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Confederation of Indian Industry

Solar Power in Karnataka
Charting the path for a bright future

Knowledge Paper for CII Karnataka Conference on Power

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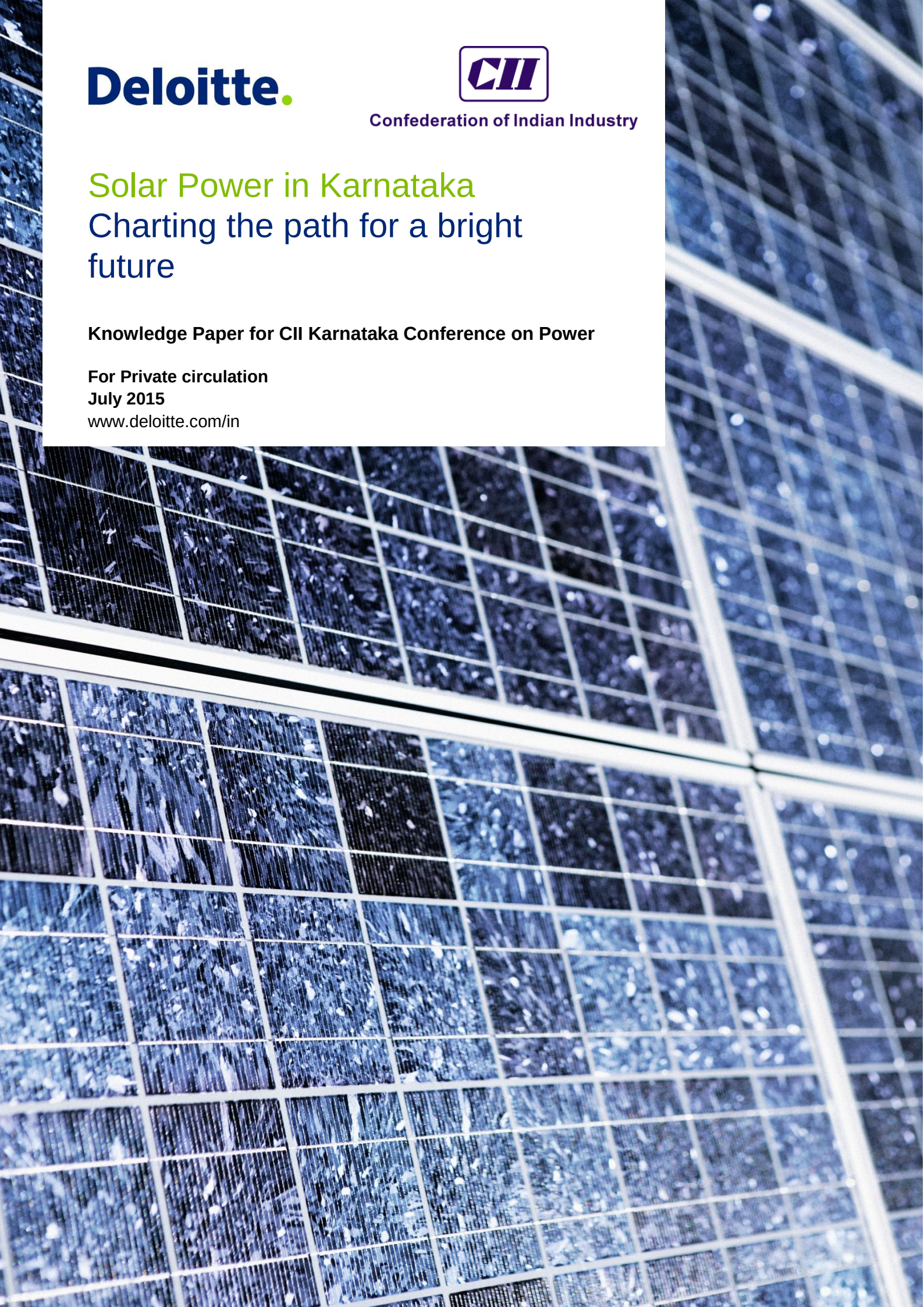

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Introduction

Recognising the importance of energy independence for holistic socio-economic development, the Government of India has over the years made consistent efforts to develop power infrastructure in the country. In view of concerns related to environmental sustainability and the need for decarbonisation, the Government has also initiated focussed efforts to increase the share of renewable energy (RE) in the energy mix. Although the share of RE technologies has increased significantly in the past few years, large potential for specific technologies in the country is still untapped, particularly in solar power (approximately 749GW and wind power (approximately 102GW)).

India's RE strategy is guided by the concerns on climate change and energy security.

