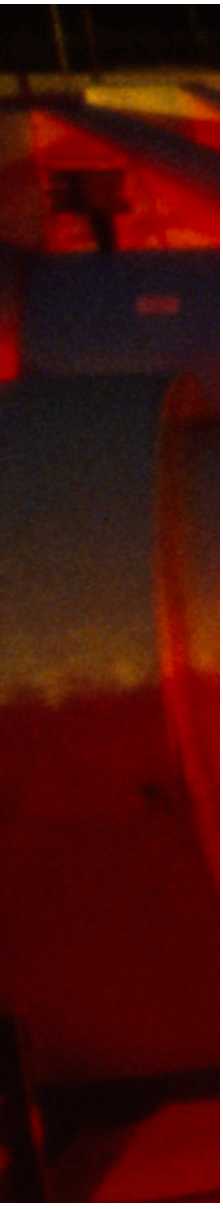
CII Karnataka Conference on Power 2012

Sustainable Power through Renewable Sources

Confederation of Indian Industry

pwc



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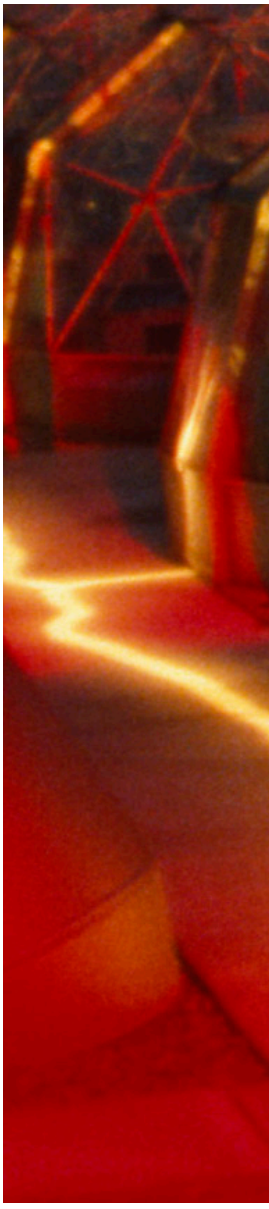
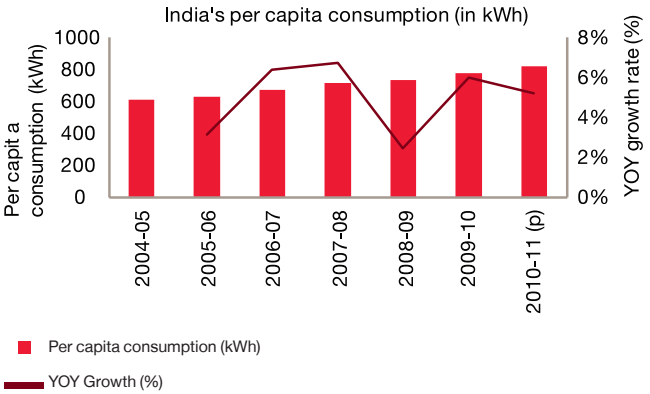


Renewable energy in India

Depleting fossil fuels and the need for greener energy

India's substantial and sustained growth has placed enormous demand on the country's natural resources. Today, India imports substantial quantities of gas, oil and coal in order to meet its growing energy demand. The increasing dependence on imported fuels may create a serious threat to the future fuel security of the country. In addition, the country's 136 GW of power generation capacity based on conventional sources has further strained the natural resources. The government has realized the importance of exploring alternate sources of energy for addressing the demand-supply mismatch and fuel security concerns.

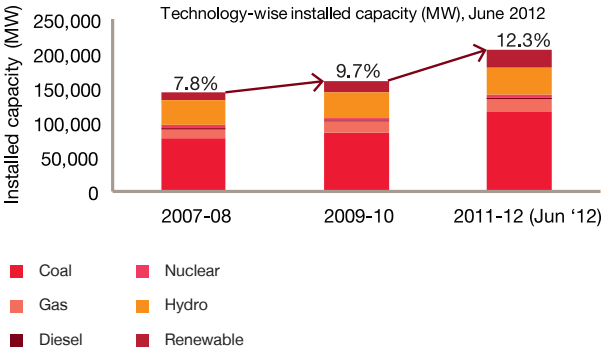
Renewable energy sources are best suited for addressing issues such as bridging supply shortages, reducing carbon emissions and enhancing energy security. The Indian government, in order to harness and promote renewable energy, has a dedicated Ministry of New and Renewable Energy (MNRE). It has also established the Indian Renewable Energy Development Agency (IREDA), which promotes, develops and extends financial assistance for renewable energy projects.



p – Provisional data
Source: CEA monthly report

1 MNRE

In addition, the government has formulated various policies at the state as well as national levels to further investments in the sector from domestic as well as foreign investors. Private sector investments, primarily driven by government incentives such as fiscal incentives, tax holidays, depreciation allowances and 100% FDI allowance have been the major drivers of the renewable sector in India. These initiatives have helped growth in the renewable sector. The installed capacity of RE sources, which formed just 2% (as on April 2002) of the total installed capacity, increased its share to a remarkable 12.3% reaching a capacity of 25,409 MW[1] (as on June 2012).



Source: CEA monthly reports

The MNRE has estimated a potential renewable capacity (excluding solar) of almost 90,000 MW out of which 48,500 MW is wind, 15,000 MW is small hydro power and 23,700 MW is bio-power[2]. However, the Centre for Wind Energy Technology (C-WET) has re-assessed India's wind potential as 102 GW. Renewable installed capacity grew by a CAGR of around 23% over the last five years (2007-12).

Out of the total renewable portfolio, wind has been the leading technology over the last few years. It has registered a growth of 34%, with its installed capacity reaching 17.6 GW in June 2012 from 13.2 GW in April 2010. On the other hand, solar energy has registered a whopping growth by reaching an installed capacity of 1 GW in June 2012 from 32 MW in April 2010. Though the contribution of wind energy to the total installed capacity of renewable technologies has remained almost the same at 69% over last year, the share of solar has increased considerably from almost 0.2 to 4.1% during the same period.

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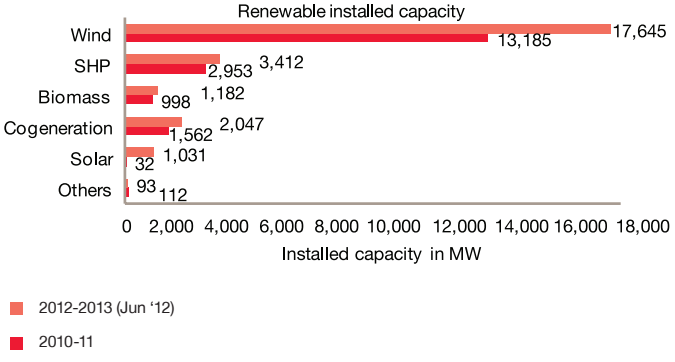


Source: MNRE annual reports

2 Strategic plan for new and renewable sector

The MNRE has set a target to commission 4,125 MW of grid interactive renewable capacity for the year 2012-13, out of which 495.03 MW has already been achieved.

