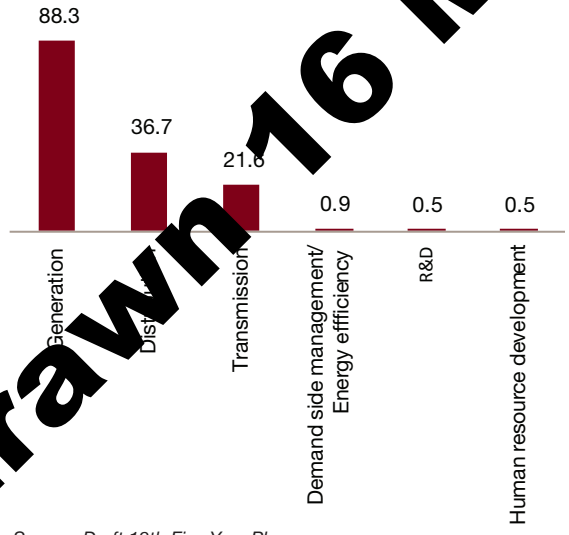
On the distribution front, the 12th Five Year Plan envisages improving the financial health of distribution companies for which a debt restructuring scheme has been launched by the government of India. Other key improvement measures proposed under in the 12th Five Year Plan include the following:

- 'National electricity fund' to provide interest relief to cover loans taken for development of the distribution sector
- Implementation of TOD metering
- Load shifting arrangement by regulators and improvement in energy efficiency and its measurement by BEE in the agriculture sector, contributing towards DSM
- Moving towards smart grid as a key focus area in the distribution sector by taking up a number of pilot projects
- Phased installation of smart metres, extending SCADA system to 100 more towns, and integration of renewable generation into the grid

Investments in the power sector

The capacity addition targets for the power sector in the envisaged 12th Five Year Plan have raised the fund requirements in comparison to the allocations in the previous five-year plans.

Planned investments (between 2012 -201[illegible] bn GBP (Total 148.5 bn GBP)



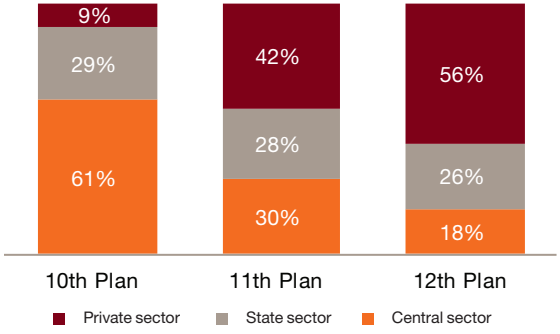
Source: Draft 12th Five Year Plan

** excludes investment in renewable generation'*

Private sector investments

Private sector participation in power is increasingly being viewed as an effective means of bridging the funding gap, and thereby achieving the desired generation capacity addition. From a mere 9% in the 10th Five Year Plan, the private sector's contribution in generation capacity addition is expected to increase to a massive 56% by the end of the 12th Five Year Plan. At present, the contribution is pegged at 29% of the total installed capacity of 212 GW in 2013.

Investments in generation



Source: Draft 12th Five Year Plan

Private participation has also taken off within the transmission sector during the 11th Five Year Plan (2007–2012) with several inter-state corridors being awarded to independent private transmission companies (IPTCs) through international competitive bidding. Through this route, seven schemes have already been awarded to private companies, and another six are in the planning stage.

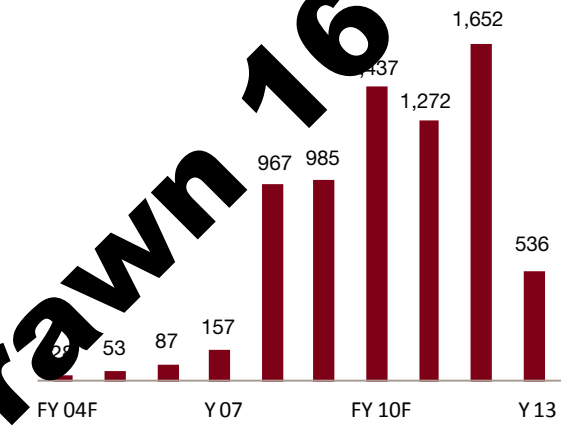
The distribution sector, post-2003, has also witnessed private investment through the privatisation of utilities in Odisha and New Delhi. Over the recent years, there have been PPP initiatives in this sector through the system of franchisee modes in states such as Bihar, Madhya Pradesh, Maharashtra and Uttar Pradesh. Initially, such an arrangement was restricted to outsourcing of functions such as billing, collection and R&M of transformers. Over time, it has evolved into an incentive-based arrangement for the private sector to invest in the distribution network, and thus become responsible for all functions, right from the stage of receiving energy from the utility up to the collection of revenues from consumers. Presently, 12 cities are operating under this model, and two others are in the advanced stages of being operationalised (details shared in subsequent sections).

Foreign investments in the sector

Policy incentives from the central gover[illegible]ve been instrumental in driving foreign [illegible]nts into the sector. One such incentive is a[illegible]100% FDI under the automatic route for t[illegible]ector in the following areas:

- Generation and transmission of energy produced in hydroelectric, coal, lignite- oil and gas-based thermal power plants
- Non-conventional energy (renewable) generation and distribution
- Distribution of elective energy to households, industrial, commercial and other users
- Power trading

FDI in power mn (USD)



Source: Source: Dept.of Industrial Policy and Promotion
1 USD = 0.6242 GBP

Several [illegible]G equipment manufacturers from Japan, E[illegible]pe and the US have already formed joint ventures with Indian companies for establishing base in India for the manufacture of supercritical boilers and turbine generators and technology transfer. Similar initiatives are foreseen in other components of the power sector value chain as well, with the proposed investment outlay and technology requirements during the 12th Five Year Plan.

> *"Electricity supply and demand lies at the heart of India's energy future and its aspirations to maintain an annual GDP growth rate of 8% in the medium term."*
>
> M Govinda Rao, Director, National Institute of Public Finance and Policy, India

Foreign participation in the power sector

- Mitsubishi Heavy Industries Ltd, Japan with L&T
- Hitachi, Japan with BGR, Tamil Nadu
- Toshiba, Japan with JSW, Tamil Nadu
- Alstom, France with Bharat Forge, Gujarat
- Ansaldo Caldie, Italy with Gammon, Tamil Nadu
- Babcock and Wilcox, USA with Thermax, Maharashtra
- Hitachi Power Europe GmbH (Germany) with BGR, Tamil Nadu
- Doosan, Korea (100% FDI) has established its manufacturing facilities on its own strength in Tamil Nadu.

Focus segments

India has traditionally been focussing on developing conventional generation. However, planners have recently also realised the importance of focussing on developing non-conventional energy-based generation and the associated T&D network.

This can be observed from the fund allocations of the 11th and the 12th Five Year Plan outlays. There are several segments where over a 100% increase in investments is envisaged as compared to the actual expenditure during the 11th Five Year Plan.

Transmission and distribution (including smart grid)

The planned investments (58 billion GBP) are more than double the actual expenditure (27 billion GBP) during the 11th Plan.

Renewable power

The planned investments (16 billion GBP) are over three times the actual expenditure (5 billion GBP) during the 11th Plan.

Energy efficiency and demand-side management

The planned investments (900 million GBP) are expected to be 10 times higher than the actual expenditure (84 million GBP) during the 11th Plan.

Focus segments in the 12th Five Year Plan (2012-2017)

Sector	Actual expenditure during 11th Plan (2007-2012) (mn GBP)*	Planned outlay for 12th Plan (2012-2017) (mn GBP)*
Transmission and distribution (including smart grid)	26,760 (32%)	58,344 (35%)
Renewable power	4,800 (6%)	16,212 (10%)
Demand side management and energy efficiency	84 (0.1%)	900 (0.5%)
Human resource development	12 (0.01%)	492 (0.3%)
R&D	48 (0.1%)	504 (0.3%)
Repair and maintenance	432 (0.5%)	3,828 (2.3%)
Generation (conventional)	52,752 (62.2%)	84,432 (51.3%)
Total	**84,876**	**164,712**

Source: CEA and the Planning Commission
** 1 INR = 0.0120 GBP*

02

Opportunities in transmission, distribution and smart grid

Power transmission

The pace of generation capacity addition in India has increased exponentially in the last decade. This in turn has also led to an imminent requirement to scale up the transmission and distribution infrastructure in the country in order to cope with ongoing and planned capacity additions.

By the end of the 1980s, strong regional grids came into existence and in 1989, the transmission wings of central generating companies were separated to set up the country's central transmission utility, namely, the Power Grid Corporation of India (POWERGRID).

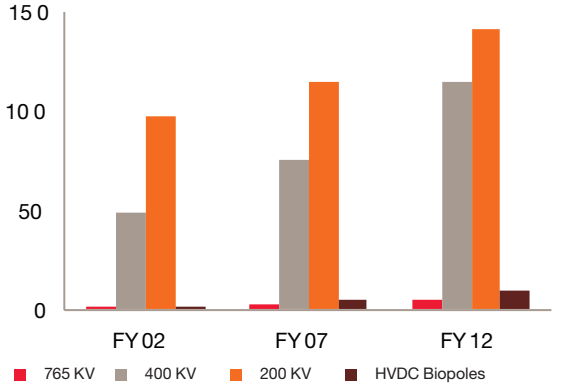
POWERGRID embarked on the development of a robust national grid in order to enhance the capacity of inter-regional links.

The 11th Five Year Plan (2007 – 2012) saw the introduction of 765 kV lines to the Indian transmission network. India is planning to add another 25,000 ckm of 765 kV lines during the 12th Five Year Plan (2012-2017) as against the installed capacity of only 5,730 ckm at the end of the 11th Plan.

Development of transmission lines of 765 kV and above voltage levels is essential for India in order to reduce the land requirement and transmission losses while increasing transmission capacity.

To realise this, 1200 kV (AC) has been decided as the next higher voltage level to be introduced in the Indian network. For this, POWERGRID has set up a 1200 kV test station at Bina in Madhya Pradesh. Research has also been initiated on 1000 kV HVDC systems.

Transmission lines ('000 ckm)



Source: Central Statistical Office

Private sector participation

In order to mobilise resources from the private sector, the MoP has issued guidelines for the development of transmission projects through tariff- based competitive bidding[4].

These guidelines envisage two distinct routes for private sector participation in transmission:

- Through project-specific joint ventures with the CTU (POWERGRID) and STUs
- Through IPTCs

Estimated funds requirement (in bn GBP*)

	Central	State	Private
11th Five Year Plan	9	7.8	-
12th Five Year Plan	12	6.6	3

Source: 1 GBP = 0.0120 INR

Private participation through the joint venture route

The CTU (POWERGRID) has formed JVs with independent private power producers for establishing transmission infrastructure associated with their respective power plants. This route is mostly adopted for high-capacity power generation projects that involve inter-state transmission.

In each of the JVs formed, except for the [illegible] HEP project, the CTU (POWERGRID) holds a 26% equity stake, while the private sector entity holds a controlling stake of 74%.

4. Refer to http://powermin.nic.in/sites/default/files/uploads/pdf/Revised_guide_lines.pdf for more details.

Joint ventures with the CTU (POWERGRID)

Project	Joint venture	Private partner	Capacity (MW)	Location	Estimated cost (mn GBP)**
[illegible] - II	Parbati Koldam Transmission Corp Ltd	Reliance (ADA) Group	800	Himachal Pradesh	79.2
Sugen - II	Torrent Power Grid Ltd	Torrent Power	1148	Gujarat	39
Karcham - Wangtoo	Jaypee Power Grid Ltd	Jaypee Group	1000	Himachal Pradesh	120
Teesta III	Teesta valley Power Transmission Ltd	Teesta Urja Ltd. (Athena)	1200	Sikkim	180
Tripura	North East Transmission Ltd	ONGC+IL&FS	727	Tripura	204
Tala HEP*	Powerlinks Transmission Ltd	Tata Power	1020	Bhutan	146.4

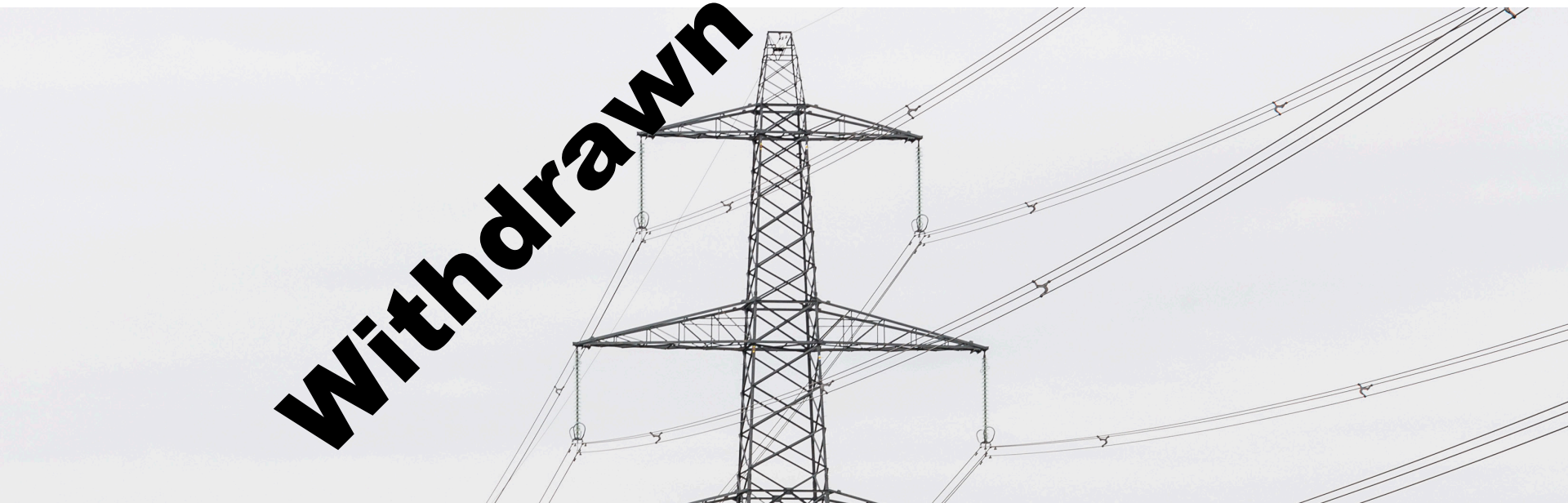
Source: Private equity share is 51% for this project. In all other projects, private developers own 74% equity share
*** 1 INR = 0.0120 GBP*

Various STUs have also developed intra-state projects by forming JVs with private developers. For example, the Maharashtra STU (Mahatransco) entered into a minority stake (26%) JV with JSW Energy Ltd to form Jaigad Power Transco Ltd, in order to construct an evacuation infrastructure for JSW Energy Ltd's 1,200 MW power project in Ratnagiri district of Maharashtra. Mahatransco also formed a similar JV called the Maharashtra Eastern Grid Power Transmission Co Ltd, with Adani Enterprises Ltd. This JV is looking at implementing a massive 765kV transmission infrastructure project passing through the districts of Gondia, Bhandara, Nagpur, Wardha, Amravati, Buldhana, Jalna and Aurangabad within Maharashtra. This transmission line will help evacuate power from the Adani Group's upcoming 3,300-mw Tiroda supercritical coal-fired power project that is being set up by Adani Power Maharashtra Ltd.