The Government of India (GoI) has over the time introduced various policy and incentive measures to promote the growth of RE in the country. The policy and regulatory support mechanisms have evolved over the years in line with the changing requirements of the energy sector. Establishment of the National Action Plan on Climate Change (NAPCC) in 2008 has been a major milestone in creating a policy & regulatory regime to help mainstream renewables based sources in the national power system. The NAPCC advised that starting 2009-10, Renewable Purchase Obligation (RPO) to be set at 5% of the total power purchase basket and be increased by 1% each year for 10 years. To meet the RPO targets, market based instrument in form of Renewable Energy Certificates (RECs) was introduced for addressing the mismatch between availability of RE resources in a state and the requirement of the obligated entities to meet the RPO.

Indian Solar Energy Landscape

Solar power sector started making rapid strides in recent years, mainly after the launch of Jawaharlal Nehru National Solar Mission (JNNSM) in 2010. Installed capacity of solar power in the country has grown from a meagre 14 MW in 2010 to 3744 MW by March 2015 (increasing more than 265 times in a span of 5 years). Since its launch, the program as received encouraging market response. Solar power is one of the fastest growing RE technology and within a relatively short period of 5 years there has been steep fall (more than 60%) in Solar PV capital cost and tariff.

One of the objectives of JNNSM was to attain global leadership in solar manufacturing (across the value chain) by developing leading edge solar technologies. To this effect, Ministry (MNRE) has raised budgetary support to Rs.920 core for R&D during the 12th Plan Period. The country's manufacturing capacity for solar goods and equipment has grown over the years with a base of 52 PV module manufacturers as of June 2014. The solar EPC segment too has grown in the

Revision of solar power target from 20GW to 100GW is expected to play an important role in the growth of renewable energy sector.

country with most of the module manufacturers expanding their role across the value. The solar manufacturing is also poised for opportunities with the launch of “Make in India Program” which aims to facilitate investment and build best in manufacturing capabilities in the country.

The mission, apart from promoting utility scale projects has also provided the impetus to proliferation of solar power through rooftop solar projects. Apart from several states governments initiating separate programs for rooftop solar development, the segment is also receiving interest of commercial and industrial players. In the background of increasing costs of conventional power, concerns regarding availability and reliability of power from grid and long term commercial feasibility of solar power, commercial and industrial consumers are installing rooftop solar technology to meet their captive needs. Investing in solar power is also helping companies meet their CSR initiative along with long term commercial gains.

Considering the cost and environmental advantages of large scale solar parks, MNRE has proposed a scheme for development of Solar Parks and Ultra Mega Solar power projects in the country. Inspired from the success of Charanka Solar Park in Gujarat, other states have also initiated development of large scale solar parks in the country. The sector is also seeing development through innovative solar models like canal top installations. Recently, the Government has launched a Scheme on “Development of Solar Cities” Programme under which 60 cities/towns are proposed to be supported for development as “Solar/ Green Cities”.

Future prospects and challenges

Favourable state level policies, feed-in-tariff regime, viability gap funding mechanism, capital subsidies, progressive net-metering arrangements and solar specific RPO obligations have created a supportive environment for development of solar power in the country. In addition, the government has significantly increased the earlier target of 20GW by 2022 under the JNNSM by five times, to 100GW in the next 7 years.

The target comprises of 40 GW of Rooftop Solar and 60 GW through large and medium scale grid connected solar power projects. With this ambitious target, India is poised to be one of the largest green energy producers in the world, surpassing several developed countries.

Addressing some of the critical issues plaguing the sector is critical to achieving the ambitious capacity addition target set by the Government. Shortfalls in administrative and institutional readiness, like cumbersome land acquisition process, long approval and clearance process, limited knowledge & capacity of key stakeholders and limited data availability have created bottlenecks in the enabling environment. One of the key issues affecting the spread of solar technology is inadequate grid infrastructure in the country. Intermittency in power generation from solar technology poses a major technical challenge for grid integration and a weak grid further impends smooth grid integration of RE.

Meanwhile, financing institutions still perceive lending to solar projects as risky, in the absence of any risk-mitigating mechanisms. In addition, leniency in imposing penalties in the event of non-compliance of RPO, despite having specific provisions in the regulations for imposing such penalties has not helped in providing the intended regulatory support from the RPO mechanism.

Though majority of states have introduced policy/regulation for net-metering, rooftop segment is still experiencing challenges in form of capacity and grid integration restrictions under net-metering arrangements. Apart from this, the

local manufacturing segment faces stiff competition from foreign players who have an advantage in terms of economies of scale, low cost financing and favourable policy/regulatory environment in their domicile.