RE programme	Target for 2012-13	Total deployment in 2012-13	Cumulative achievement up to 30 June 2012
Wind power	2500	291.70	17644.35
Small hydro power	350	16.45	3411.76
Biomass power	105	32.00	1182.10
Bagasse cogen	350	61.5	2046.73
Waste to power	20	4.00	93.68
Solar power (SPV)	800	89.38	1030.66
Total	4125	495	25409

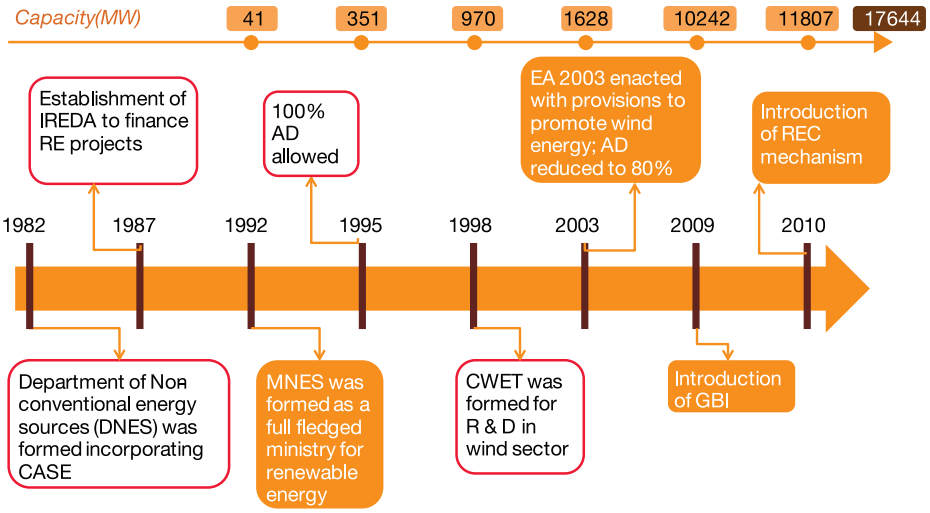
Fostering the growth of wind and solar energy

Historically, wind has been the prominent technology amongst all the renewable sources in the country, experiencing a consistent annual growth of 35% in the last decade. This has been mostly possible because of encouraging policy and regulatory framework in the form of preferential tariff, renewable purchase obligation, accelerated depreciation and other fiscal benefits to wind developers. A similar growth has been experienced in the solar space in the previous year, where country achieved a solar installation of 1000 MW. This growth can be easily associated with various promotional policies at national (JNNSM) and state levels (Gujarat and Karnataka) which were implemented in 2010 and 2011. It is quite evident from these facts that, growth in renewable sector has a strong correlation with promotional policies and regulatory support and same is illustrated in the sections to follow.

Policies and regulatory framework: Enabling the wind sector

Wind power in India has been one of the most preferred renewable sources. The MNRE and C-WET have played a major role in assessing, promoting and harnessing wind potential in India. C-WET assessed a total wind potential of 49 GW in its first round of assessment in 2010, which was revised to 102 GW in its next re-assessment exercise conducted in 2012. It is now trying to assess offshore capacity in the country. One such project near Rameshwaram in Tamil Nadu is being set up to measure the wind energy potential at 100m hub height.

The favourable policies and regulations introduced by the government have induced substantial investments in the sector.



***AD and GBI were discontinued from FY 2012-13*

The government has also provided fiscal incentives such as tax holidays, 100% excise duty exemption on certain Wind turbine generator (WTG) equipment and 100% FDI in renewable energy projects. In addition, concepts of Accelerated Depreciation (AD) and Generation Based Incentive (GBI) were introduced, giving a major impetus for the wind sector in India. Though AD and GBI have been discontinued from the year 2012-13, industry experts claim that it will not have any long-term impact on capacity addition. However, the recent development indicates that GBI may be further extended to support the growth of wind IPPs.

The introduction of the Renewable Purchase Obligation (RPO) has necessitated most states to procure renewable energy from various sources. Government has successfully introduced Renewable energy certificates (RECs) mechanism in the country to enable the states which have limited renewable potential to meet their RPO obligations. The RPO mechanisms along with implementation of REC have re-instigated growth in the sector and have encouraged many IPPs to scale up their wind capacities in India. The industry, which was initially dominated by financial investors, has now given way to serious power producers, interested in generation and carbon savings.

Though most of the wind-rich states have come up with developer-friendly policies and incentives for the promotion of wind energy in their states, these state policy frameworks have gaps which often make the development of projects longer than expected. Some concerns still exist in the state policies and regulatory framework, which need to be addressed for the rapid growth of the sector.

Solar power: National Solar Mission

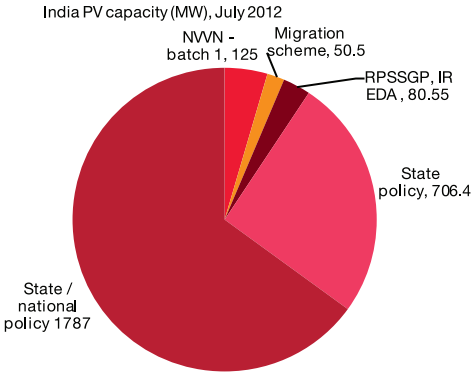
Solar power is emerging as a key source of renewable power in India with the government declaring policies to support the development of MW-scale projects. The Jawaharlal Nehru National Solar Mission (JNNSM) and the Gujarat State Solar Policy are at the forefront in terms of the capacity planned for the development in India. Both JNNSM and the state policies have encouraged MW-scale capacity additions and investments by facilitating long-term PPA agreements for solar power between IPPs and distribution companies (DISCOMS) at cost-reflective preferential tariffs.

Besides the various policies and subsidies that promote solar sector, three government bodies promote the use of solar energy, viz. the MNRE, the India Renewable Energy Development Agency (IREDA) and the Solar Energy Centre (SEC).

Conceived under the National Action Plan for Climate Change (NAPCC), the National Solar Mission (NSM) has specific goals of accelerating generation capacity addition to drive down costs and achieve grid parity by 2022 and parity with coal-based power generation in 2030. The National Policy mandates solar RPOs for all obligated entities with an RPO target of 0.25% in 2013 to be increased to 3% by 2022.

To foster investments in manufacturing industries, the Ministry of Communications and IT in July 2012 approved the proposal to provide a special incentive package to promote large-scale manufacturing in the electronic system design and manufacturing (ESDM) sector called modified special incentive package scheme (M-SIPS). The scheme is open for three years from notification. Key features of M-SIPS are as follows:

- Subsidy for investments in capital expenditure: 20% for investments in SEZs and 25% in non-SEZs