Joint ventures with STUs

Project	Ownership	Mode	Voltage level	Location	Estimated cost (mn GBP)
Jaigad Power Transco Ltd	JSW Energy	JV	400	Maharashtra	58.8
Maharashtra Eastern Grid Transmission Co Ltd	Adani	JV	765	Maharashtra	525.6

Source: 1 INR = 0.0120 GBP



Private participation through the IPTC Route

The Ministry of Power's move to set up high voltage inter-state transmission lines through the tariff-based competitive bidding route has been a defining moment in the history of India's power transmission sector.

Realising that the CTU (POWERGRID) will be unable to catch up with the brisk addition of power generation capacity, the Ministry of Power in 2006 issued guidelines for private sector entities on building transmission lines, awarded through the competitive bidding route.

Post 5 January 2011, all inter-state transmission projects (except for strategic or 1200 kV projects) as per the amendments notified on 30 June 201[illegible] National Tariff Policy[5]) will be awarded through the tariff-based competitive bidding route. Presently, there are eight notified schemes under implementation and an additional 10 notified projects are in the pipeline, for which the bidding process is in progress.

Schemes notified and under implementation (as on 31 March 2013)

Project	Implementing agency for transmission service	Scheduled COD	Estimated cost (mn GBP)*	Levelised tariff (mn GBP)*
Scheme for enabling import of NER,ER surplus by NR	Sterlite Technol[illegible]s	March 2014	204	142.56
System strengthening in NR and WR for import of power from North Karanpura and other projects	Reliance Power Tra[illegible]ission Company Ltd	September 2013 (advancement of COD sought)	324	309.6
Talcher-II augmentation system	Reliance [illegible]wer Transmission Com[illegible] Ltd	September 2013 (advancement of COD sought)	168	172.8
System strengthening common for WR and NR	Ster[illegible] Transmission Projects [illegible] Ltd	March 2014	206.4	170.5
Transmission system associated with the Krishnapattnam UMPP synchronous inter-connection between the SR and WR (Part [illegible])	[illegible]nsortium of Patel – Simplex-BS Transcomm	January 2014	52.8	35.2
System strengthening for the WR	Sterlite Transmission Projects Private Ltd	January 2014	348	239.4
Transmission system associated with IPPs of Naga[illegible]tnam, Cuddalore area – package A	Power Grid Corporation of India Ltd	March 2014	123.6	118.4
Transmission system associated with IPPs [illegible]en[illegible]iri area – package A	Power Grid Corporation of India Ltd	April 2014	156	143.6

**1 INR = 0.0120 GBP*

5. Refer to http://pib.nic.in/ne[illegible]lease.aspx?relid=72953 for details

Notified schemes for bidding (as on 31 March 2013)**

Project	Estimated cost (mn GBP)*	Designated bid process co-ordinator
Transmission system associated with DGEN TPS (1200 MW) of Torrent Power Ltd	19.2	PFC Consulting Limited (Refer to *http://pfcclindia.com/downloads/files/n508f6041dac4e.pdf* for more details)
System strengthening in the SR for the import of power from the eastern region	141.6	REC Transmission Projects Company Limited (Refer to *http://www.rectpcl.com/tenders/system-strengthening/RFQ_SSSR_Final.pdf* for more details)
Bairasuil HEP – Sarna 220 kV line	8.4	REC Transmission Projects Company Limited (Refer to *http://www.rectpcl.com/tenders/baira-siul/RFQ_Baira_Siul-Final.pdf* for more details)
Transmission system for Patran 400 kV s/s	24	PFC Consulting Limited (Refer to *http://pfcclindia.com/downloads/rrq-patran1.pdf* for more details)
ATS of Unchahar TPS	8.4	REC Transmission Projects Company Limited (Refer to *http://www.rectpcl.com/tenders/ts-unchahar/RFQ-Unchahar.pdf* for more details)
Part ATS for RAPP Units 7 and 8 in Rajasthan	37.2	PFC Consulting Limited (Refer to *http://pfcclindia.com/downloads/rfq-notification-document-pdf.pdf* for more details)
Transmission system for connectivity for NCC power projects Ltd (1320 MW)	12	REC Transmission Projects Company Limited (Refer to *http://www.rectpcl.com/tenders/ncc/RFQ-NCC.pdf* for more details)
Transmission system required for evacuation of power from Kudgi TPS (3x800 MW in Phase -I) of NTPC Limited	148.8	REC Transmission Projects Company Limited (Refer to *http://www.rectpcl.com/tenders/ntpc_Kudgi/RFQ_Kudgi.pdf* for more details)
Eastern region system strengthening scheme – VI	64.8	PFC consulting Limited (Refer to *http://pfcclindia.com/downloads/rfq-notification-document-pdf2.pdf* for more details)
Eastern region system strengthening scheme – VII	44.4	PFC consulting Limited (Refer to *http://pfcclindia.com/downloads/rfq-document.pdf* for more details)

**1 INR = 0.0120 GBP*

*** The tentative COD of these projects is expected to be during FY 2016-17*

Growth in the HVDC transmission system

Compared to AC transmission, the advantage of HVDC transmission is its ability to transmit large amounts of power over long distances with lower capital costs and losses.

The focus of investments into HVDC started increasing from the 11th Five Year Plan and gained more prominence in the 12th Plan. The contribution of HDVC is expected to increase further.

HVDC capacity (bipole or back-to-back), existing and planned (MW)

HVDC link	Link type	Implementing agency	Existing at the end of 11th Plan	Planned for 12th or early 13th Plan	Expected at the end of 12th or early 13th Plan
Chandrapur-Padghe	Bipole	MSEB	1,500	-	1,500
Rihand-Dadri	Bipole	[illegible]	1,500	-	1,500
Talcher-Kolar	Bipole	PGCIL	2,500	-	2,500
Balla-Bhiwandi	Bipole	PGCIL	2,500	-	2,500
Biswanath-Agra	Bipole	PGCIL	-	3,000	3,000
Champa-Kurukshetra	Bipole	PGCIL	-	3,000	3,000
Raigarh(Kotra)-Dulhe	Bipole	PGCIL	-	4,000	4,000
LILO of Bishwanath-Agra at Alipurduar	Bipole	PGCIL	-	3,000	3,000
Mundra-Mohindergarh	Bipole	Adani	2,500	-	2,500
Sub-total (bipole)			10,500	13,000	23,500
Vindhyachal	Back- to- back	PGCIL	500	-	500
Chandrapur	Back- to -back	PGCIL	1,000	-	1,000
Gazuwaka	Back- to- back	PGCIL	1,000	-	1,000
Sasaram	Back- to- back	PGCIL	500	-	500
Sub-total (back- to- back)			3,000		3,000

Transmission for renewable generation

Central level: During the 12th Plan, a tentative target for grid interactive renewable power addition of 18,500 MW (11,000 MW in wind, 3800 MW in solar, 1600 MW in small hydro and 2100 MW in others) has been estimated.

In an attempt to ensure smooth evacuation and distribution of green energy across the country, POWERGRID has decided to set up an exclusive cross-country green corridor for renewable energy, involving an investment of 5 billion GBP over a period of five years. The investment aims at enabling transmission of 40 GW of renewable energy capacity by 2030.

State level: The state transmission utilities of Himachal Pradesh, Rajasthan, Gujarat and Tamil Nadu have prepared comprehensive long-term transmission plans totalling to an amount of approximately 1 billion GBP, and have submitted these plans to the MNRE for financial support. These reports are currently being examined by the MNRE and the CEA.

State plans for transmission capacity for renewables

Gujarat: Capacity addition of 4500 MW of wind energy and 960 MW of solar energy is planned. An investment of 108 million GBP is proposed in the transmission infrastructure development phase.

Rajasthan: Capacity addition of 1500 MW of wind energy and 1300 MW of solar energy is planned. An investment of 282 million GBP is proposed in the associated transmission infrastructure development phase.

Himachal Pradesh: Capacity addition of 560 MW small hydro projects is planned with an investment of 48 million GBP in the transmission infrastructure phase.

Tamil Nadu: Capacity addition of 4000 MW of wind generation projects are planned with an investment of 5 billion GBP in the transmission infrastructure phase.

Trending technologies

The working group on the power sector for the 12th Five Year Plan envisages several new technologies that will increase power transmission capacity and reduce land requirement. Such technologies include the following:

- Designing and developing of equipment for 1200 kV AC system
- Development of high temperature low sag electrical conductors for transmission lines
- Design and development of equipment for UHV DC +/- 800 kV system
- Gas insulated transmission lines
- Submarine cables

Apart from the above, the following technologies are also finding increased acceptance in the sector:

- Compact towers
- High voltage gas insulated stations
- Regulation in power flow and deployment of FACTS devices
- Condition-based monitoring and preventive maintenance
- High capacity 6000 MW + 800 kV HVDC systems
- High surge impedance loading line (HSIL)
- AAAC and polymer or composite insulators
- Semi-conducting glazed insulators
- Disc insulators of 320 kN and 420 kN

FACTS devices

Flexible alternating current transmission system (FACTS) devices enable existing transmission lines to deliver maximum power, and help stabilise the grid with precise power control. FACTS devices use power electronic- based systems and other static equipment for transmission of energy.

FACTS devices are also helpful in extracting the full potential of transmission lines and are most apt for the Indian transmission sector

Power distribution

In the UK, the Utilities Act made a provision for the separation of supply and distribution activities of the former Public Electricity Suppliers (PES). This means that at present, any company holding an electricity supply license can sell electricity, and customers are free to choose their own supplier. However, in India, distribution companies still continue to jointly manage these two functions, that is, the wire business and the retail supply.

Distribution being the last and the most vulnerable link of the power sector value chain has also been receiving its due share of attention in the recent past. The 11th Five Year Plan emphasised on the creation of capacity in sub-transmission and distribution in order to strengthen the distribution sector in the country by considering the target generation capacity additions.

The central government has introduced several initiatives and schemes in order to strengthen the distribution sector in India.

Central government schemes

Rural electrification: The central government has launched a scheme for rural electrification that has so far achieved 90.3% of village electrification and 83.8% of household electrification targets by the end of the 11th Five Year Plan.

The scheme has been extended to the 12th Five Year Plan period as well, and will focus on the electrification in the north-eastern states and areas of difficult terrain in India.

The scheme is estimated to have a requirement of 7.6 billion GBP during the 12th Five Year Plan, of which government subsidy will be around 6.8 billion GBP.

Restructured Accelerated Power Development and Reforms Programme (R-APDRP): This scheme aims at reducing AT&C losses through technical upgradation and strengthening of the distribution infrastructure.

Financial restructuring programme: Debt restructuring of 22 billion GBP for state-owned distribution companies and for providing liquidity support for undertaking system improvement activities is being proposed in Rajasthan, Haryana, Tamil Nadu, Uttar Pradesh and Andhra Pradesh. These states have given their in-principle consent for participating in the FRP.

The distribution system planned for the 12th Five Year Plan includes setting up of new lines (13, 05,000 ckm), installation of new substations (88,000 MVA), augmentation of substation, with an envisaged investment of 35.6 billion GBP.

Emerging technologies

The following technologies are finding increased acceptance within this sector:

- AC or DC micro-grid demonstration for improving the reliability and power quality
- Energy storage schemes for improving the reliability of sensitive loads
- Development of interoperable standards and protocol for energy metering, load research (load modelling), and other information technology applications within distribution, etc.

Research initiatives for power distribution automation

- Customer level intelligent automation system
  - Automated meter reading
  - Prepaid metering
- Computer-aided monitoring and control of distribution transformers
  - Remotely operable load break switches
  - Low-cost controllers for capacitor switching
- Substation and feeder level automation
  - Indigenous auto reclosures and sectionalisers
- Data communication system for distribution automation
  - Interfaces for distribution line carrier communication
  - Cost-effective substation RTUs
  - Development and standardisation of distribution automation software
  - Master distribution automation software
  - Integration of geographic information system(GIS)
  - Energy audit and accounting software (EAAS)
  - Trouble call management software (TCMS)
  - Customer information system (CIS)
  - Web-based metering, billing and collection system

Private participation

Currently, three business models exist within the sector for private sector participation. These include the following:

- Privatisation of distribution companies
- Franchisee models
- PPP model

The distribution franchisee model has found maximum acceptance across states on account of the ease of its implementation and minimum resistance from stakeholders. Under this arrangement, the distribution company transfers the operations to a private operator while still retaining the licensing, assets and staff. Bhiwandi, in Maharashtra, was the first circle-level distribution franchisee awarded to Torrent Power Limited in 2007. Thereafter, states such as Uttar Pradesh, Madhya Pradesh, Maharashtra, Orissa, Bihar and Jharkhand have awarded areas to distribution franchisees which have created a huge opportunity for private as well as international developers in the power distribution business.

Input-based franchisee is the most commonly adopted model for awarding a distribution franchisee. Under this model, the energy is supplied to the distribution franchisee area by the distribution company at a pre-determined rate. The area is awarded to the bidder who offers the maximum power purchase price to the distribution company. The distribution franchisee is responsible for managing losses, meeting regulatory targets and commercial operations within the area.

Apart from the states in the table above, the states of Uttaranchal and Karnataka have also indicated interest in awarding distribution franchisee to select cities or areas within the state.

Private participation through the distribution franchisee route (as of June 2013)

Location	City	Year of award	Contract period	Revenue size (mn GBP)	Successful bidder or status
Maharashtra	Bhiwandi	2007	10 years	42.4	Torrent Power Ltd
	Nagpur	2011		40.3	Spanco Power Distribution Ltd
	Aurangabad			50.4	GTL Ltd
Uttar Pradesh	Agra	2012	20 years	41.6	Torrent Power Ltd
	Meerut	Under process	25 years	44.4	Technical consultants appointed
	Ghaziabad			177.0	
	Kanpur			96.8	
	Varanasi			42.0	
Madhya Pradesh	Gwalior	2012	15 years	39.6	Smart Wireless Ltd (Essel Group)
	Ujjain			15.6	Smart Wireless Ltd (Essel Group)
	Sagar			6.6	Smart Wireless Ltd (Essel Group)
Jharkhand	Ranchi	2012	15 years	37.6	CESC Ltd
	Jamshedpur			42.0	Tata Power Ltd
Bihar	Bhagalpur	2013	15 years	8.5	SPML Infra Ltd
	Muzaffarpur			13.4	Smart Wireless Ltd (Essel Group)
	Patna	Under process	15 years	90.0	Technical consultant appointed
	Gaya	Under process	15 years	5.2	Bids under evaluation
Jammu and Kashmir	Jammu	Under process	Bid documents under preparation	36.5	Technical consultant appointed

Smart grid

Smart grid vision for India

"Transform the Indian power sector into a secure, adaptive, sustainable and digitally "enabled ecosystem by 2027that provides reliable and quality energy for all with active participation of stakeholders."