Given the ambitious targets and supportive policy landscape, it is foreseen that solar energy will hold an important share in the energy mix of the country in the coming years. However, these critical issues need to be addressed by the policy makers & regulators, along with other market players for optimum realisation and development of high potential RE technology in the country.

Karnataka – One State, Many Opportunities

Karnataka's tryst with renewable energy started in 1902, when a 700 KW hydro-electric power plant was commissioned in Shivanasamudram to supply power to the Kolar gold fields. This was one of Asia's first major hydro-electric power plants. Karnataka has also been at the forefront in the adoption of solar energy.

In 2010, Karnataka Power Corporation Ltd. became the only state government owned utility to qualify for development of project in the first phase of JNNNSM.

In 2011, the state became the first among the southern states in India to notify a separate government policy for promotion of solar energy. However in terms of physical achievement, the progress has been slower. In comparison to an overall solar power potential of 24,700 MW, only 84 MW of solar power capacity has been commissioned in the state (as on May 2015) with another 946 MW capacity allotted for commissioning.

The Govt. of Karnataka, in its Solar Policy 2014-2021, has set a target of installing 2,000 MW solar power by 2021, including grid connected rooftop projects of 400 MW. Though the solar policy of the state aims to achieve 3% contribution from solar sources out of the total energy consumption in the state by year 2021, the Karnataka Electricity Regulatory Commission (KERC) has kept the solar renewable purchase obligation on the distribution licensees constant at 0.25% since March 2011. However, KERC offers a very liberal and predictable concessional open access regime for solar energy which includes exemption from wheeling charges, banking charges and cross subsidy surcharge for the first 10 years of operation of solar projects which are not under REC mechanism.

The solar power sector in Karnataka offers significant opportunities to both investors and consumers. In comparison to the annual increases in electricity tariff of distribution licensees, solar energy offers an alternative, which will be cheaper in the longer run. The projects may be MW scale projects located far off, with the energy being wheeled to the consumers or may be smaller rooftop based projects. Under the current cost trends, it can be seen that for HT commercial consumers, both MW scale and rooftop solar power plants are a commercially viable option even at the existing level of tariffs. In case of HT industrial consumers, if their tariff continues to grow at the historical CAGR of 4.4%, solar projects may become cheaper viz-a-viz supply from ESCOMs in the next 3-4 years.

The solar market also offers sufficient avenues for investors, with options to further fine tune their market offerings and strategy to provide the maximum returns. Along with the traditional models, there are emerging opportunities such as renewable energy service companies (RESCO), specialized forecasting services for solar power projects, participation in solar power parks to utilize the common infrastructure etc.

The state has not progressed much in terms of capacity addition in solar power when compared to most of its neighbouring states. The slow pace

of progress in physical achievements points to deficiencies and challenges in the sector which includes:

- Delays and failures in commissioning of projects allotted under competitive bidding
- Low level of solar RPO
- Non enforcement of solar RPO on captive and third party open access consumers
- Issues on land acquisition and approvals

During FY 2014-15, energy deficit in the state was 4.3%, with an overall energy shortfall of 2,717 MU.

An addition of even about 1,000 MW of solar power will be able to meet more than 50% of the existing energy deficit levels. Compared to meeting this through thermal generation, use of solar power will result in avoiding annual carbon emissions to the tune of more than 1 million tonne. Meanwhile, rooftop solar power plants provide additional benefits due to their distributed generation nature in terms of reduction in energy losses. In addition to the overall benefits to the state in terms of reduction in energy deficit and carbon emissions, the individual consumers also have potential to benefit from solar energy through the use of solar power for optimization of their power procurement costs.

With dedicated efforts of the stakeholders, including Government and the Regulatory Commission, the state can chart the course towards tapping its full solar power potential.

Introduction

Indian Power Sector – Economic growth and sustainability challenges

With a GDP growth of over 7%[1], India is one of the fastest growing economies in the world. Ensuring adequate availability of energy is a crucial requirement for sustaining economic growth. The growth in total energy requirement of the Nation is expected to be at the rate of 5.7% per year in the 12th plan and 5.4% per year in the 13th plan[2]. However, the country has not yet been able to meet its electricity requirements consistently for the past several years, thereby constraining the economic growth. Despite the significant investments in power generation, there is still an energy deficit of 3.6% and demand deficit of 4.7%.