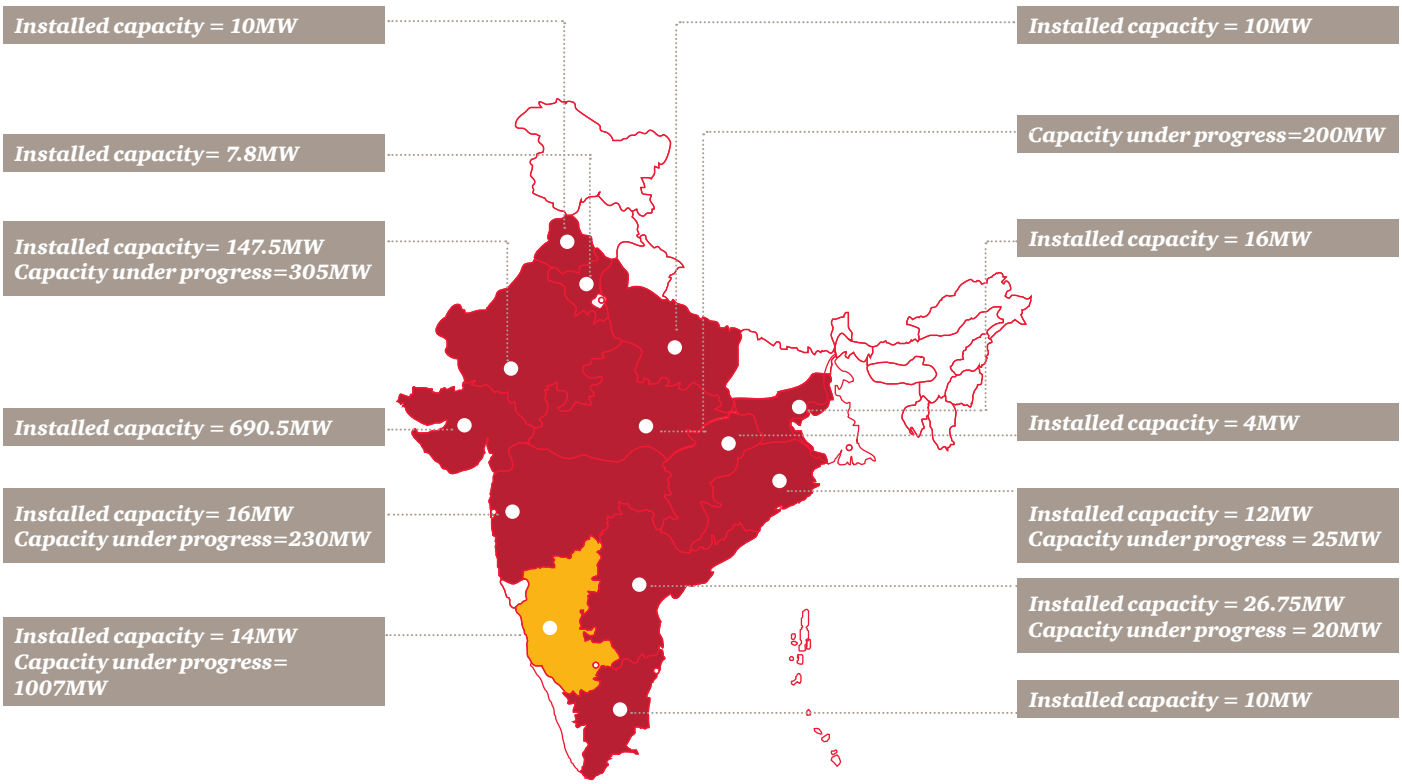


- Reimbursement of countervailing duty (CVD) and excise for capital equipment for the non-SEZ units. For high technology and high capital investment units, such as fabrication units, reimbursement of central taxes and duties is also provided.
- Incentives for investments made in a project within 10 years from the date of approval
- Incentives for 29 categories of ESDM products including solar photovoltaic, Light emitting diodes (LEDs), semiconductor chips, chip components, other electronic components and EMS. Units across the value chain starting from raw materials including assembly, testing, packaging and accessories of these categories of products are included.
- Incentives for relocation of units from abroad
- Approvals for incentives not exceeding 10,000 crore INR to be granted during the XII Plan period

July this year, India's solar power capacities crossed 1.0 GW from a mere 18 MW at the end of 2010. In addition to local favorable policies, the large installed capacities across the globe and reduced supply margin (to overcome high inventories due to shrinking EU markets like Spain, Germany and Italy) have supported in achieving this scale of capacity addition.

The graphics below displays the solar installation and capacities under progress in the country. It can be observed that Gujarat and Rajasthan have shown good progress by achieving utility scale projects adding upto 85% of total operating capacity. Karnataka has also fared well in this period with a 14 MW of operational capacity and a large capacity of 1000 MW under progress.

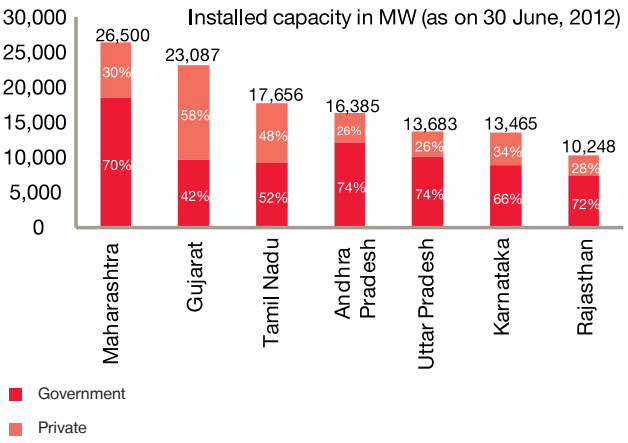
Solar capacity, July 2012 (MW)



Source: Market research

Karnataka: A promising renewable destination

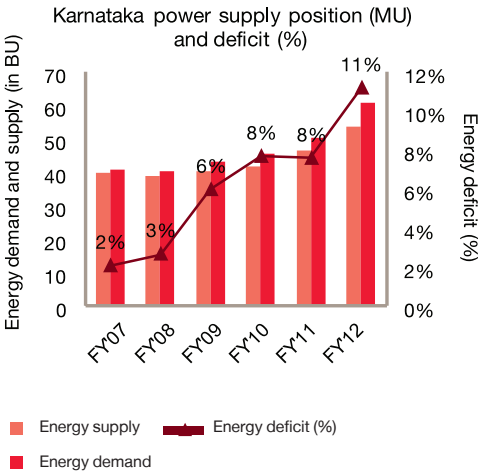
Karnataka, one of the buoyant economies in India is a power-deficit state despite having a share of 6.4% of the national electricity consumption. Karnataka has an installed capacity of 13 GW (30 June 2012) and accounts for 6.64% of the total installed capacity in India. Apart from this, proposed and ongoing projects in Karnataka together are expected to add 18 GW. Karnataka stands fifth in terms of total installed capacity of power plants and third in terms of state initiated power plants. The state is also home for major IPPs with a total installed capacity of 4.6 GW (34% of the total installed capacity)[3].



Source: CEA monthly reports

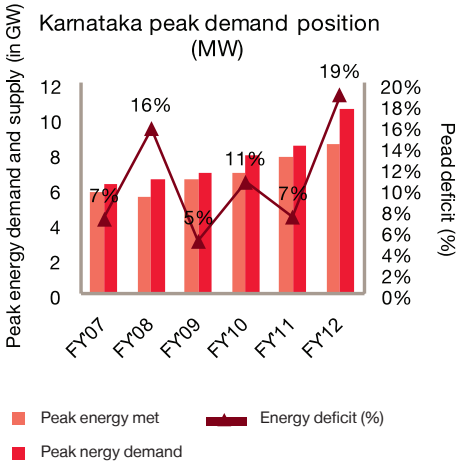
The highest power deficit in south India

Karnataka, the state with one of the highest generation potentials, has been power-deficient over the last decade. Apart from augmenting its generation, the state has been procuring power from short-term sources and through energy exchanges in order to minimise power shortages. In addition, the state government is taking steps for energy conservation through demand side management (DSM). Despite all of this, it is still not able to fulfil energy demand of the state.



3 CEA monthly reports

It has been observed that energy demand during 2006-2012 grew at a CAGR of 8% while the supply grew only by 6%, leading to constantly increasing energy deficits .The energy deficit has increased from 2.1% in 2006-07 to as high as 11.2% in 2011-12 registering a CAGR of 52% for the period. Over the last one year, the demand for energy shot up by almost 21%, while supply grew only by 16%.



Source: CEA monthly reports

As on 31 March, 2012, the state has a demand of 60,830MU against a supply of 54,023MU, resulting in a shortage of 6,807MU. The sluggish growth of energy supply can be attributed to factors such as increasing coal supply shortages from Singareni Collaries and CIL and unfavourable climactic conditions resulting in reduced water levels, which support hydel power generation.

On an average, a peak deficit of 10.8% has been registered in the state. However, it has been fluctuating between 5 and 18.9% during 2006-12. In 2011-12, the peak demand was 10,545 MW against the peak supply of 8,549 MW. When compared to the other states in the south, Karnataka has registered the highest energy and peak deficits of 11.2 and 18.9% respectively (as on 31 March 2012).