The smart grid vision has envisaged a total investment of 3.6 billion GBP on smart grid initiatives during the period 2012-2017 focusing primarily on the following:

- Medium- size and micro grids for peak load shaving
- Real-time condition monitoring, energy audit and accounting
- Smart distribution transformer control
- Advanced metering infrastructure for high-value consumers
- Fibre connectivity for all substations-33 kV and above

Smart grid in India will focus on the following:

- Minimising power cuts and enabling reduction in transmission and distribution (T & D) losses
- Improvement in supply quality
- Revenue cycle optimisation
- Managing peak power and demand response
- Efficient grid integration of renewable and distributed generation

Key initiatives already underway for transitioning to a smart grid system are as follows:

- Formation of the India Smart Grid Forum (ISGF) and India Smart Grid Task force (ISGTF)
- Constitution of five working groups to take up different tasks related to smart grid activities
- India smart grid vision and roadmap for 14th Five Year Plan (2022-27)

Working groups under ISGF

- Advanced transmission
- Advanced distribution systems
- Communications for smart grids
- Metering
- Consumption and load control
- Policy and regulations
- Architecture and design
- Pilots and business models
- Renewable and micro grids
- Cyber security

Working groups under ISGTF

- Trials or pilot projects on new technologies
- Loss reduction and theft, data gathering and analysis
- Power to rural areas and reliability plus quality of power in urban areas
- Dist generation and renewable
- Physical cyber security, standards and spectrum

Smart grid in transmission

POWERGRID has taken the initiative to implement several smart grid pilot projects within the transmission sector. Towards this, a pilot project in the northern region, involving wide area measurement system (WAMS) using phasor measurement units (PMUs), associated hardware and software at control centres has already been implemented.

Similar pilot projects in the NR, WR, ER, SR and the NER have been taken up.

Another similar project covering all states and the inter-state transmission system (ISTS) network has been taken up for the regulatory approval by CERC.

WAMS

WAMS requires installation of phasor measurement units (PMUs) at the substations and power plants. The process for PMU installation has already been started. Eight PMUs (at Moga, Kanpur, Dadri and Vindhyachal in first phase and Agra, Bassi, Hisar and Kishenpur in the second phase) have already been commissioned in the northern region, and a proposal for the installation of PMUs in other regions as well is also in the pipeline.

This will facilitate situational awareness (especially dynamic state of the grid in terms of angular and voltage stability), control and regulation of power flow to maintain grid parameters, remedial action scheme(RAS), system integrated protection scheme (SIPS) and identifying corrective actions to be taken in the event of severe contingency to prevent grid disturbances.

Smart grid in distribution

Fourteen smart grid pilot projects have been announced with different distribution utilities, covering approximately 377,000 consumers and focussing on advanced metering, outage management, peak load management, distributed generation, etc. Concentrated and planned efforts on smart grid in India reflect a growing focus on transitioning towards a smarter power sector in the years to come.

Trending technologies: The following technologies are finding increased acceptance in the smart grid domain in current times:

- Advance metering infrastructure for distribution
- Time-of-day metering including consumer home energy management systems
- Integration of renewables and electrical vehicles with the grid
- Intelligent substations with self-healing

Smart grid pilot projects in distribution

The following smart grid pilots have been announced as on [illegible] 30, 2013 for implementation across the country. POWERGRID has signed a MoU with the Puducherry E[illegible]tricity Department so as to implement India's first smart grid pilot. Other pilots are yet to be awarded.

Utility name	Area proposed	[illegible]ionality proposed	Initial consumer base
CESC Mysore, Karnataka	Mysore additional ci[illegible] area division	[illegible], AMI I, OM, PLM, MG,DG	21,824
APCPDCL, Andhra Pradesh	Jeedimetl[illegible]du[illegible]area	AMI R, AMI I, OM, PLM, PQM	11,904
APDCL, Assam	Guwahati proj[illegible]t area	PLM, AMI R, AMI I, OM, DG, PQM	15,000
UGVCL, Gujarat	[illegible]r[illegible] Deesa	AMI R, AMI I, OM, PLM, PQM	39,422
MSEDCL, Maharashtra	Ba[illegible], Pune	AMI R, AMI I, OM	25, 629
UHBVN, Haryana	[illegible]nipat city subdivision	AMI R, AMI I, PLM	30, 544
TSECL, Tripura	Electrical division no. I, Agartala	AMI R, AMI I, PLM	46, 071
HPSEB, Himac[illegible] Pradesh	ESD Kala Amb under electrical division, Nahan	AMI I, OM, PLM, PQM	650
Puduche[illegible]	Div 1 of Puduchery	AMI R, AMI I	87,031
JVVNL, R[illegible]sthan	VKIA Jaipur	AMI R, AMI I, PLM	2,646
[illegible], Chhattisgarh	Siltara, Chhattisgarh	AMI I, PLM	508
PS[illegible]CL, Punjab	Mall Mandi city sub-division, Amritsar	OM	9,000
KSEB, Kerala		AMI I	25, 078
WBSEDCL, West Bengal	Siliguri, Darjeeling	AMI I, AMI R, PLM	4,404

Legend- "functionality proposed"
AMI R: Advanced metering infrastructure for residential consumers
AMI I: Advanced metering infrastructure for industrial consumers
OM: Outage management
PLM: Peal load managemen
PQM: Power quality management
MG: Micro grid
DG: Distributed generation

Opportunities in transmission, distribution and smart grid in India

In the Indian power sector, it is observed that every programme or project undergoes four stages during its life cycle. The first stage focuses on policy formulation and programme conceptualisation, followed by the research and development stage. In some cases, pilot projects are extensively carried out in the second stage for testing the acceptability of the new product or technology as well as the prospective benefit it can bring. The third stage is the implementation stage where opportunities exist for programme management, contracting, technological collaboration, etc. The final stage of any programme is the post-implementation support to provide operational assistance as well as to monitor and evaluate the impact of the implemented programme. The opportunities present for UK companies at different stages of the programme life cycle have been captured for T&D and smart grid- related projects in the following table.

Segment	Policy and programme conceptualisation	Research and development or pilots	Programme implementation	Post implementation support
Transmission	The sector is mature and self-evolving and not many opportunities exist in policy advocacy.	**System design** Designing systems for extra high voltage levels (e.g. 1200 kV HVAC and 800 kV HVDC)	**Technical collaboration** Private sector participation has opened up the market for new players and first-time developers who need technical collaboration for bid qualification and subsequent project execution. **EPC contracts and turnkey solutions** New private sector players will reach out to experienced EPC contractors for project time and cost optimisation. **Project management consultants** Management of the project portfolio and internal capacity building	**Post- implementation service support**
Distribution	The sector is mature and self-evolving and not many opportunities exist in policy advocacy	**Pilots** Potential assessment of new technologies	**Project management consultants** Effective management of government schemes and utility- specific capital investments	**Impact assessment studies** Impact assessment studies for benefit realisation and maximisation
Smart grid	**Policy formulation** Policy advocacy with the central and state government in line with the smart grid vision	**Pilots** Technology implementation and evaluation support to implementation agencies	**Project management consultants** Effective management of scheme-specific capital investments	**Impact assessment studies** Impact assessment studies for benefit realisation and maximisation

Tendering agencies in focus states for transmission, distribution and smart grid proje

Sector	Prospective bidding agencies	Information sources
Transmission	**Central level agencies** • POWERGRID • PFC Consulting Limited • REC Transmission Projects Company Limited	www.powergridindia.com/ www.pfcclindia.com/ www.rectpcl.com/index.php
	State level agencies • Maharashtra State Electricity Transmission Co. Ltd • Karnataka Power Transmission Corp Ltd • Gujarat Energy Transmission Corp Ltd • Transmission Corp of Andhra Pradesh Ltd	www.mahatransco.in/ www.kptcl.com/ getco.co.in/getco_new/ www.aptransco.gov.in/
	Major EPC contractors or private developers • Kalpataru Power Transmission Ltd • KEC International Ltd • Jyoti Structures Ltd • EMCO Ltd • Sterlite Grid Ltd • Reliance Power Transmission Ltd	www.kalpatarupo[illegible]/index.html www.kecrpg.com www.jsl.in/ www.emco[illegible]om/home.html http://www.sterli[illegible]echnologies.com/ http://www.rinfra.com/kar_energy_transmission.html
Distribution	**Central level agencies** • Ministry of Power • Rural Electrification Corporation : RGGVY • Power Finance Corporation: R-APDRP	http[illegible]powermin.nic.in/ [illegible]ggvy.gov.in/rggvy/rggvyportal/index.html [illegible].apdrp.gov.in
	State level agencies • Madhya Pradesh Power Management Co Ltd • Maharashtra State Electricity Distribution Co Ltd • Bangalore Electricity Supply Co, [illegible] • Jharkhand State Electricity Board • Bihar State Power Holding Co L	www.mppmcl.com www.mahadiscom.in/ http://bescom.org/en/ www.jseb.in/ http://bsphcl.bih.nic.in/
	Private players for PPP • Torrent Power Ltd • CESC Ltd • Essel Infra Project Ltd • SPANCO Ltd • Tata Power • Reliance Infrastructure Ltd	www.torrentpower.com/ www.cesc.co.in/cesc/web/index.html www.esselinfraprojects.com/ www.spancopower.com/ www.tatapower.com/ http://www.rinfra.com/kar_energy_distribution.html; http://www.bsesdelhi.com/

Sector	Prospective bidding agencies	Information sources
Smart Grid	**Central level agencies** • Ministry of Power • India smart grid knowledge portal • India smart grid task force	http://powermin.nic.in/ http://indiasmartgrid.org/en/quicklinks/Pages/quickLinks.aspx www.isgtf.in/
	State level agencies • Puducherry electricity department • Uttar Gujarat Vij Co Ltd, Gujarat • Uttar Haryana Bijli Vitran Nigam, Haryana • Maharashtra State Electricity distribution Co Ltd. • CESC Mysore, Karnataka	http://electricity.puducherry.gov.in/ www.ugvcl.com/ www.uhbvn.com/ www.mahadiscom.in/ www.cescmysore.org/
	Private players for PPP • Tata Power Delhi Distribution Limited, Delhi (NDPL) • Reliance Infrastructure Ltd(BSES), Delhi • Bangalore Electricity Supply CoLtd, Karnataka	http://www.ndpl.com/ http://www.reliancepower.co.in/our_business/energy_distribution.html; http://www.bsesdelhi.com/ http://bescom.org/en/

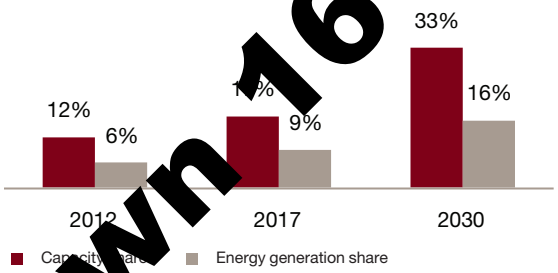
03

Opportunities in renewables

India's focus on harnessing its renewable energy potential is evident from the fact that its share in installed generation capacity is estimated to rise from 12% in 2012 to 17% in 2017 (end of 12th Five Year Plan) and is expected to reach 33% by 2030.

Private sector investments, primarily driven by government incentives such as fiscal incentives, tax holidays, depreciation allowances and 100% FDI allowances have been the major growth drivers of the renewable sector in India.

Generation from renewable energy



Source: Draft 12th Five Year Plan

India's renewable potential

India's estimated potential (2032) for power generation from renewable sources is around 183 GW. Against this, the current grid-interactive installed capacity is only 28 GW (approximately 15% of the potential).

Source	Potential (assessed upto 2032)	Installed capacity (MW)*
Wind	45,000	19,051
Solar	50,000	1,686
Biomass and co-generation	66,000	3,602
Small hydro (upto 25 MW)	15,000	3,632
Waste to energy	7,000	96

*Source: MNRE, MOSPI; *Grid connected installed capacity as on March 31, 2013*

Given India's huge untapped renewable power potential, existing energy deficit and high latent demand scenario, development of renewable energy is bound to gain pace in the near future. The 12th Five Year Plan (2012-2017) is expected to add over 30 GW of renewable capacity.

Grid connected capacity addition targets for the 12th Five Year Plan

Source	Target (MW)
Wind	15,000
Solar	10,000
Other renewable sources	5,000

Source: Draft 12th Five Year Plan

Policy enablers

Both the central and state governments play an important role in the development of renewable power through various agencies.

The Ministry of New and Renewable Energy was set up with a special focus on the development of renewable energy in the country.

IREDA was established under the MNRE in 1987 in order to extend financial assistance in developing renewable power.

MNRE schemes are implemented through renewable energy development agencies established by the states. These agencies rely on the participation of local administration, village level organisations and non-governmental organisations.

Regulatory provisions

The MNRE has formulated several schemes and regulations to ensure the development of renewable power in India.

- ***Renewable purchase obligations:*** All captive consumers and distribution licensees are required to meet a certain percentage of their consumption through renewable sources or by purchasing an equivalent amount of renewable energy certificates. These obligations are notified through regulations drafted by various electricity regulatory commissions.

The RPOs are classified broadly as solar and non-solar.

- ***Renewable energy certificates:*** Those generators of renewable energy that do not sell their power at preferential tariffs are eligible to sell RECs. (One REC = one MWh of renewable generation). These RECs are traded on power exchanges in the country.

Government initiatives

- ***Jawaharlal Nehru National Solar Mission:*** The Jawaharlal Nehru National Solar Mission (JNNSM) sets an ambitious target of 20 GW of grid-connected and 2 GW of off-grid solar power by 2022 against a current installed capacity of less than 1 GW.

  Various projects were awarded to the developers under Phase I of JNNSM through a reverse auction process conducted in two batches. The projects awarded under two batches, witnessed decline in tariffs indicating mounting price pressures on developers. The lowest tariff bid under batch I (Phase I) of the mission was 13.14 pence per kWh for solar PV which fell to 8.99 pence for projects bid under batch II.

  JNNSM Phase II (2013-2017) has been launched formally with the notification of draft policy documents in December 2012. Phase II envisages the installation of 10 GW of grid connected and one GW off-grid capacity by the end of 2017.

The policy document of Phase II envisages that out of the 10 GW of grid connected capacity; 4 GW will be developed under the central scheme and 6 GW under various state-specific schemes.

Solar Energy Centre: A solar energy centre has been set up in Gurgaon, Haryana to serve as an interface between various stakeholders in the solar sector for implementing activities related to research and development, prototype testing, human resource development and also advisory services.

- ***Centre for Wind Energy Technology (C-WET):*** A research centre has been established to improve India's wind energy potential. The initial wind energy potential estimated at around 50 GW at a 50-meter mast height designs can be doubled to 100 GW if C-WET's 80-meter mast designs find commercial acceptance.
- ***Fiscal incentives***
  Generation based incentive: Developers can avail fiscal support on tariff from the MNRE, provided they do not sell power under preferential rates. GBI schemes are currently available for solar and wind projects.

  Accelerated depreciation: Those developers that are not availing GBI can write off 80% of the project value in the first year as depreciation to reduce their tax burden.

Major new schemes envisaged under the 12th Five Year Plan

The 12th Five Year Plan envisages several new initiatives to promote the development of other renewable sources such as biomass and waste-to-energy.

Biomass: The National Bioenergy Corporation of India is being envisaged for implementing initiatives such as the proposed National Bioenergy Mission and takeover of the ongoing National Biomass Cook Stove Programme.

Waste-to- energy: JNNURM supports waste-to-energy projects in the country and envisages setting up projects creating 200 MWe of energy recovery capacity from urban waste during the 12th Five Year Plan.

> *"Clean and green energy is a priority of the government. However, despite cost advantages in labour, land and construction, the consumer pays a high price for renewable energy. One of the reasons is high cost of finance. In order to provide low-cost finance, the government will provide low interest bearing funds from the National Clean Energy Fund (NCEF) to IREDA to on-lend to viable renewable energy projects. The scheme will have a life span of five years."*
>
> Finance Minister in his Budget 2013 speech

Solar

The demand-supply scenario according to the JNNSM Phase II policy document (draft) highlights that all states, except Gujarat and Rajasthan face a deficit in terms of their installed solar capacity to meet the solar RPO.