Figure 1: Power supply scenario - Energy deficit

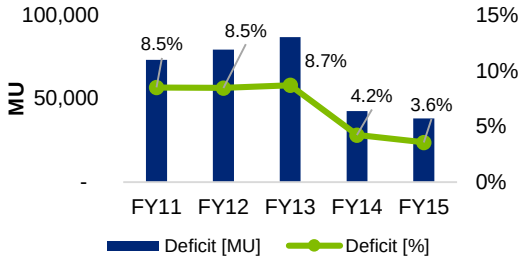
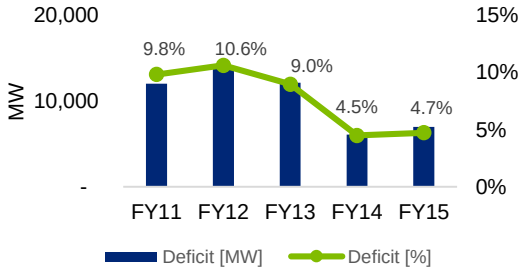


Figure 2: Power supply scenario - Demand deficit



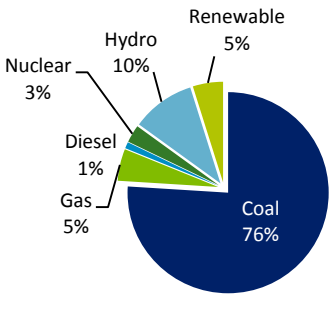
Source: Central Electricity Authority

Even the per-capital electricity consumption in the country (1,010 kWh in 2014-15[3]) is less than half of the world average. As efforts are made to improve the living standards and to make electricity available to the entire population, the energy requirements are expected to rise further. While it is important to increase the electricity generation in line with the increased demand, it is also important to consider the means for increasing such generation.

In 2014-15, renewable energy sources contributed to only 5% in the total electricity generation, with large hydro power plants contributing another 10% whereas fossil fuel based power plants contributed to 82%. In the longer term, such a heavy dependence on fossil fuel is not in the interest of the country, due to concerns on environmental sustainability, energy security and energy cost inflation.

More than 3/4th of the electrical energy generated in the country is from coal/ lignite based power plants

Figure 3: Breakup of gross electricity generation in India during 2014-15



Total: 11,05,446 MU

Source: Central Electricity Authority

1 Economic Survey 2014-15, Ministry of Finance, Government of India

2 Planning Commission, Government of India

3 Central Electricity Authority (April 2015), Growth of Electricity Sector in India From 1947-2015

A carbon intensive generation mix is not in line with the global efforts against carbon emissions and global warming. As the pressure keeps increasing on the governments for decarbonisation of their energy mix, India will also be forced to reduce its dependence on fossil fuels.

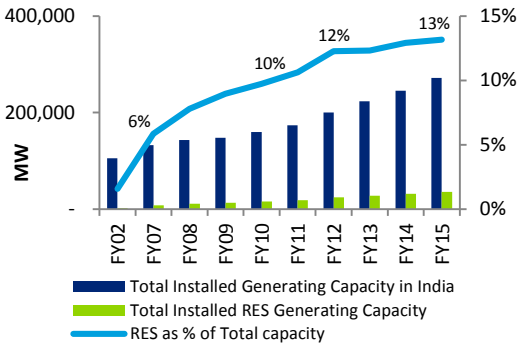
The upcoming 21st UN Conference of the Parties, known as COP21, is expected to see nearly 200 countries committing to slash greenhouse gas emissions

Though India has not yet made any statement on its 'Intended Nationally Determined Contributions' for COP21, high level adoption of renewable energy forms a keystone of India's policy towards reduction of carbon emissions and combating climate change. Renewable energy is also considered as a major instrument to improve the energy security of the country, as a significant portion of the fossil fuel requirements in the country is currently being met by imports. In addition, there are benefits due to its distributed nature (in terms of transmission and distribution losses) and the insulation from fuel cost inflation.

Growth of Renewable Energy

With climate change concerns taking the center stage in the domestic and international policy arena, renewable energy (RE) has become an important agenda of India's energy planning process. To this effect the government has set aggressive targets, and has put in place several incentives and policy initiatives at the Central and State levels for both grid connected and off-grid renewable energy. The installed capacity mix for electricity generation has undergone significant change in the recent years with the share of renewable energy capacity reaching at 13% in FY15.