In order to reduce the demand-supply gap, initiatives have been taken to improve the generation capacity of the state. The government through its state annual budget 2012-13 has provided an outlay of 10,289 crore INR for the sector. Projects include the following:

- The 500 MW second unit of BTPS and 600 MW second unit of UPCL are expected to be added during 2012-13.
- The implementation of the third unit of 500 MW at Bellary, two units of 800 MW each at Yeramarus, and one unit of 800 MW at Edlapur are underway.
- Work for the 1500 MW Chhattisgarh thermal power plant and the 700 MW gas plant at Bidadi, both of which are being set up by the KPC, is expected to commence during 2012-13.
- Work on the 4000 MW thermal plant by NTPC is expected to commence during 2012-13.

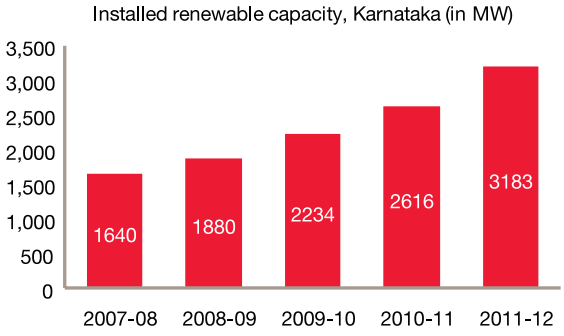
In spite of the various efforts by the state government, Karnataka continues to face major constraints in its generation capacity. Delays in getting coal linkages and environmental clearances for power plants from the central government have over time widened the gap between the demand and supply of electricity. In order to address these issues and to reduce the increasing dependence on conventional resources, state government is exploring various alternative options including accelerated capacity addition of renewable project in the state.

Parameters	Andhra Pradesh	Karnataka	Kerala	Tamil Nadu	Puducherry
Energy deficits (%) - FY 2012	7.2	**11.2**	2.1	10.5	1.4
Peak power deficits (%) – FY 2012	14.8	**18.9**	5.1	17.5	4.5
% of private sector in total installed capacity – FY 2012	24.5	**33.8**	5.1	47.6	0.01
% of renewable energy in total installed capacity – FY 2012	5.5	**23.8**	4.25	41.7	0.01

Source: CEA monthly reports

The renewable sector

Among the states in India, Karnataka has one of the highest potentials for renewable energy. Thermal and hydro have been the main sources of electricity in the state . Currently, renewable sources are contributing to around 24% of the state's installed capacity. The renewable energy potential is estimated at 28GW, primarily from wind, small hydro, co-generation and biomass sectors. Until now 2,106 MW of wind, 88.5 MW of biomass, 948.7 MW of bagasse co-generation, 646 MW small hydro and 14 MW of solar have been explored, implying a large potential remaining to be tapped. Further, the government has allotted projects of 17,278 MW, amounting to nearly 60% of the full potential.



Source: CEA monthly reports

Renewable energy source	Total capacity – planned (MW)	Total no of projects	Commissioned capacity during 2012-13 (MW)	No of commissioned projects during 2012-13	Cumulative commissioned capacity (MW)	No of commissioned projects
Wind	14,112	658	125	3	2,106	139
Hydro	4,146	836	0	0	647	77
Biomass	450	65	0	0	89	12
Waste to energy	56	7	0	0	0	0
Cogen	1,738	81	34	1	949	43
Solar (grid)	1036	46	5	1	14	4
Total	21,539	1693	164	5	3804	275

Source: KREDL

Policy and regulatory framework

The government of Karnataka has introduced policies to make the investment environment conducive for investments.

Karnataka Renewable Energy Policy (2009-14)

The Karnataka Renewable Energy Policy 2009-14 was formulated under the supervision of KREDL to achieve a capacity addition of 6,600 MW of renewable sources in Karnataka at an estimated cost of 23,890 crore INR by 2014. The policy aims at systematic and faster development of renewable energy sources as it attempts to stimulate a minimum capacity addition of approx 1,000 MW each year. Following are the objectives of the policy:

- Additional capacity of ~4.3 GW by 2014
- Emphasis on energy conservation and efficiency by a saving of 1500MU per year (900 MW by 2014)
- The policy is applicable to all renewable projects sanctioned after the date of notification in the official gazette and covers energy efficiency and conservation along with DSM and clean development mechanism (CDM) implementation. The policy has set year-wise renewable energy targets to be harnessed and respective capital investments for 2009-14 as follows:

Renewable source	Target MW	Year-wise proposed capacity addition				
		2009-10	2010-11	2011-12	2012-13	2013-14
Wind	2969	630	680	530	530	599
Mini and small hydro	600	100	100	150	150	100
Co-generation in sugar industry	281	56	56	56	56	57
Biomass/bio-gas	300	60	60	60	60	60
Waste to energy	50	10	10	10	10	10
Solar PV/GSP/thermal sector	126	6	30	30	30	30
Total	4326	862	936	836	836	856

Source: Karnataka Renewable Energy Policy (2009-14)

The policy emphasises on the rapid expansion of power capacity, especially wind generation, where Karnataka has lost its place to other wind-rich states in India. The following are some policy highlights:

- Project financing for renewable energy through the creation of Green Energy Fund (Akshaya Shakthi Nidhi)
- Establishment of renewable energy economic zones by procuring 10% of the land of current and future SEZs and dedicating it for renewable energy to be kept at the disposal of KREDL
- Ten per cent of barren government land to be reserved with KREDL to set up renewable energy power projects in Karnataka
- Lands to be sub-leased by KREDL to renewable energy developers for 30 years
- KREDL to provide time-bound clearances from various departments and ensure scheduled project execution
- KPTCL and KREDL to jointly undertake the responsibility of developing required transmission and distribution lines necessary to renewable energy projects. KPTCL will undertake the augmentation of transmission lines and lying of new lines and receiving stations as required.
- Identification of renewable energy as an industry
- Power purchase agreement (PPA) between power producers and ESCOMs to be assigned by the government at the time of allotment
- In co-ordination with KERC, government to provide incentives for biomass power generation projects
- Support for solar energy
  - KERC along with MNRE determines tariff for solar PV and solar thermal projects.
  - Rooftop grid-connected solar power quantum fed to the grid eligible for any incentive will be available from the MNRE. Additional subsidies applicable will be extended to rooftop projects.
  - Net metering facility will be extended to solar power systems installed on commercial establishments and individual homes connected to the electrical grid.
- Strategy for solar thermal and CSP and solar PV
  - Grid connected solar projects of 1 MW and above are considered priority projects.
  - Through the Solar Karnataka Programme, 25,000 solar rooftops (targeted) of five to 10kWp with net metering will be taken up with a 250 MW potential during the next five years with a generation potential of 350MU.
  - Solar cities will be developed in the state.
  - A bye law amendment by the local body will make mandatory the use of solar water heating systems.

Karnataka Solar Policy (2011-16)

Under the Karnataka Renewable Energy Policy, a target of 126 MW of solar power was envisaged up to 2013-14. This included the power that the state was likely to get under the JNSSM. After the enactment of the Karnataka RE policy, the KERC issued RPO regulations. In addition, the central government decided to increase solar energy consumption from 0.25% in FY'11 to 3% by 2022. In the light of these developments, the state government decided to implement a dedicated policy, the Karnataka Solar Policy 2011-16 for the development of solar projects.

The KREDL as the state nodal agency is responsible for implementing the policy. Some of the key points include the following:

- The proposed 200 MW solar-based projects by 2015-16, for the procurement by ESCOMs will be added at an annual capacity of 40 MW.
- The minimum capacity shall be 3 MW and maximum 10 MW for solar PV based projects. For solar thermal projects, the minimum capacity shall be 5 MW.
- The project for allotment shall be through a competitive bid process, based on the KERC tariff order.
- Captive power plants and the sale of power to third parties are not a part of the 200 MW capacity. Wheeling charges and open access charges will be applicable as determined by the KERC or the CERC.
- An additional 50 MW is reserved for the central or Karnataka state owned undertaking for setting up solar projects in the state for bundling with thermal power from outside the state at government approved rates.
- Solar energy generators can sell electricity to ESCOMs at a pooled cost of power purchase as determined by the KERC and CERC and sell REC to obligated entities.