Under the Electricity Act, 2003, a distribution utility need not necessarily gain power from the state itself and can procure power through a competitive bidding route depending on the lowest tariffs (landed costs) bid for.

States that are in a power surplus, indicate the presence of a good investment climate and are preferred project destinations for developers. Power generated from such states can easily be sold to utilities in other states through the competitive bidding route.

The states that face RPO deficit indicate potential grounds for upcoming projects as respective state governments and state-owned generating companies are expected to invest towards RPO compliance

RPO compliance in top solar potential states

States	Solar RPO requirement (MW)					Installed capacity (MW)	Deficit capacity for 2012-13 (MW)
	2012-13	2013-14	2014-15	2015-16	2016-17	August 2012	
Maharashtra	208.63	431.51	669.37	922.97	1193.12	21	187. 63
Tamil Nadu	133.86	293.09	481.30	702.56	961.44	10	123.86
Andhra Pradesh	140.80	302.92	488.77	701.03	942.62	24.75	11 .05
Uttar Pradesh	123.44	262.55	418.84	593.93	789.56	14.38	10
Karnataka	91.69	193.70	306.91	432.26	570.75	19	72.69
Madhya Pradesh	76.15	163.24	262.47	375.12	502.60	7.96	3.19
Punjab	72.75	164.13	277.75	417.78	589.13	9.33	3.42
Gujarat	117.01	256.89	423.02	619.16	849.62	689 1	-572.80
Rajasthan	77.60	163.98	259.88	366.10	483.50	201.65	-124.05

Source: JNNSM phase II policy document[6]

Additionally, several deficit states have announced their capacity addition plans during Phase I of the JNNSM and issued bids.

Capacity addi s announced in various state bids

State	Solar programme capacity (MW)
Tami	3,000
ka	600
rashtra	205
Madhya Pradesh	200
Odisha	50
Gujarat	968.5
Rajasthan	200
Total	**>5,000**

Source: MNRE Energy A s, November 2012

Based on e deficit solar RPO and the announced bi , the following states appear to be the most pro ac e pursuing their commitment to develo ng solar power.

Focus states

Tamil Nadu
Gujarat*
Karnataka
Rajasthan*
Maharashtra
Madhya Pradesh
Andhra Pradesh

** Gujarat and Rajasthan continue to remain in the focus radar of developers despite having solar capacity in surplus of the states' mandatory obligation due to their high potential, progressive policies and industrial demand (especially Gujarat).*

6. It is pertinent to note that each state to meet its renewable purchase obligation either through purchase of power or through purchase of RECs. The developers in surplus states can opt to sell renewable power at an average p r purchase price and be eligible to trade RECs in the market or sell surplus power directly to other deficit states through inter-state transmission lines. However, constraints on inter- te nsm on capacity for renewable power and weak REC market has made inter-state sale of renewable power offsetting of RPO through RECs a challenge at the moment and each deficit sta s to develop renewable capacity within the state itself.

Ongoing solar projects (as on June 30, 2013)

States	Project	Developer	Status
Tamil Nadu	Setting up 1000 MW of solar power plants as envisaged in the state's Solar Policy 2012	The list of developers who received the LoI is not available in the public domain. An indicative list of developers awarded the project includes the following: Welspun Energy – 30 MW GRT Jewellers – 15 MW Sun Edison – 10 MW	Tamil Nadu Generation and Distribution Corporation (TANGEDCO) had run the bid and received proposals for 500 MW. The LoI was awarded in March 2013 to 26 developers with a cumulative bid capacity of 226 MW. The initial tariff has been fixed at 7.77 pence per unit. Projects are planned to be commissioned by January 2014.
	100MW solar PV plant in Paramakudi	Raasi Green Earth Energy	Agreement signed between developer and Tamil Nadu Industrial Development Corporation (TIDCO) to set up the project 10MW to be commissioned by end of 2013
Andhra Pradesh	10 MW solar PV plant at NTPC Ramagundam Thermal Power Plant under Phase 1 of the envisaged 25 MW solar plant	National Thermal Power Corporation (NTPC)	Bids invited and PPA executed with AP discoms Project facing litigation hurdles locally To be commissioned by the end of 2013
	Installation of 1,000 MW of solar PV farms under the state solar policy	As the LoI has not been awarded to any developer, nothing can be said firmly about those who have agreed to set up projects at the tariff decided by APTransco. List of major bidders (in no specific order of preference) include: Power Ltd – 170 MW Projects Pvt Ltd – 95 MW Infraprop Pvt Ltd – 80 MW Solar Pvt Ltd – 60 MW Mahira Power Systems Pvt Ltd– 40 MW Surya Green Power Pvt Ltd – 50 MW Essel Mining and Industries Ltd – 50 MW Madhucon Sugar and Power – 35 MW NCS Sugars – 35 MW Kranthi Edifice Pvt Ltd – 35 MW Azure Green Tech Pvt Ltd – 30 MW	APTransco, the nodal agency to run the bidding process, received 330 bids from 184 bidders with a cumulative bid capacity of 1,712 MW. The lowest bid is at 7.78 pence per unit and the maximum at 13.18 pence per unit. The LoI has not been awarded yet.

States	Project	Developer	Status
Madhya Pradesh	130 MW solar PV project in Mandsaur, MP 50 MW solar PV project at Rajgarh, MP	Welspun Energy NTPC	The project achieved financial closure in March 2013 and is expected to be commissioned in May 2014. Under construction and commissioning expected in 2013
Chhattisgarh	100 MW solar PV project	Welspun Energy	The project is in a nascent stage. The MoU was signed with the state government in November 2012. The project is estimated to be commissioned by 2015.
Multiple	MNRE pilot (phase I) to install rooftop solar PV installations in Delhi, Gurgaon, Hyderabad, Bengaluru, Chennai, Jaipur and Greater Noida	SunEdison – 1.5 MW Thermax Ltd – 2 MW Azure Power - 2 MW	Projects awarded in Bangalore (2 MW), Chennai (2MW), Delhi (1MW) and Hyderabad (0.5 MW) in December 2012 and are expected to be commissioned by September 2013.
Karnataka	130 MW solar PV	NA	Karnataka Renewable Energy Development Ltd has floated tenders inviting bids for one or more projects having three to 10 MW capacity. Tenders will close in April 2013. Projects are required to be commissioned within 24 months of executing the agreement.
	500 MW solar park in Chitradurg	NA	The project is in the initial stages of planning with 100 MW planned in the first stage.
Gujarat	25 MW solar PV project in Kutchh and rooftop solar pilot project in Sanand	Veer Energy	As of November 2012, the developer had acquired land in Kutchh for the solar PV project. The developer has collaborated with Alstom AG Swiss for technology. No update is available on expected commissioning. The developer has tied up with US-based New Millennium Solar Equipment Corporation for the rooftop solar project.
Rajasthan	75 MW solar PV projects in villages of Bhadla, Tehsil Phalo in Rajasthan under competitive bidding of Rajasthan Solar Policy 2011	Gitanjali Mining and Ind Ltd – 20 MW Rona Dyechem Pvt Ltd – 25 MW Energo Engg Projects Pvt Ltd – 10 MW Sidhidata Solar Urja Ltd – 5 MW Arjun Green Power Pvt Ltd – 5 MW Star Solar Pvt Ltd – 5 MW Sungold Energy Pvt Ltd – 5 MW	Projects have been awarded at a tariff of 7.74 pence per unit in April 2013. Projects are in the initial stages of construction.
Maharashtra	ADB finance[illegible] solar project on BOM[illegible] Maha[illegible] will have ownership of assets [illegible] years after which they will be transferred to the bidder	Currently under bidding	Mahagenco has invited the bids.

Trending solar technologies

Technologies under JNNSM Phase I: Phase I of the JNNSM primarily focussed on the following technologies:

- Parabolic trough collector based solar thermal systems
- Thin film based solar PV
- Crystalline silicon based solar PV

Some developers also installed solar thermal projects based on solar tower, compact linear Fresnel reflector and dish sterling systems. However, these capacities were small as compared with the conventional parabolic trough collector systems.

Technologies under JNNSM Phase II

- ***Solar parks and cities:*** Phase II will focus on developing large-scale projects such as solar parks and cities to meet targeted cumulative solar capacity of 10 GW in 2017. The foundation of the solar cities development programme was laid during the 11th Five Year plan when the MNRE gave an in-principle approval for developing 48 solar cities7.
- ***Rooftop solar PV:*** Phase II will focus on the deployment of both off-grid and grid connected rooftop PV systems in the country.
- ***Off-grid schemes:*** Various off-grid solar PV and thermal schemes have been identified as thrust areas for promotion during Phase II.
- ***Other applications***
  - Distributed generation (e.g. rooftop solar)
  - Industrial process heat applications
  - Solar water irrigation pumping systems
  - Off-grid lighting such as solar powered lanterns, home lighting systems, and street lighting systems
  - Solar cookers
- ***Hybrid systems:*** Phase II is also envisaged to focus on developing solar hybrid systems with solar energy contributing at least 40% to the total generation.
- ***Solar R&D:*** The following areas are highlighted under Phase II:
  - Materials for solar thermal applications such as receivers for parabolic technology, self-cleaning reflective surfaces, receiver modules for central towers, organic solar cells, etc.
  - Hybrid and storage technologies
  - High temperature photovoltaic, concentrated photovoltaic
  - Heat cycles for solar thermal with air as heat sink
  - Low cost tracking systems

Other technologies: Private developers are continuously innovating and creating new solar PV applications. Building integrated solar PV systems is another such innovation. BIPV installations integrate solar PV cells with the architecture of the building through specially designed glass laminates.

Business models for grid connected solar projects

Capital investment models: There could be several business models to set up grid connected non-captive solar projects. The most prevalent of these are the following:

- Development based model
- Rooftop lease model

Development based model: This is the traditional model, where the developer has the flexibility to select land, technology, project execution, O&M mode (turnkey, EPC, etc.). In most cases, EPC installation of project components is in the scope of the OEM. Post installation O&M may be retained by the developer if such in-house capabilities exist or are outsourced to a professional O&M firm.

Rooftop lease model: Developers hire rooftops to install PV systems against power supply for the captive consumption of rooftop owners. The developer may award the project to an OEM through EPC contracts.

Revenue models under JNNSM: Three major revenue models are available under JNNSM (Phase II) for solar projects:

- Bundling scheme
- Generation based incentive
- Viability gap funding

Bundling scheme: Under this scheme, expensive

7. Refer http://www.mnre.gov.in/solar/grid-connected-centralized-systems/solar-cities/ for details

power from solar plants is bundled with relatively cheaper power from the unallocated NTPC thermal power quota and is sold to the distribution companies through a single trader at a weighted average price. This model was successfully implemented during Phase I and was well accepted by state-owned distribution companies. However, a bundling scheme will have limited scope in Phase II due to limited availability of unallocated power from the NTPC.

Generation based incentive: Under Phase I, solar projects under the rooftop PV and small solar power generation programme were allowed GBI equal to the difference of the tariff determined by the CERC and the base rate of 6.6 pence per kWh (for FY 2010-11 and escalated at 3% every year thereafter). The projects were selected on first-come-first served basis. Projects in the states not covered under Phase II will only be eligible for this scheme. Maximum permitted projects from a state will be upto the capacity to meet that state's solar RPO. Considering the levelised tariff of 9.4 pence per kWh allowed by the CERC for solar technologies in FY 2013-14 and base tariff of 7.2 pence per kWh, the GBI for Phase II is expected to be around 2.4-3.6 pence per kWh which is considerably lower than that allowed under Phase I.

Viability gap funding: This is a PPP scheme that provides viability gap funding of upto 20% of the total project cost. Projects are established by the developer on build, own and operate basis. Under this scheme, projects are awarded through a competitive bid with the project being awarded to the bidder with a minimum VGF requirement. VGF is envisaged to be provided on deferred payment basis to ensure completion of projects. The National Clean Energy Fund is being proposed as the source for the proposed VGF. It is being envisaged as the most important mode of project development under Phase II.

The VGF model has been introduced for over 750 MW capacities under Phase II of the JNNSM. The tariff will be fixed at 7.8 pence per unit for 25 years with the project being awarded to the developer seeking the lowest VGF. The Solar Energy Corporation of India (SECI) is the nodal agency for administering the VGF scheme.

Other models/JNNSM sales models for solar projects: There are several other models that a solar developer can use to sell power.

APPC and REC: Under this mechanism of sale of solar energy, energy is sold at an average power purchase cost (APPC) as notified by the SERC from time to time. Over and above this price, developers can claim RECs on the generated energy sold to the state which can be traded in power exchange. This is an easy to implement the sales option but suffers the risk of not achieving financial closure as lenders do not back market determined REC price.

Open market sales: Developers can explore options to sell power through bilateral agreements with voluntary green power purchasers such as corporates who may wish to procure green power as a part of their corporate social responsibility initiatives or to conventional captive power producers for offsetting their RPO. This mechanism is preferred and practical when the generator and consumers are located within the same state.

Wind

India has a potential of around 45,000 MW of grid connection wind power projects of which it has realised 19,051 MW as installed capacity as on 31 March 2013.

India's installed capacity is the fifth highest in the world with a share of around 6.5% in the global installed capacity as on December 2012[8].

Green shoots: Revival of India's wind sector - Union Budget 2013

The Indian wind energy market had witnessed a drop in investment and growth in installed capacity during FY 2011-12. One of the reasons being discontinued benefits such as accelerated depreciation and generation based incentives. The Union Budget 2013 re-introduced the GBI scheme to bring the sheen back to India's wind sector. A budgetary allocation of 96 mn GBP has been made for FY 2013-14 but the funds are yet to be released to IREDA for disbursement to the sector.

Top potential states

State	Potential (MW)	Installed capacity (MW)
Andhra Pradesh	5,394	192
Gujarat	10,609	2,9[illegible]
Karnataka	8,501	1,[illegible]
Maharashtra	5,439	[illegible]
Tamil Nadu	5,374	6,[illegible]8
Rajasthan	5,005	2,071
Jammu and Kashmir	[illegible]11	-
Madhya Pradesh	[illegible]0	376
Odisha	910	-

Source: MOSPI
Installed capacity [illegible]n March 31, 2012

Based on the fact that Jammu and Kashmir and Odisha have not made capacity additions despite the huge potential that exists in these states, the following can be identified as the states to watch out for wind power related investment.

Focus states

Gujarat
Andhra Pradesh
Karnataka
Maharashtra
Tamil Nadu
Rajasthan
Madhya Pradesh

These states have also been identified by C-WET as high potential states.

8. Source: World Wind Energy [illegible]ion. Refer http://www.wwindea.org/webimages/WorldWindEnergyReport2012_final.pdf for details

Ongoing wind power projects

Announced capacities: Several developers have already made public their wind capacity addition plans for the next five years with projects being at various levels of execution.