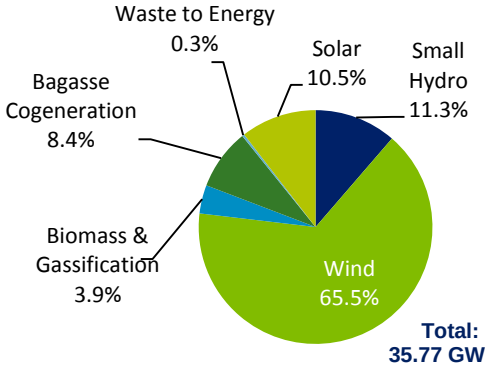
Figure 4: Growth of Installed Capacity & Percentage share of RES



Source: Central Electricity Authority

Wind energy dominates India's renewable energy sector, accounting for about 66% of installed capacity. Solar power constitutes only 10.5% of the total RE capacity mix[4] (3.7 GW by the end of FY15). However, it may be noted that the overall potential for solar energy in the country is estimated to be about 749 GW. Therefore, considering the reducing trend of capital cost and the high potential, a supportive policy framework is expected to significantly raise the contribution of solar power towards the country's energy mix.

Figure 5: Renewable Energy Capacity Mix



Source: MNRE - March 2015

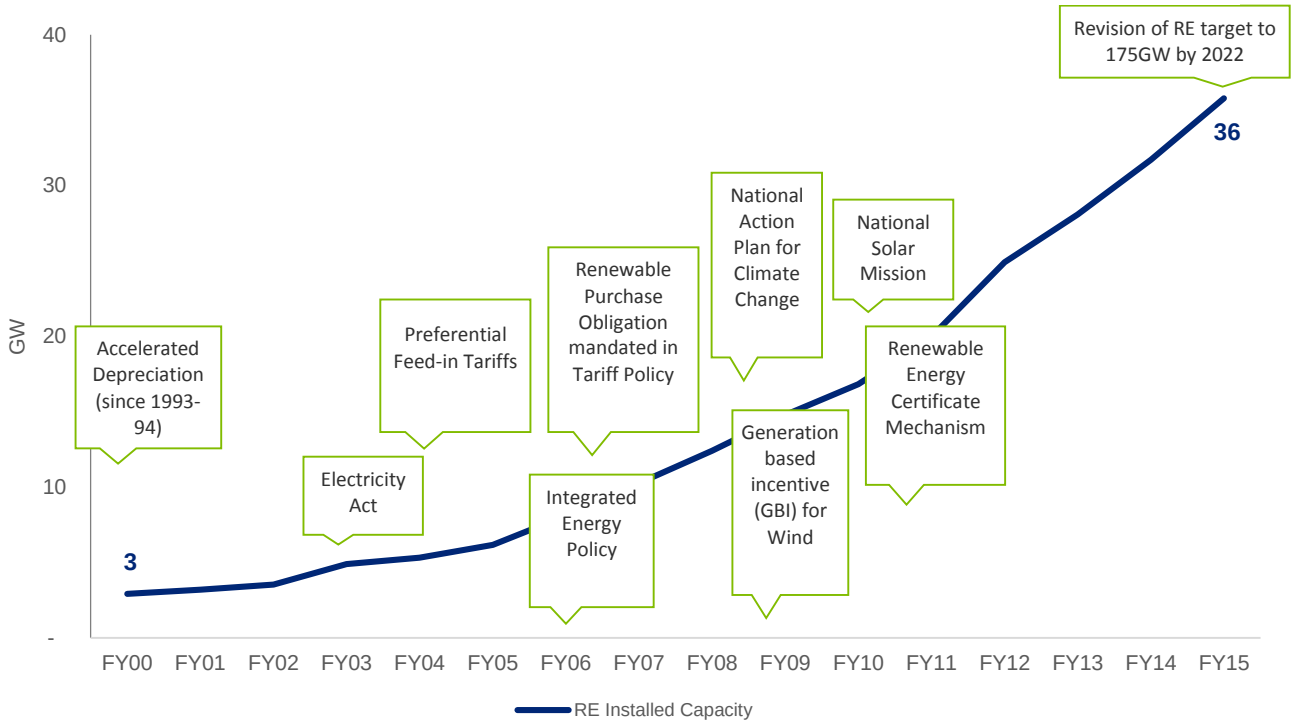
4 Ministry of New and Renewable Energy, Govt. of India

Key Policy Initiatives

It is well recognized globally that early commercialization of Renewable Energy (RE) technologies is highly dependent on support from the government through a mix of policy and regulatory instruments. Acknowledging the role of renewable energy technologies in enhancing sustainability, access to energy and security of supply, the Government of India (GoI) has introduced various policy and incentive measures to promote the growth of Renewable Energy (RE).

This has resulted in India's renewable energy installed capacity growing at a compounded annual rate of over 18%, rising from about 2.9 GW at the end of FY 1999-00 to about 35.8 GW by end of FY 2014-15.