Karnataka Semiconductor Policy (2010)

The government of Karnataka through the Karnataka Semiconductor Policy 2010 has given an impetus to the growth of semiconductor industries in the state.

The policy specifically encourages and provides assistance to solar PV manufacturing units under the Karnataka Renewable Energy Policy. Highlights of the policy include the following:

- Location of land with access to infrastructure like ports, airport in close proximity; Karnataka Power Corporation Limited (KPCL) and KREDL also taking steps to develop solar farms on JV and PPP mode in districts like Bijapur, Gulbarga, Raichur and Bellary
- Fiscal incentives to micro, small, medium manufacturing enterprises (MSMEs)
- Exemption of stamp duty for MSME, large, mega projects (100% for Zone 1 and Zone 2; 75% for Zone 3)
- Exemption from entry tax (ET) (100% exemption from payment on plant and machinery, capital goods, for initial three years from commencement of project implementation; on raw materials, inputs, component parts and consumables for five years from the commencement of commercial production)
- For 100% export oriented units, 100% exemption from payment of ET on plant and machinery and capital goods, for an initial three years from commencement of project implementation; for other export oriented units (EOUs), 100% exemption from ET on raw materials, inputs, component parts and consumables for three years from commencement of commercial production
- Interest subsidy for micro manufacturing enterprises: interest at 5% on term loan
- Hundred per cent exemption of electrical duty and tax for three to five years

Renewable Purchase Obligation in Karnataka

- Renewable purchase obligation (RPO) casts an obligation on distribution companies, open access consumers and captive power producers to procure part of their energy needs from green energy and is an important market driver for the promotion of renewable energy sources.
- Under the RPO order, released by the KERC in March 2011, electricity supply companies such as BESCOM, MESCOM, HESCOM, GESCOM as well as captive and open access consumers in the state have to source a certain portion of their energy consumption from RE.

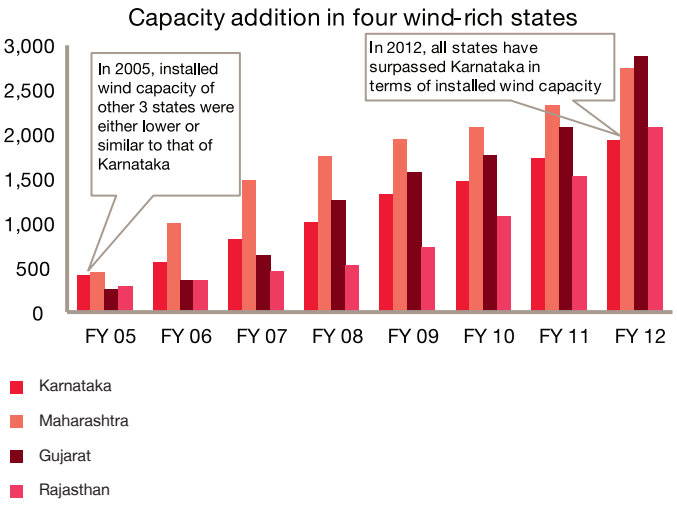
Consumers	RPO for RE sources other than solar	Solar RPO
BESCOM/MESCOM/ CESC	10%	0.25%
HESCOM/GESCOM/ Hukkeri Society	7%	0.25%
Open access/captive consumers	5%	0.25%

Wind energy

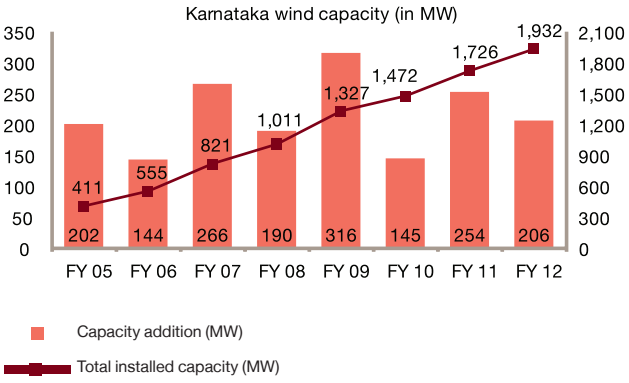
Karnataka is one of the wind-rich states in India and has a potential of around 14 GW. Currently, capacity of ~2 GW has been installed through 274 projects. As per the Karnataka's Renewable Energy Policy, a target of 2,969 MW installed capacity is set to be achieved by 2013-14. This development is likely to attract investment of around 15,680 crore INR.

The following graph depicts the capacity added over the last seven years. The preferential tariff framework has enabled Karnataka to be among the top five wind-energy generating states with an installed capacity of 1,932 MW (as on March 2012). A significant capacity addition of around 80% of this development has been observed after the notification renewable tariff order of January 2005, which approved a preferential tariff of INR 3.10/kWh for wind projects. State further revised the wind tariff to INR 3.7/kWh till 2014 through a notification in December, 2009. A capacity addition of more than 600 MW has been observed since then, which is not a very encouraging development considering a significantly high wind potential in the state and developments experienced in other wind rich states.

This sublime growth indicates that the wind policy and tariff framework had failed to encourage the investment in the sector in the state. The more evident reasons have been lower than expected preferential tariff and long control periods in the fast changing market driven factors. States such as Rajasthan (proposed wind tariff in the range of Rs 4.90 - Rs 5.44 per unit) and Gujarat (present wind tariff Rs 4.61 per unit), which were behind Karnataka in wind capacity addition in 2005 have fared better than Karnataka. Maharashtra (present wind tariff ranging between 3.73 - Rs 5.96 per unit on the basis of wind zones), which had marginally higher installed capacity than Karnataka in 2005, is currently significantly ahead of Karnataka with 2,733.5 MW of wind capacity. Regulatory commissions in these states have revised their preferential tariffs more frequently than Karnataka keeping in pace with the changing market parameters.



Source: C-WET



Source: C-WET

The following table summarizes various policy and regulatory provisions for wind sector in six wind rich states. The table below indicates that although the policy support in the form of banking, concessional wheeling and transmission charges, etc are favorable, the preferential tariff do not offer a very encouraging proposition for investment in Karnataka as compared to states like Maharashtra, Rajasthan and Gujarat.

State	Wheeling and transmission charges	Banking	FIT (INR per unit)	Cross-subsidy surcharge (CSS)	RPO
Karnataka	5% wheeling charges and losses	12 months; 2% banking charges	3.70	Nil	7 – 10% Captive & Open Access (OA) – 5%
Tamil Nadu	High Tension/Extra High Tension: 5% for all OA consumers LT: 7.5% for all OA consumers	1 year TOD banking Charges @ 5% of energy generated in billing month	3.51	50 % CSS applicable for WEGs	9%
Gujarat	Normal OA charges	1 month banking for captive consumers	4.61	Nil	7% in FY 13
Maharashtra	Normal OA charges	12 Months	Zone 1: 5.67 Zone 2: 4.93 Zone 3: 4.20 Zone 4: 3.78	25% CSS	2010-11: 6% 2011-12: 7% 2012-13: 8% 2013-16: 9%
Rajasthan	50% of normal transmission charges	Banking and withdrawal on six-month basis. Withdrawal not allowed in Dec, Jan and Feb	4.46 - 4.69	Nil	5.1% for wind with overall 7.1% in FY 13
Andhra Pradesh	As per rules and regulations of the Commission	Allowed	3.50	50% CSS for generation from renewable sources	5%

Source: Latest tariff orders

Future wind potential in Karnataka

It is expected with minor changes in the policy framework, Karnataka may join the top three states in terms of annual wind capacity additions. Large untapped wind potential and above average wind profile are the key factors which will attracts investor in the states. It has been observed that the wind velocity in Karnataka ranges from 0.85 m/s to 8.27 m/s. Some of the available potential areas for development of wind farms are:

- Chikkodi in Belgaum
- Kappadagudda Extension
- Hill ranges of Guledagudda–Gudur.
- Hill ranges of Sureban, Yere Kittur, Kallur and Mallur
- Basidoni
- Hill ranges of Halolli to Katkol (Godachi, Khanpet and Torgal)
- Hill ranges of Halagatti, Mudakavi, Tadasi and Vasan
- Govinakoppa
- Hill ranges of Soudatti to Ugargol
- Hill ranges of Hanumana Hatti to Kakti
- Zalki of Indi Taluk

Solar energy

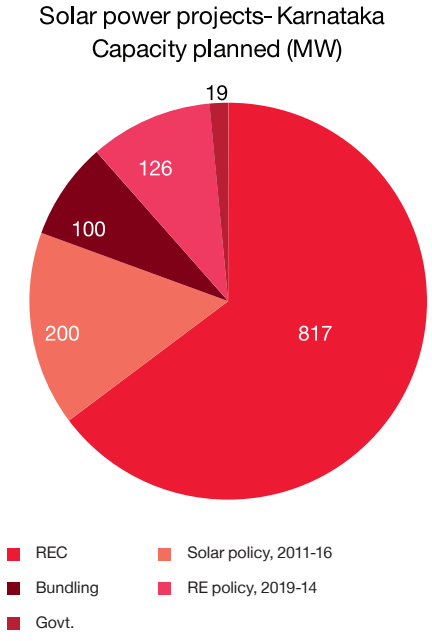
The Karnataka Renewable Energy Policy (2009-14) and Solar Policy (2011-16) have provided impetus for the growth of solar projects in the state. With an installed capacity of ~14 MW, the state has over 1.2 GW of solar power projects in the pipeline under various schemes.

Through the 'Arunodaya program', KPCL has commissioned solar PV plants of 14 MWp capacity thus far (3 MWp each in Kolar, Belgaum and Raichur in 2009 and a 5 MWp in Mandya district) in Karnataka. In 2010, the energy produced by the 3 MWp in Belgaum was ~ 3.9 MUs, based on report submitted to CERC. The plants seem to have overcome the initial technical issues and are performing at the desired plant load factor (PLF).

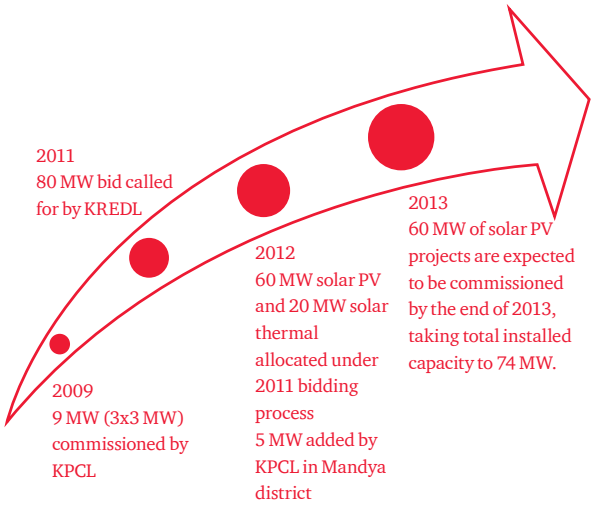
Favourable districts	Indicative levels of solar insolation level (kwh/m2/day)		
	Summer	Monsoon	Winter
Uttara Kannada	6.31	4.16	5.48
Dakshina Kannada	6.16	3.89	5.21
Mandya district	5.41	3.45	3.73

Source: ASTRA, IISc

Certain districts in Karnataka receive global solar radiation in the range of 5.1–6.4 kWh/m2 during summer, which is best suited for solar PV projects. An independent study has identified coastal parts of Karnataka with higher global solar radiation. Hence IPPs are keen to set up PV projects in and close to districts of Mandya, Uttara Kannada, Dakshina Kannada, Gulbarga, Raichur, Belgaum, Bidar, Bijapur and others.



Development of solar energy sector in Karnataka



Karnataka has recently concluded a bid process, in which 80 MW (60 MW for solar PV and 20 MW for solar thermal) was allotted to developers at tariffs between 7.94 –8.50 INR (solar PV) and 10.94 –11.32 INR (solar thermal). In addition, it is the only state in the country to have supported solar projects under the REC mechanism. Close to 950 MW of project proposals submitted to KREDL, which are under different stages of PFR and DPR preparation. These developments indicate that the solar sector in Karnataka is gaining momentum.

Grid augmentation by KPTCL and PGCIL

Developing a robust and reliable transmission system is important for ensuring the growth of the RE sector. Good potential sites of RE sources such as wind, solar and hydro power are usually located far from the existing electricity grids and consumption centres. Therefore it is important to augment the existing transmission networks for reaching these potential sites and ensuring that the power from these sources is utilised efficiently. Expanding networks will be crucial to achieve renewable energy objectives efficiency and effectively. Also, the increase in penetration of renewable energy and expansion of transmission network must go hand in hand, thus scaling up the investments required in transmission infrastructures.

Creation of adequate transmission infrastructure

The transmission system in the country consists of the interstate transmission system, which is mostly maintained by Power Grid Corporation of India Limited (PGCIL), and the intrastate transmission system, which is maintained by respective state transmission utilities. In the 12th plan, MNRE targets a renewable capacity addition of 29.5 GW. Creation of adequate transmission infrastructure for meeting the RE target is critical and challenging due to following reasons:

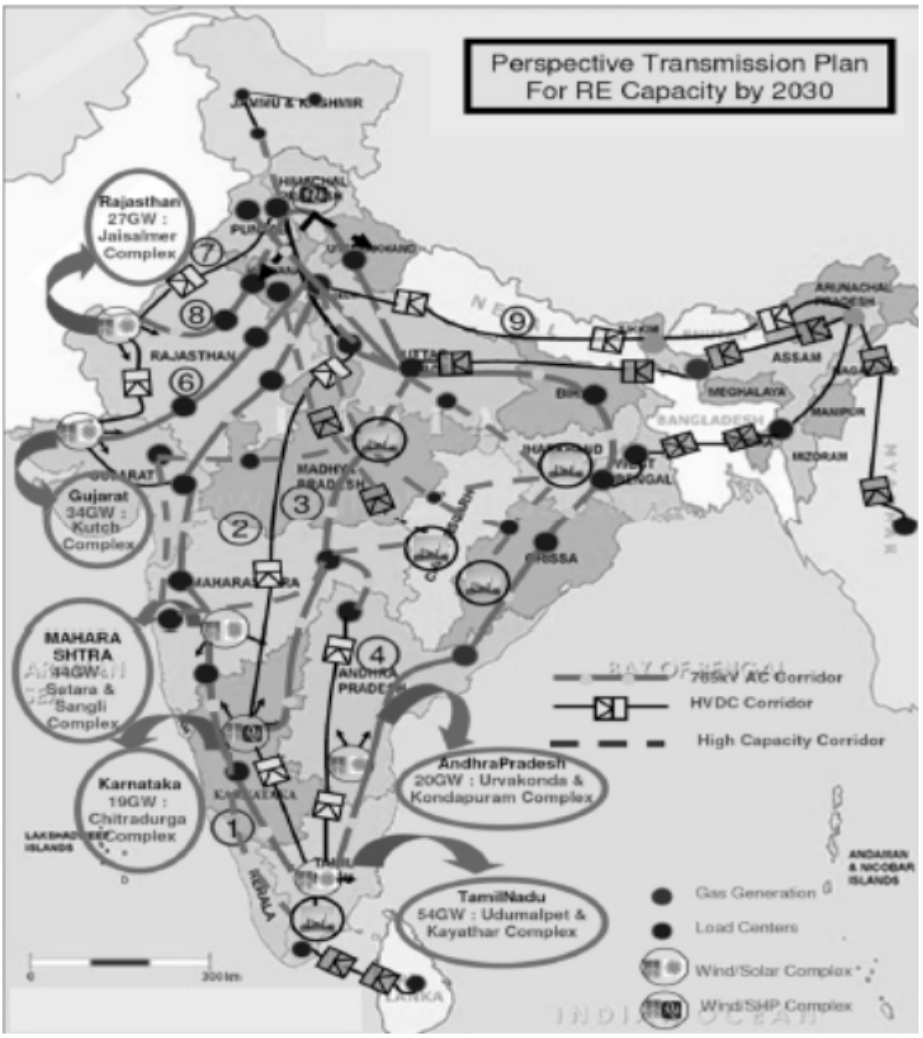
Location-specific RE potential: The renewable energy potential is location-specific and most of the good potential sites are located either in remote areas or areas with complex terrains.