Announced capacity additions

Developer	Planned capacity addition upto 2018 (MW)
Mytrah Energy India Limited	5000
NTPC Ltd	1,025
Indian Energy Ltd	1,000
Welspun Energy Ltd	850
Greenko Energies Pvt Ltd	665
RS India Wind Energy Ltd	500
Inox Renewables Ltd	400
Tata Power Co. Ltd	388
Beta Wind Farm Pvt Ltd	300
Suryachakra Green Power Pvt Ltd	300
Gujarat State Petroleum Corp Ltd	200
Reliance wind energy Ltd	200
CLP India Pvt Ltd	163
Gamesa Wind Turbine Pvt Ltd	160
Indowind Energy Ltd	128
Green Infra Ltd	125
GAIL Ltd	115
ONGC	[illegible]
NHDC Ltd	[illegible]
Others	1,[illegible]66
Total	**16,636**

Source: CMIE, extracted from Febru[illegible] 2013 edition of PowerLine

A brief profile of select ongoing projects (as on 30 June 2013)

State	Developer	Project	Status
Andhra Pradesh	Mytrah Energy	MoU with state government to set up 1,000 MW of wind capacity by 2017	The company is developing 100 MW project in Vajrakarur in Anantpur district
Rajasthan	ONGC	102.9 MW wind energy project	• Equipment supply contract awarded to Suzlon Energy • Evaluation bid for selection of project management consultants otherwise • Project expected to be commissioned by FY 2013-14
	NALCO	47.6 MW project in Jaisalmer, Rajasthan	• Contract awarded to Gamesa wind turbines and Suzlon Energy • Project expected to be commissioned by September 2013
Tamil Nadu	Sri Kumarswamy Mineral Exports Ltd	21.75 MW project in Dindigul and Tirunelveli district, Tamil Nadu	• Contract awarded to Suzlon Energy for installing the project • Project expected to be commissioned by April 2014
Maharashtra	NSL Renewable Power	75 MW wind farm at Satara	• Project being executed by ReGen, a group firm of NSL. ReGen will also operate and maintain the project • IFC is financing 19 million USD for this 93 million USD project • First phase of 25.5 MW is expected to be commissioned by March 2013

Source: Various news agencies

Trending wind technologies

Currently, two types of wind turbines have been installed in India:

- Stall regulated with fixed blades
- Pitch regulated with adjustable blades

Mast height for most machines is upto 50 meters

High mast designs: As briefly discussed earlier, C-WET has undertaken a MNRE funded programme to validate the wind potential at different height in the seven focus states. Acquisition of land, equipment and instrumentation for the programme is under progress. Mast designs that are 80-120 meters high have found acceptance across the globe, though in India they are still being tested. There are merely 120 meter mast height monitoring stations in India. Acceptability of high mast designs will be a challenge till wind potential gets proven through investment in increasing converge of monitoring stations and availability of reliable historical data through C-WET monitoring stations.

Offshore wind: MNRE has released a draft of the National Offshore Wind Energy Policy 2013 in the current year[9]. The policy identifies coastlines of Kerala, Goa, Gujarat and Tamil Nadu as high potential zones for developing offshore wind projects. A National Offshore Wind Authority is being envisaged as a nodal agency for promoting offshore wind energy projects. However, development of offshore wind will require investments in terms of resource assessment and environmental impact assessment studies in the initial phase. Subsequently, matters related to technology, grid connectivity and incentive framework will be formalised.

9. Refer http://mnre.gov.in/file-manager/UserFiles/draft-national-policy-for-offshore-wind.pdf for details

Highlights of the Draft National Policy for Offshore Wind Energy in India

- To Promote Deployment of Offshore Wind Farms in the first instance upto 12 Nautical Miles from Indian coast
- Establishment of a National Offshore Wind Energy Authority under MNRE as a nodal agency to carry out resource assessment, enter into contract with developers and act as a single window agency facilitating statutory clearances
- Setting up of a Offshore Wind Energy Steering Committee to oversee execution and implementation of offshore wind energy development activities
- Leasing of off-shore wind blocks to developers through open international competitive bidding process
- Development of power evacuation infrastructure to be the responsibility of state utilities/ a designated authority
- Fiscal incentives such as tax holidays for initial ten years of operations may be made available to developers/ OEMs for manufacturing/ procurement of technology and equipment
- C-WET to test wind turbine designs according to international standards

Business models for wind energy projects

Capital expenditure models: OEMs in the wind energy market have developed the concept of 'shovel ready' projects which is unique for the sector and different from a usual 'development based' model followed by other renewable energy project developers.

Shovel ready solution: The OEMs offer the entire project as an integrated solution comprising of pre-construction activities such as wind resource assessment studies, identification, acquisition of land and EPC support. Such projects can be commissioned within six months of awarding the contract as these are standard packages. Also, acquisition of land in this case is comparatively hassle free as against the development based model. However on the flipside, the turbines being offered by the OEM may not be the best fit for the wind profile. The developer is constrained to accept the entire solution as an integrated package and has no say in choosing the turbine.

Development based model: This is the traditional model where all the developer has the flexibility to select and acquire land from professional land aggregators and equipment depending on the wind profile of the proposed site from any OEM in the market. This ensures greater generation efficiency. The construction time is higher than shovel-ready projects.

Revenue and sales models: There are two prevalent revenue models for wind energy projects:

- APPC+REC
- Captive sales

APPC+REC: Developers can avail RECs and trade them at power exchanges if they sell power to distribution utilities at the APPC notified by SERCs from time to time.

Captive sales: An investor or a group of investors may set up a project as a captive or group captive and sell the surplus power to a distribution utility through a banking arrangement.

Waste to energy

Waste to energy (W2E) in India is at a nascent stage with few projects being operational. Challenges obstructing evolution include poor waste management with inefficient separation of waste and no specific policies that promote W2E projects.

Government incentives and schemes

The Ministry of Urban Development developed a Solid Waste Management Manual in 2000. Chapter 15 of this manual covered in details the various techno-commercial aspects in recovery of energy from municipal solid waste[10].

Subsequently, a National Master Plan for Development of Waste-to-Energy in India[11] was developed to utilise urban and industrial waste for power projects in 2001. After more than a decade since the plan was launched, W2E implementation is still to scale up in India.

National schemes such as the Jawaharlal Nehru Urban Renewal Mission (JNNURM) are expected to aid better solid waste management practices in urban centres. These in turn are expected to fuel growth of W2E projects.

Budgetary support

The central government, in the Union Budget 20 has pledged supporting municipalities a bodies that will implement W2E proj fiscal instruments such as viability (VGF), repayable grant and lo

10. Refer http://urbanindia.nic.in/p wm/swm_manual.htm# for details
11. Refer www.indiaenvironme org.in/files/summar-NMP_10.pdf for details

> *"We will evolve a scheme to encourage cities and municipalities to take up waste-to-energy projects in PPP mode which would be neutral to different technologies. I propose to support municipalities tha will implement waste-to-energy p jects through different instruments su viability gap funding, repay t and low-cost capital."*
>
> The Indian Finance M ist in his Budget 2013 speech

Top potential s

Potential for W exists only in select states that have large pop ns and have witnessed a high degree of urbani and industrialisation.

Ins d y in high potential states

State	Potential (MW)	Installed capacity (MW)
Maharashtra	287	5.72
ttar Pradesh	176	5
Karnataka	151	1
Tamil Nadu	151	5.65
West Bengal	148	-
Delhi	131	16
Andhra Pradesh	123	43.16
Gujarat	112	-
Madhya Pradesh	78	3.9
Bihar	73	-
Rajasthan	62	-

Source: MOSPI Energy Statistics 2013, as on March 31, 2012

As no state has launched a W2E specific policy, it is expected that these projects will come up primarily in those of the aforementioned states that already have installed capacities and have realised the benefits.

Focus states

Andhra Pradesh
Delhi
Maharashtra
Tamil Nadu
Gujarat
Uttar Pradesh

Ongoing W2E projects (as on June 30, 2013)

State	Developer	Project	Status
Maharashtra	Nashik Municipal Corporation	0.84 million GBP W2E plants of 260kWe capacity	• The project is being developed in collaboration with the German government • Technology has been sourced through a German partner • Construction of the project is yet to commence
Andhra Pradesh	Greater Hyderabad Municipal Corporation	40 MW project in Greater Hyderabad Municipal Corporation (GHMC) area under PPP	• Ramky Enviro Engineers Ltd has been selected to develop the project • GHMC has acquired the land clearances • Construction is yet to commence • EPC contracts not awarded
Kerala	Kochi Corporation	W2E plant converting 500 tonnes of municipal solid waste per day	The bids received in March 2013 were rejected and the corporation will now invite the bids again through open competitive bidding
Tamil Nadu	Municipality of Thanjavur	440 kW waste to energy project in Thanjavur at an investment of 0.11 mn GBP	Announced in April 2013 Tender documents not issued yet
	Tirunelveli Corporation	Municipal solid waste processing plant adopting W2E technology at Ramavanpuram for Tirunelveli City Municipal Corporation under PPP on design, finance, build, operate and transfer (DFBOT) basis	RfP issued for the following shortlisted bidders: • Essel Infra projects Ltd, Mumbai • Ramky Energy and Environment Ltd, Hyderabad • AAPL Infra Private Limited, Madurai • IL&FS Environmental Infrastructure & Services Ltd, New Delhi Bids will be opened on 19 July 2013
	Coimbatore Corporation	W2E project processing 500 tonnes of municipal waste per day	The corporation has approved the project and the tenders documents are yet to be issued
Uttar Pradesh	State appointed body	Proposed W2E plant in Lucknow	• The plant is in initial stages of discussion • The government of Uttar Pradesh has met delegates from Renewable Energy Alternatives (REA) to analyse project feasibility
Delhi	Municipal Corporation of Delhi	24 MW plant utilising 3,000 tonnes of municipal waste per day	This upcoming project at Narela Bawana Road was announced in March 2013 (state government's budget) and is at the initial planning stage

Source: Various news agencies

MNRE Pilots: Apart from the aforesaid announced projects, MNRE has launched a programme on energy recovery from municipal solid waste for the year 2012-13 with the following objectives:

- To set up five pilot projects
- To create conductive conditions and environment to develop waste to energy projects

The projects will be awarded on the basis of technical qualification of developers and each project will be evaluated by the Integrated Finance Division of MNRE

The aforesaid programme offers financial assistance to developers of pilot projects on various fronts:

- Financial assistance of 0.24 mn GBP per MW with an upper ceiling of 1.2 mn GBP per project
- A 20% higher assistance for the North East Region, Himachal Pradesh, Sikkim, Jammu and Kashmir and Uttarakhand
- Financial assistance of 50% of the DPR cost with an upper ceiling of 12,000 GBP
- Financial assistance for training courses and awareness workshops
- Financial assistance for resource assessment and performance evaluation studies

Trending technologies

W2E in India is in a very nascent stage and developers are relying on the proven technologies to replicate them in the Indian context.

Business models in W2E

Capital investment model: W2E project in Ind are primarily being awarded under the P out through competitive bidding based o the l tariff bid. BOT and BOOT are the mo on PPP models. The developer is provided land token lease basis and free garbage a e plant site the municipal authority. The Ti okhla 16 MW integrated W2E plant i ew was awarded to JITF Urban Infrastructu d on similar basis.

Revenue and sales model: The concessionaire usually enters int PPA with the distribution companies ope in the area of the municipal authority to ell wer at a tariff bid for during the bidding p s.

Biomass

India being an agrarian economy, biomass-based power projects hold good potential.

A variety of materials such as bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells and sawdust can be used in biomass-based plants for power generation.

Biomass-based projects are often used for co-generation by industries such as sugar mills where they generate process steam to meet their heating requirements apart from generating electricity.

The MNRE estimates that around 32% of India's primary energy consumption is derived from biomass. A crucial constraint is the use of inputs like rice husk, straw, cotton stalk, coconut shells, soya husk and de-oiled cakes as cattle fodder resulting in shortage of input material to realise the potential of electricity generation using biomass.

Off-grid systems for rural electrification through biomass gasifiers have also picked up pace especially with the success of husk gasification plants in Bihar.

MNRE's biomass power and cogeneration programme[12]

The MNRE has been implementing this program[illegible] since the mid 1990s. As of 31 March 201[illegible] had biomass and cogeneration based installed [illegible]pacity of 3,135 MW as against an estimated po[illegible]ial (2032) of 66,000 MW.

Under the programme, the MNRE offers capital subsidy for setting up biomass and bagasse cogeneration projects.

Fiscal benefits such as claiming accelerated depreciation i.e. 80% depreciation being charged the first year of operation, on certain equipme[illegible] an income tax holiday for a period of 10 [illegible] is available to biomass power generatio[illegible]

Focus states

Maha[illegible]tra
Andhra P[illegible]desh
Karnataka
[illegible]ar Pradesh
Ta[illegible]l Nadu
[illegible]njab
Rajasthan

As biomass potential is also limited by the availability of fue[illegible]he region, it is these aforesaid states that possess potential for development of biomass or cogeneration power.

[illegible]op potential states

States	Potential (MW)	Installed capacity (MW)
Andhra Pradesh	878	363
Karnataka	601	441
Maharashtra	1537	604
Tamil Nadu	601	533
Uttar Pradesh	1,426	645
Punjab	345	91
Rajasthan	62	83

Source: MOSPI

12. Refer http://www.mnre.gov.[illegible]es/grid-connected/biomass-powercogen/ for details

Ongoing biomass and co-generation projects (as on 30 June 2013)

State	Developer	Project	Status
Punjab	Punjab Biomass Power Ltd	Setting up of 84 MW of plants based on rice straw by 2017	12 MW plant under planning
Maharashtra, Madhya Pradesh, Rajasthan	Orient Green Power	45 MW additional biomass based capacity	Ready for commissioning Awaiting power evacuation infrastructure development
Bihar	Husk Power Systems	The company has installed over 80 rice husk based biomass gasification power plants in Bihar	Investors could become a franchise partner with Husk Power System The plant is operated and owned by the franchise partner backed by installation and maintenance support from Husk Power Systems

Source: Various news agencies

Trending technologies

Biomass based projects deploy a thermo-chemical process to convert biomass to electricity. Such a conversion can be realised through combustion, gasification or pyrolysis of input waste.

Combustion: It is the most common large-scale technology used commercially in India. It is similar to that of a thermal plant based on coal, except for the boiler design. Combustion based biomass systems primarily find acceptance in industrial off-grid and captive cogeneration applications. These can further be classified under two broad heads:

- Bagasse based co-generation in sugar mills
- Non-bagasse based co-generation in other industries

Gasification: Biomass gasification systems are prevalent for low budget low scale community energy systems in rural areas. However, these low budget rural electrification systems are set up as decentralised distributed generation systems through technologies sourced from local unorganised markets.

Rice husk power system: Rice husk based off-grid biomass gasification power projects have gained much importance in the recent times mainly in the states of Bihar and Uttar Pradesh. According to MNRE estimates[13], around 70 rice husk based gasifiers of 32 kW capacity each have been installed in rural areas. Each system is being estimated to be capable of supplying power to around 200 to 250 rural households.

MNRE also provides financial support of 180 GBP per kW in addition to 1,200 GBP per km support for installation of associated distribution network.