Figure 6: Key policy initiatives and growth of RE in India



Source: Ministry of New and Renewable Energy

Solar energy in India

Utilization of the vast potential

With 250–300 sunny days in a year, about 5,000 trillion kWh of energy is incident on an annual basis over India's land area with most parts receiving 4-7 kWh per sq. m per day. Recently a study carried by National Institute of Solar Energy (NISE) estimated that the country has a total solar power generation potential of 748.9 GW**.** In comparison, the total installed capacity of solar energy as on end of June 2015 is 4,061 MW[5] – a mere 0.5% of the overall potential.

Not even 1% of the total solar energy potential has been harvested in the country yet.

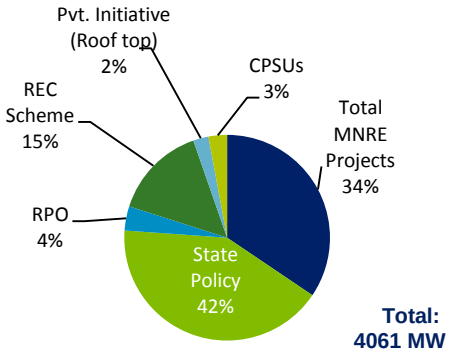
Performance of the Indian Solar Sector

The National Solar Mission

To tap the solar potential in the country, India has embarked on an ambitious program under the Jawaharlal Nehru National Solar Mission (JNNSM), targeting to achieve an installed capacity of 20,000 MW of solar power by 2022. However, realising the vast potential and fast technology growth, this target was revised to 100,000 MW to be achieved by 2022.

Under JNNSM phase I, a total of 960 MW of solar projects were awarded. Apart from these grid connected large scale plants, small scale and rooftop plants of capacity less than 2 MW each were also allotted under GBI scheme under the Rooftop PV and small Solar Power Generation Programme (RPSSGP). Under Phase II (Batch I), a total of 750MW of capacity was allocated, which was equally divided between projects with domestic content requirement and open category projects[6]. Under the State policy framework, Gujarat has been the key state which has developed around 1000 MW of solar power since the announcement of Gujarat Solar Policy in July 2009.

Figure 7: Break-up of Commissioned Capacity of Grid Connected Solar Projects

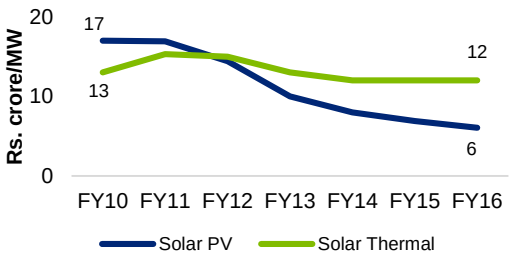


Source: MNRE, as on 25.6.2015

Solar Power on the path towards Grid-Parity

With technology innovations and increasing installations, solar power is fast reaching grid parity. Since the launch of JNNSM in 2010 Solar PV capital cost and tariff have decreased by more than 60%. Over time, as coal prices increase and solar power tariff reduces under improved technology regimes and falling module prices, grid parity is likely to be achieved sooner than anticipated and compete at par with conventional energy sources.

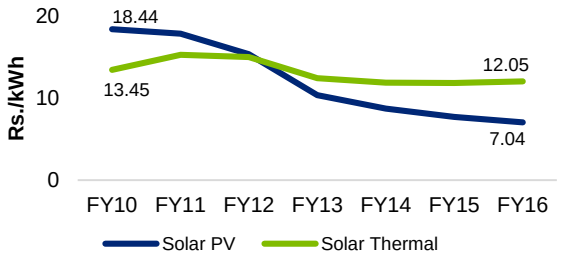
Figure 8: Trends in Solar Power benchmark Capital Cost



[5] *Ministry of New and Renewable Energy, Commissioning Status of Grid Connected Solar Power Projects, as on 25th June 2015*

[6] *Solar Energy Corporation of India (25th February 2014), Notification regarding selected Projects of 750 MW Grid connected Solar PV Projects under JNNSM Phase-II Batch-I*

Figure 9: Trends in Solar Power benchmark tariff



** Tariffs shown are for projects which are not availing AD benefit.*

Source: Central Electricity Regulatory Commission

Competitive bidding conducted by central and state governments have seen further reduction in tariffs from the relevant benchmark costs. The figure below details the results of recent solar bidding across different states in which competitive rates were obtained for solar power:

Rooftop Solar

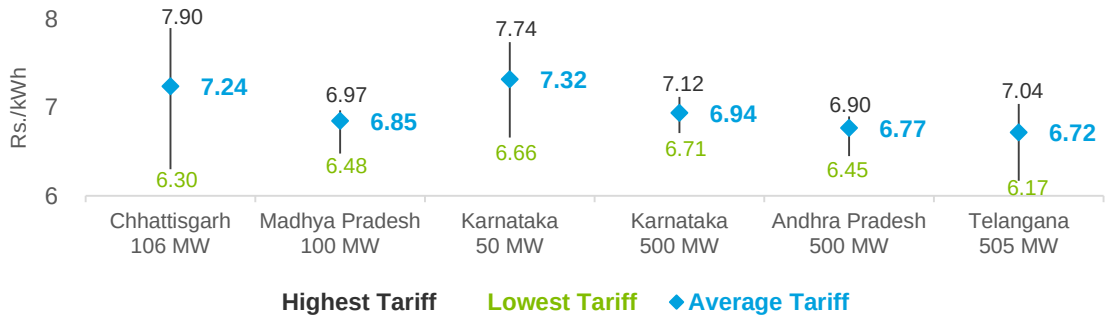
Unutilized space on rooftops and around buildings provides a large aggregate potential for generating solar power. Small quantities of power generated by each individual household, industrial building, commercial buildings or any other type of building can be used to fully / partially fulfil the requirement of the building occupants and surplus, if any, can be fed into the grid.

In June 2010, MNRE launched a programme based on Generation-Based Incentives (GBI) to give a boost to Rooftop PV and Small Solar Power Plants connected to the distribution network (at or below 33 kV level) -"Rooftop PV & Small Solar Power Generation Programme" (RPSSGP). Currently, 71 projects have been commissioned in 12 states under the RPSSGP scheme with installed capacity of 90.8 MW[11].

MNRE has also launched a national level 'Grid Connected Rooftop and Small Solar Power Plants Programme' on June 2014 which provided Central Financial Assistance (CFA) of up to 30% of the capital cost for plants ranging from 1 kWp to 500 kWp. Currently, CFA is reduced to 15%, and is available only for non-industrial and non-commercial consumers.

MNRE is making concerted efforts to promote grid connected solar rooftop projects and has enhanced its target for such projects under JNNSM to 40GW by 2022. The ministry has also written to the Department of Revenue, Ministry of Finance to consider granting Income Tax exemption to the users who install grid connected solar rooftop plants on their roofs. In addition, the ministry has got the Department of Financial Services, Government of India to issue an advisory to all public sector banks to provide loans for installation of grid interactive rooftop solar PV plants under home loan / home improvement loan schemes.

Figure 10: Solar Power Tariff trend across States in 2014



** Tariff displayed for AP are calculated levelized values derived based on published first year tariff.*

Source: CSPDCL, KREDL, MPPMCL, APSPDCL, TSSPDCL, Deloitte Research

Technology Evolution

Globally, crystalline silicon (c-Si) technology has been the preferred technology for solar PV, in comparison to thin film (TF) technology in the past several years. The thin film technology, which initially emerged as a low cost option has been steadily losing market share over the years due to decline in prices of crystalline silicon, and accounted for only 11% of the global PV market at the end of 2011[7]. On the contrary, in India, during phase I of JNNSM, nearly 70% of the PV installations were based on thin film technology. This was mainly due to:

- Absence of mandatory domestic content requirement (DCR) for thin film viz-a-viz crystalline silicon
- Availability of low-cost, long-tenor debt from the Export-Import (EXIM) bank of United States for purchase of thin film cells and modules from United States

Domestic manufacturers in the country have struggled to be competitive in a volatile and rapidly declining price environment led by foreign suppliers. However, in line with the global trends, the crystalline silicon technology is now regaining prominence in the Indian market too. Setting aside a fixed quantum of projects to be compulsorily under domestic content requirement category by the Govt. has been a major influential factor behind this change. For example, in Phase II, Batch I of JNNSM, 350 MW of the total 700 MW capacity was set aside specifically under "domestic content requirement" category.

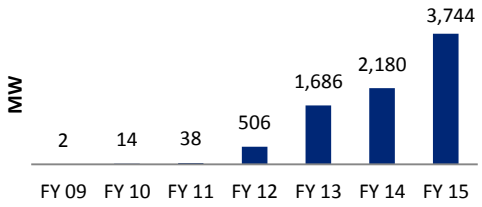
The Govt. has now taken measures to correct the unintended technology consequence of JNNSM Phase I and has made DCR applicable for thin film technology also

[7] *The World Bank (2013), Paving the way for a transformational future – Lessons from JNNSM Phase I*

Key drivers

The solar energy sector has risen significantly in the last three years, reaching 3744 MW in 2015 from just 38 MW in 2011 driven by multiple initiatives of Central Government and State Governments.