Intermittent nature of RE: Solar and wind energy are intermittent in nature. This gives rise to variability in generation and causes significant disturbance in the grid. Integrating RE sources such as solar and wind, which produce peak energy during different times of the day, will reduce supply fluctuation and lead to better utilisation of the transmission system.

Interstate transmission of renewable power: Generally, most of the power generated through future capacity addition would be absorbed within the state for meeting the RPO requirement. However, once few states meet their RPO requirement, interstate RE transactions will increase, requiring augmentation of both interstate and intrastate transmission systems. In case of large scale RE generation, it is not possible to absorb the energy locally. Hence, a robust transmission system is required to wheel this power to other regions and avoid loss of generation. Construction of such a robust transmission infrastructure requires the deployment of huge funds.

Addressing evacuation problems of RE sources

Power Grid Corporation of India Limited (PGCIL), in a move to support the ongoing RE capacity addition, is planning to set up an exclusive countrywide green corridor for renewable energy transmission in the country. An investment of 42,000 crore INR over the next five years is being planned for the development of this corridor. Out of this amount, 20,000 crore INR is being invested to strengthen intra-state network, while the remaining 22,000 crore INR will be spent on the interstate network. The perspective transmission plan for RE capacity by 2030 as envisaged by PGCIL is given below.



PGCIL has also taken initiatives to provide a suitable mechanism to address the intermittent nature of wind and solar power generation, to enable large scale integration of renewable energy and the forecasting and scheduling of renewable energy. The proposed investment for the establishment of green energy corridor will also include other work such as energy storage, real time monitoring system and setting up of an RE management centre. The key functions of the centre are listed below:

- Day-ahead, hour-ahead, week-ahead and month-ahead forecasting of RE generation
- Real-time tracking of generation from RE sources and its geo-spatial visualisation
- Coordination with respective load dispatch centre for RE generation and control for smooth grid operation
- Single source information repository and coordination point for RE penetration
- Provide on-line dynamic security assessment tools for analysing dynamic performance, harmonic performance, etc.

Significant transmission augmentation

Karnataka's power sector is managed through seven main utilities: Karnataka Power Corporation Ltd (KPCL), Karnataka Power Transmission Corporation Ltd (KPTCL) and five electricity supply companies (ESCOMs). KPTCL is mainly vested with the functions of transmission of power and load dispatch in the state.

No. of receiving substations/ length of transmission lines in ckt km (as on 30.06.2012)	958/30,743
a) 400 kV	4/2291
b) 220 kV	89/9696
c) 110 kV	331/9026
d) 66 kV	544/9730

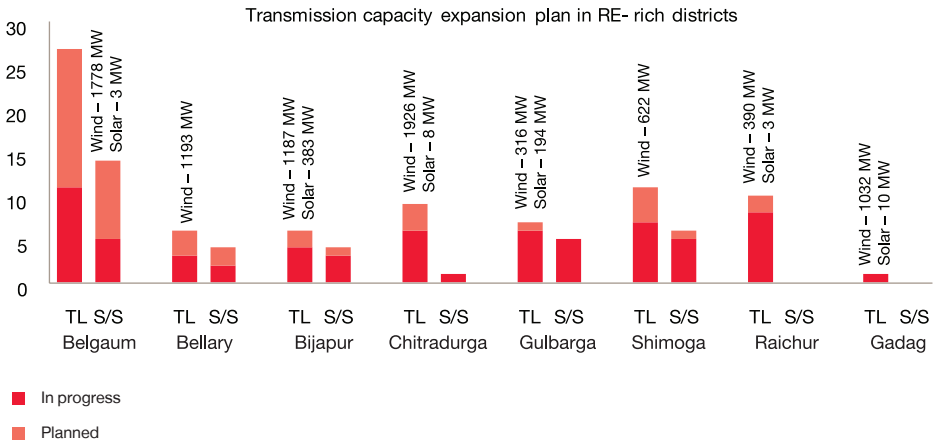
Source: KPTCL website

KPTCL has taken up the task of laying new transmission lines, construction of new sub-stations and augmentation of the existing sub-stations to support the increasing generation capacity addition in the state. KPTCL plans to increase its transmission capacity to 21,920 MW by 2016-17 by establishing 338 new substations at estimated capital investment of INR 12,000 Crs. As a part of this expansion plan, KPTCL proposed to establish two 765 kV substations at Raichur and Tumkur. The following table showcases the year-on-year planned transmission capacity addition by KPTCL.

Voltage Class	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
765 kV	-	-	1	1	-	-
400 kV	-	-	1	2	-	-
220 kV	6	3	10	12	8	1
110 kV	25	15	30	40	24	10
66 kV	20	13	29	45	26	16
Total	51	31	71	100	58	27
Transmission capacity in MW	15,200	16,220	16,820	18,520	20,560	21,920

Source: Annual Report 2010-11

To achieve the planned transmission expansion and augmentation, KPTC has formulated a zone-wise plan. In 2010-11, KPTCL incurred capital expenditure of 1094.7 crore INR and added 36 substations. Similarly, it has planned for capacity addition in a phased manner across the state. The graphics below indicates the planned capacity addition in districts having significant renewable capacity and potential:



Note: (1) Capacity identified for wind and solar by KREDL are displayed above the bars; (2) TL: Transmission line; (3) S/S – substation

Augmentation of transmission network

Planning and augmentation of transmission network is a long process and usually takes four to five years. On the contrary, a renewable energy power plant can be built with a much lower gestation period of 2-3 years. Therefore, the transmission planning for renewable projects have to be done on case to case basis depending upon the topology of the local grid, spatial distribution of renewable sources and the total quantum of power to be evacuated. Few renewable rich states such as Himachal Pradesh, Rajasthan, Gujarat and Tamil Nadu have already prepared a comprehensive long term transmission plan which may require a total investment of about INR 8,200 crores and is submitted to MNRE for financial support. To achieve an accelerated capacity addition of renewable projects, Karnataka is also required to come up with a similar comprehensive long term transmission plan for enabling unrestricted evacuation of power from such intermittent source of power. State government has already taken a step towards achieving this objective by announcing incorporation of a new state utility by name State Transmission Utility (STU), from January 2013. The new utility will look into transmission planning, while other organizations including KPTCL would have to bid for taking up transmission tasks. This step is expected to address the evacuation related issue pertaining to renewable capacity additions in the state.

Key Challenges to be addressed

Karnataka is emerging as an attractive investment destination for both wind and solar energy sectors. The introduction of various policies and regulations has prompted several IPPs and wind farm developers to set up their projects in the state.