13. Refer http://pib.nic.in/newsite/PrintRelease.aspx?relid=94235

Incentives in state policies to renewable developers (as on 30 June 2013)

State	Policy	Electricity duty	VAT	Octroi, entry tax	Wheeling charges	Cross subsidy surcharge	Banking arrangement	Other benefits
Madhya Pradesh	Solar (2012) Wind (2012)	Exempt	Exempt for wind power plants	Exempt	Calculated on 4% of energy injected	No relief	00% energy on basis	• 50% on stamp duty for purchase of private land • Eligible for benefits under state's industrial policy
Gujarat	Wind (2007)	Exempt for third party sales	N0 relief	No relief	Calculated on 4% of energy inject	ief	Nil	Exemption to underdraw from the grid to the extent of 30% of the installed capacity assigned for captive use
	Solar (2009)	Exempt	N0 relief	No relief	No relief	Exempt	Nil	Exemption to underdraw from the grid to the extent of 50% of the installed capacity assigned for captive use
Karnataka	Renewable energy policy (Draft)	No relief	No relief	Exempt	N f	No relief	Nil	-
Tamil Nadu	Solar (2012)	Exempt for five years	No relief	No reli	As per the orders f TNERC	No relief	Nil	Exemption to underdraw from the grid to the extent of 100% of the installed capacity assigned for captive use
Andhra Pradesh	Solar (2012)	Exempt	Exempt	ief	Full exemption	Relief for third party sale. No relief for captive use	100% energy on calendar year basis with restrictions during peak hours and seasons	Refund of stamp duty and registration charges for land purchased for setting up solar power project
Rajasthan	Biomass (2010)	50% exempt for 7 y s	lief	No relief	50% of normal charges	Nil for open access	Nil	• No other biomass power project shall be permitted within the reserved area of existing, approved and earlier registered projects • Eligible for benefits under state's industrial policy

State	Policy	Electricity duty	VAT	Octroi, entry tax	Wheeling charges	Cross subsidy surcharge	Banking arrangements	Other benefits
Rajasthan	Wind (2012)	Full exemption for captive consumption	No relief	No relief	No relief	No relief	No relief	• Eligible for benefits under state's industrial policy
	Solar (2011)	Exemption for captive consumption	No relief	No relief	No relief	No relief	No relief	• In principle clearance of solar power projects • Exemption from intra-state ABT • Water resource department to allocate required quantity of water • Eligible for benefits under state's industrial policy
Uttar Pradesh	Biomass (2010)	Electricity generated by project developer will be exempted from electricity Duty for a period of 7 years from the date of commissioning.	1% for first grid interactive project in the district and for first five captive projects in the district	No relief	No relief	No relief	Nil	• No other biomass power project shall be permitted within the reserved area of a project No area shall be kept reserved for biomass power project of capacity less than 5MW • The raw material will be provided by the local body at a single point, free of cost • 50% exemption in stamp duty on acquisition of private land • Eligible for benefits under state's industrial policy
Maharashtra	Power generation from non-conventional sources (2008)	Exempt for a period of 10 years from date of commissioning	No relief	100% refund for equipment of Wind Power Project	No relief	No relief	Nil	• 11% subsidy from the total share capital of the project shall be paid from the Green Energy Fund for the wind power projects installed and commissioned by co-operative institutions • Capital subsidy of one crore INR per project will be given for installing bagasse based cogeneration projects • Small hydro power projects upto five MW will be given a subsidy of 600 GBP per KW subject to a maximum limit of 0.18 million GBP per project

Glossary of terms[14]

Octroi or entry tax: Octroi is the tax on entry of goods for use or consumption within areas of the local administrative bodies.

Value added tax (VAT): VAT is a multi-point destination based system of taxation, with tax being levied on value addition at each stage of transaction in the production and distribution chain. The term 'value addition' implies the increase in value of goods and services at each stage of production or transfer of goods and services. VAT is a tax on the final consumption of goods or services and is ultimately borne by the consumer. State governments, through taxation departments, are carrying out the responsibility of levying and collecting VAT in the respective states.

Wheeling charges: Charges payable for the operation whereby the distribution system and associated facilities of a transmission licensee or distribution licensee, as the case may be, are used by another person for the conveyance of electricity;

Cross-subsidy surcharge: Surcharge levied on consumers for providing a minimum level of support which is required to make the electricity affordable for consumers of very poor category.

Banking arrangement: As the demand for power in India is highly seasonal, a lot of power distribution companies in India bank their power which is nothing but a deferred use. During the season of excess power, they bank it with their neighboring states and during the season for high demand, they take it back.

14. Refer http://business.gov.in/taxation/vat.php for details on taxation in India

Opportunities in re[illegible]ab[illegible]n India

In the Indian power secto[illegible] observed that every programme or project undergoes four sta[illegible]s during its life cycle. The first stage focuses on policy [illegible]rmulation and programme conceptualisation, followed by th[illegible]rch and development stage. In some cases, pilot proje[illegible]e ex[illegible]sively carried out in the second stage for testi[illegible] th[illegible]ability of the new product or technology as wel[illegible]e[illegible]spective benefit it can bring. The third stage is the [illegible]e[illegible]ation stage where opportunities exist for programme [illegible]agement, contracting, technological collaboration, etc. The fina[illegible]tage of any programme is the post implementation support to provide operational assistance as well as to monitor and evaluate the impact of the implemented programme. The opportunities for UK companies at different stages of the programme life cycle for renewable energy based projects have been presented alongside.

Opportunities in renewables in India

Segment	Conceptualisation	Research and development/ pilots	Programme implementation	Post implementation support
Solar	**Policy formulation** Opportunities in policy advocacy and formulation in states that are yet to issue sector specific policies	**Feasibility studies** Feasibility studies to promote new technologies such as rooftop solar, concentrated solar power, etc. **Detailed project reports** Consultants could be hired to prepare DPRs for new technologies involved in large scale projects such as the upcoming solar parks and cities	**Technical collaboration** Technical collaboration between proven technology providers from developed nations **EPC contracts and turnkey solutions** Support industries and corporate planning to install to fulfil their captive RPO **Project management** For projects being executed by new developers with limited sector experience **Equipment supply** Indian developers continue to rely on imported solar PV cells and inverter modules.	**Design effectiveness studies** Offer expert advice on assessment of effectiveness in new designs and module configurations
Onshore wind	**Policy formulation** Opportunities in policy advocacy and formulation in states that are yet to issue sector specific policies	**Forecastig studies** International consultants can be hired in by developers or C-WET to conduct potential assessment studies at wind sites by developing elaborate wind forecasts. **Feasibility studies** Opportunities exist in development of new designs and equipment such as high mast designs	**Technical collaboration** Technical collaboration between proven technology providers from developed nations especially on plant availability. **Project management** For projects being executed by new developers with limited sector experience	**Design effectiveness studies** Offer expert advice on assessment of effectiveness in new mast designs and assessment of incremental potential upon large scale implementation of new designs
Offshore wind	**Policy formulation** Policy formulation As only a draft policy has been announced for harnessing offshore wind in India; opportunities for UK companies in policy advocacy and formulation flowing from UK's strengths in offshore wind	**Feasibility studies** As offshore wind is in nascent stages in India, opportunities exist in areas such as potential assessment, site selection, pilots, etc.	No immediate opportunity since the market is still evolving. However, similar to the onshore wind plants, future opportunities in technical collaboration and project management	As the market for offshore wind has not matured to the expected potential there are no immediate opportunities under this

Segment	Conceptualisation	Research and development/ pilots	Programme implementation	Post implementation support
W2E	**Preparedness assessment** Local administration's preparedness for large-scale programme roll-out **Policy formulation** Policy advocacy and formulation in states that are to issue sector specific policies	**Feasibility studies** Feasibility studies to identify project sites **Pilots** Pilots to streamline waste-to-energy supply chain **Environment impact assessment studies** Preparing an environmental acceptance roadmap for W2E projects	**Technical collaboration** Developers, local administrative bodies prefer to partner with foreign technology suppliers from developed nations to avoid environmental issues. **Equipment supply** Equipment import from economies where this technology has found commercial success	With the segment being in nascent stage, negligible opportunities exist
Biomass /Co-generation	**Policy formulation** Policy advocacy and formulation at central and state levels	**Forecastig studies** Techno-commercial feasibility studies to introduce new technologies	**Technical collaboration** Technology collaboration to suit Indian business environment **Equipment supply** The National Biomass and Cogeneration Programme levies concessional excise duties on equipment required for initial setting up of biomass plants. With such concessions, developers may import technologically advanced equipment to set up more efficient plants.	• Benefit enhancement studies • Socio economic benefit studies

Tendering agencies in the focus states for developing renewable energy projects

State	Prospective bidding agency	Information source
Andhra Pradesh	New & Renewable Energy Development Corporation of Andhra Pradesh Ltd	http://nedcap.gov.in/
Madhya Pradesh	Madhya Pradesh Urja Visas Nigam Ltd	http://www.tenders.gov.in/department.asp?id=838
Uttar Pradesh	Uttar Pradesh New and Renewable Energy Development Agency	http://neda.up.nic.in/tenders/tender.h
Gujarat	Gujarat Energy Development Agency	http://geda.gujarat.gov.in/tender_archive.php
Tamil Nadu	Tamil Nadu Energy Development Agency	http://www.teda.in/
Punjab	Punjab Energy Development Agency	http://peda.gov.in/eng[illegible]tml
Rajasthan	Rajasthan Renewable Energy Corporation Ltd	http://www.rrecl[illegible]/Tenders.aspx
Maharashtra	Maharashtra Energy Development Agency	http://www.mahaurja.com/Tender.html
Karnataka	Karnataka Renewable Energy Development Ltd	http://kredlinfo.in/TenderDet.aspx

04

Opportunities in energy efficiency

India's increasing generation capacity has been unable to keep pace with the power demand in the country.

The energy efficiency market in India is at a nascent stage with most states still in the process of formulating their policies for rolling out energy efficiency plans and incentive schemes. The stage is therefore set for new market entrants due to limited competition, the significant potential that the segment holds together with the targets and investment envisaged by the Government of India. Some significant energy efficiency initiatives in the country have been listed below:

The Energy Conservation Act (2001)

It laid the foundation for promoting efficient use of energy specifying energy consumption standards for equipment and appliances, establishing and prescribing energy consumption norms and standards.

Bureau of Energy Efficiency (BEE)

Envisaged by the EC Act, the BEE together with the Ministry of Power introduced a number of schemes for promoting energy efficiency including Standards and Labelling (S&L), Energy Conservation Building Code (ECBC) and energy efficiency in existing buildings, Bachat Lamp Yojana (BLY), SDA strengthening, energy efficiency in SMEs, agriculture and municipal DSM and contribution to the State Energy Conservation Fund (SECF).

National Mission for Enhanced Energy Efficiency (NMEEE)

NMEEE, a part of the National Action Plan on Climate Change (NAPCC), was launched in 2009 with the primary objective of promoting sustainable markets for energy efficiency. A total investment of 8.9 billion GBP and a combined savings potential of 23 mtoe of fuel, 99 M greenhouse gas emissions and 20 GW of avoided generation capacity by FY 2014-15 is estimated.

Initiatives under NMEEE

Perform achieve and trade

Market based mechanism to enhance cost effectiveness in improving energy efficiency in terms of energy-intensive large industries and facilities through tradeable energy savings certificates

Market transformation for energy efficiency

Accelerate the shift to energy efficient appliances in designated sectors while ensuring affordibility

Launch of super-efficient equipment programme (SEEP)

Promote clean development mechanism(CDM)

Energy efficiency financing platform

Stimulate necessary funding for Energy Service Company (ESCO)

MoUs signed by BEE with PTC India Ltd, SIDBI and HSBC Bank

Framework for energy efficient economic development

Develop fiscal instruments to promote energy efficiency such as Partial Risk Guarantee Fund (PRGF) and Venture Capital Fund for Energy Efficiency (VCFEE)

Promoting investment in energy efficiency

Several schemes have been launched by the central government along with several banks to make investment in energy efficiency attractive in India.

- SIDBI and BEE are preparing a World Bank funded project titled 'Financing energy efficiency at MSMEs'.
- SIDBI's financial scheme for energy-saving projects in the MSME sector under JICA line of credit.
- A credit linked capital subsidy scheme (CLCSS) has been offered by the MoMSME.
- IDBI has also issued an energy audit subsidy scheme and an equipment finance scheme.

Various activities undertaken in energy efficiency resulted in avoided power capacity additions of approximately 11 GW during the 11th Five Year Plan.

The 12th Five Year Plan (2012-2017) has taken this target further and envisages electricity savings of 44.8 BU for which an outlay of 897 million GBP has been made.

The 12th Five Year Plan highlights that the following sectors will see the highest fund requirements to achieve their targeted electricity savings namely;

- Industrial (56%),
- Equipment and appliances (22%),
- Agriculture (5%)
- Commercial (1%).

These sectors therefore are the immediate focus areas in the energy efficiency market.

Entry through the ESCO mode

ESCOs operate on a business model where performance based payment contracts ensure achieving and surpassing the energy efficiency targets set for the ESCO. The ESCO business model is relatively new in India and to promote its development, BEE has embarked upon an accreditation programme wherein 12 ESCOs have been accredited (as on October 2012, refer http://www.emt-india.net/ESCO/BEE_Empannelled_ESCO_List_Oct_2012.pdf). Additionally, a Super ESCO, Energy Efficiency Services Limited (EESL) was established by the government of India as a public corporation owned by four power-sector public undertakings, for meeting the market development and implementation functions of India's NMEEE.

To be able to operate in India and participate in most of the bids floated, it is mandatory for an ESCO to get itself accredited or graded from a credit rating agency and empanelled with BEE. Post this, any one of the following ESCO models can be adopted:

- ***Shared savings model:*** The more common and accepted business model, in which the ESCO finances the project and assumes performance as well as financial risk. The customer only shares a portion of its actual savings.
- ***Guaranteed savings model:*** Having found limited acceptance in India, this ESCO model offers a guarantee that the project's energy savings will cover the debt service of the customer in case the actual savings fall below expected targets.

Other entry modes

Apart from entering as an ESCO, a company from the UK can also enter the Indian energy efficiency market as one of the following:

- As an appliance and equipment manufacturer with customers ranging from power distribution utilities, government departments, municipal corporations, industries, residential households, commercial buildings, etc
- As a consultant for carrying out the monitoring and verification (M&V) of the actual energy savings arising from the implementation of an energy efficiency or savings programme. E.g. M&V of savings accrued from an ESCO model for sharing the apportioned gains; or redeeming energy certified under the CDM, etc
- As an energy auditor
- As an energy manager

Green shoots

The Indian energy efficiency market is at a nascent stage and therefore there exists a huge opportunity for players who have an established technological credibility and are willing to undertake big-ticket projects while ensuring a guaranteed performance and satisfying the consumer.

Sector-wise energy savings targets and fund requirements (12th Five Year Plan)

The Indian government has started giving priority to the energy efficiency segment evident from the fact that for the 12th Five Year Plan, the Planning Commission has estimated a fund requirement of 0.89 billion GBP. The areas within this segment which would require the highest investment share have been indicated in the table below:

Sectors	Schemes	Scheme requirement (mn GBP)	Sector requirement (mn GBP)	Electricity saving (BU)	Thermal saving (mn GBP)
Utility based DSM	DSM programme for utilities	36.0	36.0	-	-
Industries	Industries	452.4	506.4	12	10.4
	SMEs	10.4		1.8	1.6
Residential sector	Bachat Lamp Yojana	1.2	1.2	4	-
Equipment and appliances	Standards and Labelling (S&L)	21.6	198.0	0.4	4.3
	SEEP	176.4		6.6	-
Agriculture sector	Agricultural DSM	46.8	46.8	0.7	-
Commercial sector	ECBC and energy efficiency in existing buildings	8.4	8	5.1	-
Municipal sector	Municipal DSM	6.0	6.0	0.5	-
State designated agencies	SDA strengthening	16.8	25.2	-	-
	State Energy Conservation Fund (SECF)	8.4		-	-
National awards	National awards, painting and awareness		12.0	3.4	5
Innovative technologies, areas	Energy Efficiency Re ch Centre	24.0	24.0	-	-
HRD	HRD	34.8	34.8	-	-
Total			**898.8**	**44.9**	**21.3**
Total electricity saving at bu U				**60.2**	

Source: Planning Commission

Energy efficiency in industry

The growth of the economy is dependent on the output of the industrial sector of the country, which combined with SMEs today consumes about 40 to 50% of the total commercial electricity consumption. This segment therefore has large potential for energy savings. The policies, targets and incentives are devised separately for large industries and SMEs in order to achieve maximum impact.

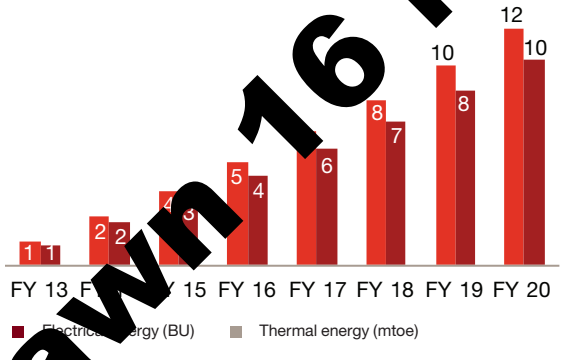
Large industries

The 12th Five Year Plan envisages an energy savings potential of 11.43 mtoe from the 478 consumers in the eight energy intensive industry segments. This savings potential is expected to further rise annually and projected to stand at 10.03 mtoe and 11.53 BU in thermal and electrical energy respectively, in the year 2019-20.

The number of participants for the proposed energy savings are comparatively lower than the UK wheree there are around 1,000 participants to meet the EU ETS targets. Also, trading will account for over 50% of the emissions reduction needed to meet UK targets between 2013 and 2030.

The legally binding carbon budgets for the UK will in turn help reduce UK emissions to at least 35% (below 1990 levels) in 2020 and 80% by 2050. For the UK, the total verified EU ETS emissions in 2012 was 231.2 MtCO2, the average annual Phase II cap for the UK is 245.6 MtCO2 and the actual allocation to UK installations covered by the EU ETS in 2012 w 229.0 MtCO2[15].

Large industries energy savings targ

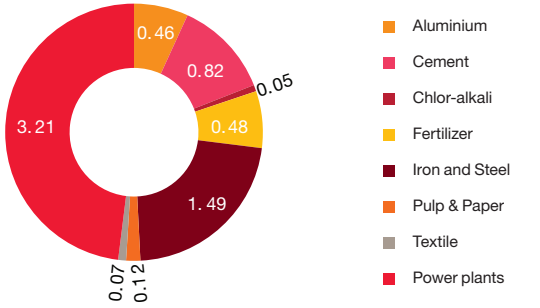


aft 12th Five Year Plan

The insti[illegible] designed to help achieve this target in[illegible] are as follows:

- No[illegible]ation of energy-intensive sectors as designated consumers (DC) which leads to more concerted efforts for achieving energy savings through the adoption of exclusive energy management policies.
- The National Energy Conservation Award for voluntary energy audits (saving of 1% in the last four years)
- Enhanced capacity building of energy management professionals
- Implementation of Perform, Achieve and Trade (PAT) Scheme: A market-based mechanism for enhancing cost-effectiveness in

PAT saving target (2012-15) mtoe



Source: Bureau of Energy Efficiency

15. Source: https://www.gov.u[illegible]ment/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050/supporting-pages/eu-emissions-trading-system-eu-ets

Top states with designated consumers (DCs) in eight energy-intensive industries*

State	Aluminium	Cement	Chlor-alkali	Fertiliser	Iron and steel	Power plant	Pulp and paper	Textile	Grand total
Rajasthan	-	15	2	3	-	7	-	31	58
Gujarat	-	8	7	4	4	17	2	11	53
Maharashtra	1	4	-	2	10	[illegible]	2	14	45
Tamilnadu	-	9	4	1	-	[illegible]	3	5	43
Andhra Pradesh	-	17	2	2	1	12	4	1	39
Chhattisgarh	1	7	-	-	21	9	-	-	38
Odisha	5	2	-	-	15	3	3	-	28
Uttar Pradesh	1	2	1	7	1	12	3	-	27
Total India	**10**	**85**	**22**	**29**	**67**	**144**[16]	**31**	**90**	**478**

Indicates the state with the highest number of industries of each sector

**Refer http://beenet.gov.in:90/downloadbooks.aspx?fname=BEE_PAT_Booklet_Final.pdf for detail*

16. Ministry of Power is focusing on [illegible]g renovation and modernisation (R&M) of coal-based power plants of central and state power utilities, for which the CEA has introduced a scheme for plants with an annual generation capacity [illegible]0 MW.

PAT highlights (2012-2017)

- First PAT cycle to achieve target of 6.6 mtoe by 2014-15
- Second PAT cycle to include refineries, chemicals, petrochemicals, automobile manufacturing, sugar, glass, etc.
- ISO 50001 to promote benchmarking of energy management system in industries and facilities
- Partial Risk Guarantee Fund (PRGF) and Venture Capital Fund for Energy Efficiency (VCFEE) proposed
- Three per cent interest subsidy scheme for adopting energy-efficient technologies by designated consumers

Focus states for PAT

Rajasthan
Gujarat
Maharashtra
Tamilnadu
Andhra Pradesh
Chhattisgarh
Odisha
Uttar Pradesh

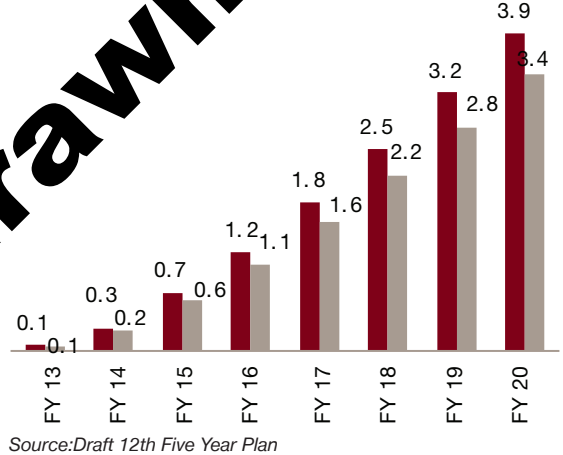
Small and medium enterprises

Significant energy savings potential exists for this segment and accordingly, BEE has set a target reduction of 5.75% (1.75 mtoe) during the 12th Five Year Plan. Thirty-five such clusters have been identified till date. The states with the maximum clusters can be the focus at

SME programme highlights (2012-2017)

- Situation analysis assessing baseline information and preparedness of the management for taking part in this programme
- Energy use and technology analysis
- Capacity building
- Implementation of energy efficient measures
- Facilitation of innovative financing mechanisms through SIDBI

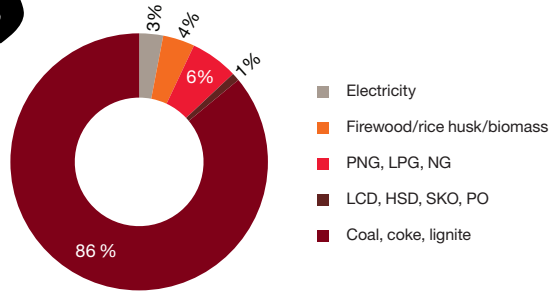
SME's energy saving target



Source:Draft 12th Five Year Plan

The BEE SME programme envisages a savings potential of 4.9 mtoe for 4,158 SMEs in the listed 35 units.

SME energy conservation



Source: Bureau of Energy Efficiency

Equipment and appliances

Standards and labelling (S&L)

The S&L programme was successful in the 11th Five Year Plan and avoided capacity additions of 7.3 GW. In the 12th Five Year Plan as well, 21 appliances are expected to be covered under the programme and 10.4 BU of electrical energy and 4.3 mtoe of thermal energy is expected to be saved by FY 2016-17.

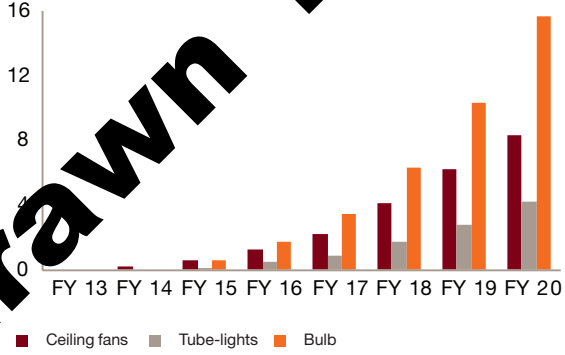
S&L programme highlights (2012-2017)

- Inclusion of at least five new equipment and appliances
- Standby power loss reduction
- Check-testing, label verification, market impact assessment for appliances and equipment covered
- Upgradation of energy performance standards

Super Efficient Equipment Programme (SEEP)

A part of the market transformation for energy efficiency (MTEE), SEEP will compensate manufacturers for a major part of the incremental cost of producing super-efficient appliances (SEAs). SEAs may consume 30 to 50% lesser power than current five-star rated equipment of BEE. The current SEAs will cover ceiling fans, tube-lights and bulbs, from which a total saving of 6.5 BU in 2016-17 is expected.

SEEP energy savings target (BU)



Source:Draft 12th Five Year Plan

SEEP highlights (2012-2017)

- Compensate manufacturers for part of the incremental cost of producing SEAs and encourage them to sell at affordable prices
- To introduce more efficient appliances than the ones currently available in India

Focus **equipment**

Ceiling fans
Tube fluorescent lamps
LED lighting

The British High Commission network in India has been invited by a state government to assist in the implementation of renewable energy projects starting with LED solar street lighting systems. The government is seeking expertise in drawing up tender documents and evaluating bids. Interested companies will be introduced directly to concerned stakeholders by UKTI.

Energy efficiency in buildings

Energy Conservation Building Code (ECBC)

Energy efficiency measures in buildings have accelerated over the past few years leading to the designing of ECBC by BEE for promoting energy efficiency in new commercial buildings with a connected load of 100 KW or more. This is similar to the Energy Performance of Buildings Directive (EPBD), first published in 2002, which required all EU countries to enhance their building regulations and to introduce energy certification schemes for buildings.

The voluntary star labelling (ECBC compliance being equivalent to one star rating) programmes for day use office buildings, BPOs and shopping complexes have been developed by BEE and 123 buildings have so far been awarded energy star ratings label. 75% of new buildings to be constructed and 20% of existing buildings during 2012-2017 are expected to be ECBC compliant.

ECBC provides design norms for the following areas of building design:

- Building envelopes such as walls, roofs, windows, facade, etc.
- Heaving ventilation and air conditioning systems
- Illumination systems
- Electrical power systems and motors
- Water heating systems

The estimated energy savings is expected to be 5.1 BU during the period. ECBC is a voluntary programme and the Energy Conservation Act, 2001 empowers states to modify the code as per their local needs.

Other codes and rating programmes

- ***National Building Code (NBC):*** A building code for all building construction activities across India.
- ***Leadership in Energy and Environmental Design (LEED)-India:*** LEED India promotes a whole-building approach to sustainability similar to the LEED rating system developed by the U.S. Green Building Council (USGBC). Promoted by the Confederation of Indian Industry (CII), Godrej Green Business Centre, the rating system is managed by the Indian Green Building Council (IGBC) (refer http://www.igbc.in for details).
- ***Green Rating for Integrated Habitat Assessment (GRIHA):*** The Energy and Resources Institute (TERI) developed a Green Rating for Integrated Habitat Assessment (GRIHA) — a rating system for new commercial, institutional and residential buildings which are not air-conditioned (Refer http://www.grihaindia.org/ for details). This was required as the LEED rating system largely focuses on air-conditioned buildings, while most Indian buildings are not air-conditioned.

BEE had run a pilot project to improve energy efficiency in eight government buildings in Delhi including the presidential residence. Particularly in case of the presidential residence, the investment made by the ESCO in upgrading energy efficiency was recovered in less than a year through savings on electricity bills.

ECBC programme highlights (2012-2017)

- BEE to support central and state governments in undertaking energy audits
- BEE to assist in development of standard documents for performance contracting and monitoring and verification protocols for carrying out retrofits through ESCO mode

ECBC implementation status (as on 30 June 2013)

Notified
Odisha
Rajasthan
Karnataka
Uttar Pradesh
Uttarakhand
Pondicherry
Lakshdweep islands

Targeted for implementation in FY 2012-13
Andhra Pradesh
Haryana
Madhya Pradesh
Tamil Nadu
Maharashtra
West Bengal

Under amendment
Chhattisgarh
Gujarat
Punjab

Based on the status of ECBC implementation, th
following are the focus states for this segmen

Focus states

Odish
Rajast
Ka
Pradesh
Utta hand

Demand side management in agriculture

Agricultural consumption has substantially increased over the years due to subsidised electricity in the country and has a huge energy saving potential. 20,885 pump sets were identified during the 11th Five Year Plan with an annual saving potential of MU. This saving potential is targeted to b 7 B the end of 2016-17 which will eventuall in a reduction in power purchase costs a ore, in government subsidies to agriculture co mers.

The eight states where DPRs ha been prepared for carrying out agriculture l a ount for almost 70% of the national agr ltura nsumption.

To undertake agriculture D , three different business models have been proposed namely; 'DISCOM model' 'ESCO model' and the 'HYBRID model'. The be fit s aring is proposed in ratio of the terms of the od and capital investment sharing.

Solar pu s are being increasingly promoted by state go ments in India for pumping ground water f ation purposes. The respective governments are providing all types of financial support for farmers wanting to switch to this non-conventional source of energy. Some of the front runners are Punjab, Tamilnadu, Andhra Pradesh and Rajasthan.

Agri ltu l DSM highlights (2012-2017)

- ve g innovative financial mechanisms enture Capital Fund (VCF) and Partial k Guarantee Fund (PRGF) for large scale mplementation PPP mode
- Monitoring and verification protocol; budget 3 million GBP
- Integrated water and energy conservation scheme (100 joint demo projects); budget 1.2 million GBP
- Technical assistance and capacity development of stakeholders; budget 0.72 million GBP

The BEE conducted a pilot project for agricultural DSM in Solapur, Maharashtra to replace existing pumps with energy-efficient pumps. The estimated energy saving potential was around 20 to 25% of the total agricultural consumption which is almost one-fourth of India's electricity consumption.