However, few challenges need to be addressed in order to realize the true renewable potential in the state. Some of the challenges which require immediate action from various stakeholders in the state are listed below:

Wind energy

- ***Land acquisitions and clearances:*** While most of the wind potential in Karnataka is being identified in forest areas, clearances from the Forest Department or any other land authority is still a bottleneck for the sector, putting a number of projects on hold. Despite the existence of the Renewable Energy Policy in Karnataka, projects are still getting delayed. In order to address this issue, the government is appointing a special committee, which will simplify the procedure concerning the granting of projects and clear the road blocks.
- ***Power evacuation:*** Another issue hindering the smooth development of wind projects is the lack of efficient power evacuation infrastructure. As some of the identified sites are in rural areas, there is no adequate evacuation infrastructure to connect the power-generating plants to the transmission grid.
- ***Reallocation of cancelled projects:*** There is no clear road map on the reallocation of cancelled projects, thus further delaying the process of setting up new plants in the state. As per KREDL, projects of 140 MW have been cancelled, 93 MW rejected and 240 MW surrendered.
- ***Strict enforcement of RPOs:*** Regulatory commission must ensure that RPO targets are taken seriously by obligated entities and annual compliances are followed religiously. Although state has penalty mechanism in place, however implementation mechanisms need to be developed and enacted.

Solar energy

- It is important to improve the stability of the system and reduction of system T&D losses to an optimal level, consistent with density, load pattern.
- The cost of solar electricity produced on-grid is around 8.5 INR/unit, as seen from the recent bid process. This high cost is largely due to import of silicon-based solar wafers used for the manufacture of solar cells and import of thin-film based solar modules with no significant manufacturing base in India. Karnataka government should implement a semiconductor policy and M-SIPS for strengthening the manufacturing sector.
- India's PV sector is predominantly manufacturing oriented and current research and development (R&D) in the solar sector is on a slow track due to lack of collaborative effort. Technological innovations that improve the efficiency of current solar energy systems are necessary to exploit the solar energy potential in India. In order to facilitate this, government has to frame comprehensive R&D schemes and provide incentives along with the current subsidy schemes.
- Lack of standards result in the fragmentation of the market among manufacturers and suppliers. Standardisation of systems will lead to rationalisation of cost as companies can invest in R&D and newer technologies to meet common specifications.
- Since the solar projects are capital-intensive sector, the lack of attractive debt terms in the market is a major deterrent for developers. Hence, the viability of solar projects hinges on the developer's ability to reduce debt costs. However, access to low-cost funds for equipment supply through financial institutions will help players opting for both crystalline PV technology (domestic content) and thin-film technology.

These challenges, which pose to be major impediments of growth of the sector, need to be addressed by the governments in order to achieve the expected growth in the country. growth.

The way forward

Addressing key issues

Karnataka aims to increase the RE capacity to well over 4 GW by 2014. For this purpose, the role of the government, through its nodal agency KREDL, has become important in addressing a few issues being faced by the RE sector in the state.

- ***Creating a dynamic tariff framework:*** Tariff indexation on a year-on-year basis is a critical driver of growth. With ever-changing project economics, the regulatory commission and nodal agency should work to build in more dynamic tariff framework.
- ***Financing:*** Financing of RE projects has been one of the most difficult tasks until now. However, KREDL has simplified the process by creating a Green Energy Fund (Akshaya Shakthi Nidhi). The fund is accumulated by levying 0.05 INR/kWh on commercial and industrial customers and is expected to generate capital of 55 crore INR annually. This fund is expected to promote PPP mode, decentralised generation and distribution RE projects for the benefit of rural sector. This fund is expected to reduce the dependence of Karnataka's RE projects on central funds.
- ***Special development zones:*** KREDL will provide 10% of current and future SEZs for development of RE projects. These are referred to as Renewable Energy Economic Zones. Some of these identified sites are listed below:
  - Sugar and co-gen, power development: Bidar, Belgaum, Bagalkot, Shimoga and Mandya Districts
  - Power generation industrial zone development: Raichur, Bellary, and Bijapur and Chitradurga Districts
  - SEZs at Shimoga, Hassan, Bangalore, Udupi, Mysore and Bellary
  - Time-bound clearances and project execution: Timely clearances from various departments for the projects are vital for the successful commissioning of the RE projects. KREDL has taken the onus of ensuring timely clearances and project execution. It has also established dedicated commissions for timely clearances of the proposed projects in the sector. Following is a summary of the timelines for a few approvals and clearances:

Forest land	Clearances within a period of **four months**
Departmental clearances	Within **90 days**. The Administrative Department will monitor the reports in a time bound manner.
Statutory clearances approvals	Within **90 days and 120 days in case of forest clearance**
Single-window clearance	The single window will review the issues relating to the statutory clearances of various departments. The clearances/approvals that are not given within the specified time period will be dealt by the single window empowered committee.
Project execution	It is mandatory for the developer to complete the project and commission the project with grid synchronization within a period **three years from the date of the statutory clearances.** KREDL will obtain all required statutory clearances within **six months.**

In spite of these guidelines, projects are getting delayed, which necessitates immediate review and assessment of the reasons behind it.

- ***Industry status for RE:*** The government has identified power generation through renewable sources as an industry in order to provide it with various tax exemptions and industrial incentives.
- ***Carbon trading, an alternative source of revenue:*** Generation through renewable sources emits lesser CO2 as compared to conventional sources of energy such as coal. Trading this reduction in the emissions trading market can be another source of income for the project developers. This will help in partially offsetting the high cost of renewable energy production.
- ***Development of off-grid application:*** For electrification of un-electrified hamlets and villages suffering from major electricity supply shortages throughout the year, powering telecom towers, irrigation pumps and street lighting, promotion of off-grid applications are fundamental and need government support.
- ***Establishment of localised mini-grids:*** Localised mini-grids based on renewable technologies can be set up in locations that lack grid connectivity due to physical or financial barriers. Electricity generated by such mini-grids can be distributed through localised LT networks at a low initial setup costs and power tariff comparable to that of conventional grid power. Central government subsidy can finance initial setup, state and local governments can fund distribution overlay, and revenue collected from sale of electricity can fund the operation and maintenance expenses.
- ***Establishment of reliable ground measurement data:*** Non-availability of reliable site potential data makes the accurate evaluation of the returns from a project, technology selection and financing very difficult. Going forward, the state need to plan along with central agencies for additional assessment stations for renewable technologies.

As a step towards the development of the solar sector, the government has planned to create a 500 MW solar park, based on the Gujarat model, by March 2014. It will start with a small capacity of 80-100 MW and gradually scale up to provide huge opportunities for private developers. Such initiatives also provide momentum for the private players to invest in the sector in both generation as well as transmission. However, these initiatives lose steam over time due to various political and regulatory glitches. Therefore, there is a dire need for mechanisation and strict adherence to policies and timelines to enable the RE sector grow by leaps and bounds in the future.

Key takeaways

The conference will showcase the changes needed at the policy and regulatory level to facilitate capacity addition in Karnataka. It will also serve as a platform to identify new investment opportunities. Some key takeaways expected from the conference are listed below:

- The state government's commitment and supportive policies and regulatory frameworks are vital for capacity addition in the RE sector.
- The government should play the role of a facilitator by providing infrastructure for renewable energy projects like connectivity, electricity, water supply, land approvals and clearances, etc.
- Key advancements are happening in future renewable technologies.
- Several issues, challenges and risks are involved in financing RE projects.
- The availability of various financing options from private equity players, banks and other financial institutions are essential for the success of RE projects.
- Initiatives such as smart metering, net metering, smart grid, etc. can help in efficient management of RE projects.
- There is a need for initiatives for skilled and competent manpower development in the RE sector.
- PGCIL, KPTCL and ESCOMs have taken various initiatives to augment the existing transmission and distribution network.
- The financial health of the state electricity board is a cause of concern for a project developer putting up a power project in Karnataka. The event would address key aspects like mitigating the risk of default of payments by the utility companies.
- Government should take initiatives for creating a favourable manufacturing scenario.
- ESCOMs should take initiatives in e-governance in for efficient management of RE projects.

Notes

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