Focus states

Maharashtra
Punjab
Haryana
Rajasthan
Gujarat
Andhra Pradesh
Karnataka

Opportunities in energy efficiency in India

In the Indian power sector, it is observed that any programme or project typically goes through four stages during its life cycle. The first stage focuses on policy formulation and programme conceptualisation, followed by the research and development stage. In India, within some segments, pilot projects are extensively carried out in the second stage for testing the acceptability of the new product or technology as well as the prospective benefit it can bring in. The third stage is the implementation stage where opportunities exist for programme management, contracting, technological collaboration etc. The final stage of any programme is the post- implementation support to provide operational assistance as well as to monitor and evaluate the impact of the implemented programme. The opportunities present for UK companies at different stages of the programme life cycle for energy efficiency related projects have been presented below:

Sector	Conceptualisation	Research and development and pilots	Project implementation	Post implementation support
Large industries and SMEs	**Preparedness assessment** • Estimation of energy saving potential and expected investments • Policy formulation • Policy formulation for PAT second cycle (inclusion of new industries)	**System design** • DC specific baseline estimation and target setting for PAT Cycle 1 (FY 2014-15) • Creating the trading mechanism platform for ESCert trading **Detailed project reports** • Preparation of DPRs for the selected SMEs in the identified clusters	**Project management consultancy** • Implementation assistance for adopting ISO 50001 to promote energy management system • Programme implementation support to DC including energy performance contracting • Technology collaboration • Collaboration with DCs for implanting state of the art efficient technologies	**Impact assessment** • Monitoring and verification of compliance of activities performed by the DC
Commercial – buildings	**Policy formulation** • SDA level policy formulation for ECBC	**Equipment testing** • Technology collaboration for setting up of testing facility for building service appliances – elevators, AC ducts, etc. and to evaluate performance of building materials	**Project management consultancy** • Monitoring and verifying savings by SDAs • EPC and Turnkey contracting • Performance contracting through ESCO for new and retrofitting of existing buildings	**Impact assessment** • Benefit assessment studies
Agriculture	**Policy formulation** • State specific policies need to be formulated	**Pilots** • Pilot execution through the ESCO route; only one out of eight DPRs has been carried out	**Project management consultancy** • Project execution for replacement of inefficient pumps through the ESCO route (complete or partial guarantee)	**Impact assessment** • Socio-economic impact assessment
Equipments and appliances	**Policy formulation** • S&L: Standards and regulations for new equipments under the scheme • S&L: Support to SDAs in designing incentive schemes specific to appliance • SEEP: At a nascent stage, innovative policy measures can be brought in	**Detailed project reports** • SEEP: Business plan for manufacturers to move to super efficient technology including market assessment, behaviour analysis, etc.	**Project management consultancy** • S&L: Support to SDAs in project execution and rolling out **Technology collaboration** • SEEP: Collaboration with manufacturers for implementing state of the art, efficient technologies at affordable costs	**Impact assessment** • Impact assessment studies for benefit realisation and maximisation

Tendering agencies in some of the major Indian states for energy efficiency projects

State	Prospective bidding agencies – State Designated Agencies (SDA)	Information sources
Andhra Pradesh	New & Renewable Energy Development Corporation of Andhra Pradesh Ltd.	http://www.nedcap.go[illegible]n/
Assam	Assam State Designated Agency	http://www.asda.g[illegible]nders.htm
Gujarat	Gujarat Energy Development Agency	http://geda.g[illegible]v.i[illegible]
Haryana	Haryana Renewable Energy Development Agency	http://[illegible].gov.in/index.php?model=tenders
Karnataka	Karnataka Renewable Energy Development Ltd	h[illegible].in/TenderDet.aspx
Kerala	Energy Management Centre – Kerala	http:[illegible].keralaenergy.gov.in/emc_tenders.html
Maharashtra	Maharashtra Energy Development Agency	http://www.mahaurja.com/Tender.html
Manipur	Manipur State Designated Agency	[illegible]p://manipursda.nic.in/
Punjab	Punjab Energy Development Agency	http://www.peda.gov.in/eng/tender.html
Rajasthan	Rajasthan Renewable Energy Corporation Ltd	http://www.rrecl.com/Energy.aspx

05

Case studies

The Indian power sector has progressed in the past few years due to India's growing power needs and favourable policy environment. As a result, several focus segments have emerged and have seen quite some influx of foreign investments. Companies from the UK have also leveraged on the growing opportunities in India and started making their presence in the Indian power sector market fel[illegible]. A few of them, in fact, have been quite suc[illegible]l i[illegible] their endeavours. This section tries t[illegible] ho[illegible]ase the success of such projects through a few [illegible]udies.

Aerial LiDAR enters Indi[illegible] power sector

Network Mapping, a UK and [illegible]ba[illegible]d aerial LiDAR service provider, perfor[illegible]d the survey work as a consultant to Jabalpur [illegible]ran[illegible]ission Company Ltd. (JTCL) and Bhopal – Dhule Transmission Company Ltd (BDTCL). Bo[illegible] companies are owned by Sterlite Grid Ltd., a tra[illegible]n[illegible]on line developer in India.

The purpose [illegible]f th[illegible] project was to employ LiDAR technolog[illegible]ptimise route corridors for planned transm[illegible] lines which maximise load transfer c[illegible]y and reliability and minimise construction [illegible]s[illegible]d delays.

Aerial LiDAR surveys provide for a greater survey width to be covered in a short span as compared to the conventional methods of surveying. This attribute of Network Mapping's aerial LiDAR survey allowed JTCL and BDTCL to overcome challenges in areas where the lines were to cross tribal villages and schools.

Tribal eth[illegible]icit[illegible] and their relationship with the wi[illegible]r Indian population and the government is a se[illegible]sitive issue in India. Network Mapping re-aligned these [illegible]tes using the LiDAR data so that such issues were avoided in these areas.

The project attracted commentary from the Chancellor in the UK and the Finance Minister of India as an initiative that improved the Anglo-Indian relationship.

"It is a matter of great pride that Sterlite Grid becomes the first organisation in India to undertake and accomplish an aerial LiDAR survey as a part of the construction of its transmission line assets.
All the tower spotting concerns are known prior to construction itself and resolved thereby helping in faster project implementation and lesser provision for contingencies."
-Pratik Agarwal, Director, Sterlite Grid

"We're very grateful to Sterlite Grid for giving us this opportunity. This seminal project demonstrated that LiDAR data is now available in India and when combined with PLS-CADD™, provides an invaluable technology for the development of overhead lines. This has opened the opportunity for aerial LiDAR to be used in support of India's rapid infrastructure growth and to deliver utilisation and reliability improvements to existing grid infrastructure".
David Langworth, Chairman, Network Mapping

C-WET focuses on offshore wind

Scottish Development International (SDI), the international economic development agency of Scotland, under the guidance of Centre for Wind Energy Technology (C-WET), India's leading wind energy R&D institute, undertook a technical feasibility study for assessment of offshore wind energy potential in favourable areas in southern Peninsula and Gujarat. Indicative sites identified in the study include Dhanushkodi near Rameswaram in Tamil Nadu and Gulf of Kutch in Gujarat.

UK firm supplies equipment to Alstom India

Lindhurst Engineering, UK secured against competitive bidding, a business from Alstom India facility at Baroda, Gujarat. Lindhurst is a globally approved supplier to Alstom for over 10 years. Lindhurst willdesign, manufacture, install and commission 2 x Coil Manipulator Machines for Alstom facilities in both, UK and India.

Intelligent Energy's MoU to strengthen fuel cell market in Indian telecom sector

Intelligent Energy, a UK based fuel cell developer, has signed an MoU with Microqual Techno Limit a company with exclusive rights from the Power Grid Corporation of India Limited and other sta transmission companies to use transmis infrastructure in Punjab, Rajasthan, Hima Pradesh and Jammu and Kashmir to telecommunications infrastructure stations, to explore the use of fu tower sites.

"The partnership would deliver innovative and cost-effective ways to manage and accelerate the future growth of telecoms in India".
-Peter Brown, Managing Director of Stationary Power, Intelligent Energy

"Making use of existing power infrastructure while also providing reliable distributed powe would help accelerate the roll out of mo coverage in India."
Mahesh Choudhary, Chief Executive Founder, Microqual

Cyan Technology enters the smart metering interface market

Cyan Technology, the C ridge, UKbased wireless solutions company, has ent the Indian market and is providing its secure and scalable metering solution, CyLec, the deployment of AMR and AMI.

Cyan technology has undertaken seven pilot projects in the sta Tamil nadu, Jharkhand, Puducherry, Haryan tar Pradesh, Maharashtra and Gujarat. the earlier pilots was carried out in an ial cluster in Noida, a part of the National Capital Region, near Delhi. Cyan demonstrated a e communication link to a pilot installation of networked smart meters. Using its CyLec wireless communication solution for electricity meters, comprising radio frequency modules, gateways configured as Data Concentrator Units (DCUs) and communication software, Cyan was able to perform live retrieval of metering data and meter status including tamper alerts, and remote disconnect.

The solu n demonstrated was developed in co tion and cooperation with several leading Indian companies in the utility sector such as Capital Meter om Delhi, who supplied the wireless meters and Phoenix IT Solutions, Vishakhapattnam whose nPower MDMS system was used to process the etering data. CyLec permits utilities to collect metering data live from the meters at preset times and to directly load the readings into a MDMS system that enables direct billing to be performed.

"We selected a challenging, busy and noisy industrial environment for the pilot installation as we wanted to demonstrate the robust capabilities of CyLec. I am very pleased to report that the meter network was configured and made operational in a very short time. Anyone can demonstrate a network in a car park or other simple, controlled environments, but CyLec has been developed to work reliably in the real world."
-Bijan Mohandes, Vice President, Sales and Marketing, Cyan Technology

Abbreviations

Abbreviation	Description
APPC	The average power purchase cost for a state represents the weighted average pooled power purchase by distribution licensees (without transmission charges) during the financial year
AMI I	Advanced metering infrastructure for industrial consumers
AMI R	Advanced metering infrastructure for residential consumers
AT&C	Aggregate technical and commercial
BEE	Bureau of Energy Efficiency
bn	Billion
BTG	Boiler, turbine and generator
BU	Billion units
BLY	Bachat Lamp Yojana
CDM	Clean development mechanism
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CIS	Customer information system
Ckm	Circuit kilometres
CLSS	Credit Linked Capital Subsidy Scheme
COD	Date of commissioning
CPP	Captive power plants
Crore	Equivalent of 10 million (10,000,000)
CSO	Central Statistical Office
CTU	Central Transmission Utility
C-WET	Centre For Wind Energy Technology
DC	Designated consumer
DG	Distributed generation
DIPP	Department of Industrial Policy and Promotion
Discom	A company in the Indian power sector that takes undertakes electricity distribution and retail supply business

Abbreviation	Description
DLCC	Distribution line carrier communication
DPR	Detailed project report
DSM	Demand side management
EA	The Electricity Act, 2003
EAAS	Energy Audit And Accounting Software
EC Act	The Energy Conservation Act (2001)
ECBC	Energy Conservation Building Code
EPC	Engineering, procurement and construction
ER	Eastern region
ERC	Electricity Regulatory Commission
ESCO	Energy Service Company
EU	European Union
EUETS	European Union Emission Trading Scheme
FACTS	Flexible alternating current transmission system
FDI	Foreign direct investment
FEMA	Foreign Exchange Management Act
FII	Foreign institutional investment
FIPB	Foreign Investment Promotion Board
FRP	Financial restructuring plan
FTS	Fees for technical services
GBI	Generation based incentives
GBP	British pound sterling
GCF	Gross capital formation
GDP	Gross domestic product
GIS	Geographic information systems
GW	Gigawatt

Abbreviations

Abbreviation	Description
HEP	Hydro electric power plant
HRD	Human resources development
HVAC	Heating, ventilation and air conditioning
HVDC	High voltage direct current
IDBI	Industrial Development Bank Of India
INR	Indian rupee (1 INR = 0.0120 GBP)
IPP	Independent power plants
IPTC	Independent private transmission company
IREDA	Indian Renewable Energy Development Agency Ltd
ISGF	India Smart Grid Forum
ISGTF	India Smart Grid Task Force
ISTS	Inter-state transmission system
JETCO	Joint Economic and Trade Committee
JICA	Japan International Cooperation Agency
JNNSM	Jawaharlal Nehru National Solar Mission
JNNURM	Jawaharlal Nehru National Urban Renewal Mission
kV	Kilovolt
Kwh	Kilowatt hour
Lakh	Equivalent of one hundred thousand
LED	Light emitting diode
LNG	Liquefied natural gas
LoI	Letter of intent
MG	Micro grid
mn	Million
MNRE	Ministry of N enewable Energy
MoMSME	Ministry of Small And Medium Enterprises

Abbreviation	Description
MoP	Ministry of Po er
MoSPI	Ministry of Statisti nd Programme Implementation
MP	Madhya P desh
MSEB	Maharash State Electricity Board
MSME	nd medium enterprises
MT	M tonnes
MTE	Market transformation for energy efficiency
mtoe	Million tonne of oil equivalent
MVA	Megavolt ampere
MW	Megawatt
Mwh	Megawatt hour
NAPCC	National Action Plan On Climate Change
NEF	National Electricity Fund
NER	North eastern region
NHPC	National Hydro Power Corporation
NLDC	National Load Despatch Centre
NMEEE	National Mission for Enhanced Energy Efficiency
NR	Northern region
NRI	Non resident Indian
NTPC	National Thermal Power Corporation
OECD	Organisation for Economic Co-Operation And Development
OM	Outage management
PAT	Perform Achieve and Trade
PDC	Phasor data concentrators
PGCIL	Power Grid Corporation of India Limited
PIO	Person of Indian origin

Abbreviations

Abbreviation	Description
PLM	Peak load management
PMU	Phasor measurement units
POSOCO	Power System Operation Corporation
PPA	Power purchase agreement
PPP	Public private participation
PQM	Power quality management
PRGF	Partial Risk Guarantee Fund
PV	Photo voltaic
R&D	Research and development
R&M	Repair and maintenance
RoE	Return on equity
R-APDRP	Restructured-Accelerated Power Development And Reforms Programme
RAS	Remedial Action Scheme
RBI	Reserve Bank Of India
REC	Renewable energy certificates
RF	Radio frequency
RLDC	Regional Load Despatch Centre
RPO	Renewable purchase obligation
RTU	Remote transmission unit
S&L	Standards and labelling
SCADA	Supervisory control and data a[illegible]
SDA	State designated agenc[illegible]
SEA	Super efficient appl[illegible]
SECF	State Energy Co[illegible] Fund
SECI	Solar Energy [illegible]ion Of India
SEEP	Super Effic[illegible]uipment Programme
SERC	State Electricity Regulatory Commission

Abbreviation	Description
SIDBI	Small Industria[illegible]ment Bank Of India
SIPS	System Integrated [illegible]tection Scheme
SLDC	State load [illegible]espatch centre
SME	Small and [illegible]ium enterprises
SR	[illegible]n
SREDA	[illegible] Renewable Energy Development Agency
STU	State transmission utility
T&D	Transmission and distribution
TCMS	Trouble call management software
TDS	Tax deducted at source
TIDCO	Tamil Nadu Industrial Development Corporation
tn	Trillion
ToD	Time of day
TPS	Thermal power station
UHV	Ultra high voltage
UK	United Kingdom
UMPP	Ultra mega power project
UP	Uttar Pradesh
US	United States Of America
USD	United States dollar
UT	Union territory
VCF	Venture capital fund
VCFEE	Venture capital fund for energy efficiency
VGF	Viability gap funding
W2E	Waste to energy
WAMS	Wide area measurement system
WR	Western region

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UK Trade & Investment (UKTI) is the Government Department that helps UK-based companies succeed in the global economy. We also help overseas companies bring their high-quality investment to the UK's dynamic economy acknowledged as Europe's best place from which to succeed in global business. UKTI offers expertise and contacts through its extensive network of specialists in the UK, and in British embassies and other diplomatic offices around the world. We provide companies with the tools they require to be competitive on the world stage.

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