Figure 11: Growth of solar power in India



Source: MNRE

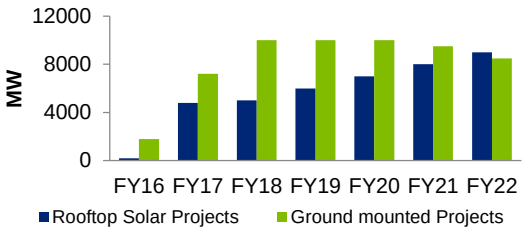
Jawaharlal Nehru National Solar Mission (JNNSM)

The Jawaharlal Nehru National Solar Mission (JNNSM) was launched to promote solar energy in the country. The objective of the Jawaharlal Nehru National Solar Mission was to create conditions for reduction of solar power costs and achievement of grid parity through rapid scale-up of capacity and technological innovation. The mission adopted a 3 pronged approach to achieve a target of 20GW by 2022. However, realising the success and potential of solar technology in the country, the govt. of India recently revised the target to 100GW to be achieved by 2022.

The capacity is proposed to be achieved through deployment of 40GW of rooftop solar projects and 60GW through large and medium scale projects. According to estimates of MNRE, the total investment in setting up 100 GW will be around Rs. 6,00,000 cr. In the first phase, the Government of India is providing Rs. 15,050

crore as capital subsidy to promote solar capacity addition in the country.

Figure 12: JNNSM Revised Year Wise Targets



Source: MNRE

State level policies

Apart from national level solar mission, several state governments in India have declared solar policies to promote harnessing of solar generation. With high solar potential, Gujarat has been at the forefront and was the first state to award projects under its state solar policy, even before projects were awarded under JNNSM. The states usually offer easier project and land related approvals and fiscal benefits under their solar policies.

Feed-in-Tariff

Almost all the states have notified feed in tariff for solar power plants. This paved the way for utilities to procure electricity through solar power projects and also formed the basis for having tariff based competitive bidding.

Viability Gap Funding (VGF)

Under Batch I of the JNNSM Phase II, the capital cost subsidy is offered in the form of VGF. It is provided to the project developers in order to help them reach a viability threshold at a pre-fixed tariff.

Subsidies

In addition to incentives for utility scale projects, the NSM has set a target of allocating 40 GW of grid-connected rooftop solar projects by offering subsidies. The Ministry of New and Renewable Energy (MNRE) provides up to 15% capital subsidy for roof top systems (off-grid) and for projects up to 500 kW. A few states in India such as Kerala, Tamil Nadu and Uttarakhand have announced an additional state subsidy of 20% on top of the MNRE subsidy. This can be a significant financial driver for smaller projects.

Net Metering

To support distributed generation of solar energy, several state governments are incentivizing rooftop solar systems through net metering schemes. Several states such as Andhra Pradesh, Uttarakhand, Tamil Nadu, Karnataka and West Bengal have finalized net metering policies. Net-metering based rooftop solar projects would facilitate self-consumption of electricity generated and allow for feeding the surplus into the network of the distribution licensee.

RPO and REC

In the interest of long term development of renewable energy sector, the Central & State Electricity Regulatory Commissions have taken the initiative to promote renewable energy by specifying minimum renewable energy procurement obligations as per the provisions of Electricity Act 2003 and other policies.

In addition, Central Electricity Regulatory Commission has introduced a market for tradable Renewable Energy Certificates (RECs) as an alternative mechanism for fulfilling RPO. It is aimed at addressing the mismatch between availability of RE resources in a state and the RPO. Under the REC mechanism, developers are eligible to receive one certificate for every 1,000 kWh of renewable electricity fed into the grid. Obligated entities can buy these certificates to fulfil their obligation.

Solar PV Value Chain

With the growing impetus around solar energy, securing a robust domestic supply chain would not only eliminate the risk around the high cost technology but also reduce import dependence. An increased domestic manufacturing base will also enable substantial value addition increasing upstream and downstream employment opportunities.

Figure 13: Solar PV Industry Value Chain

The domestic manufacturers face stiff competition from foreign manufacturers and suffer from low capacity utilisation

Research & Development

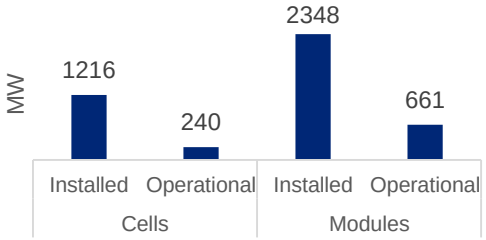
MNRE has issued policy guidelines[8] for 'Research, Design, Development, Demonstration (RDD&D) and Manufacture of New and Renewable Energy' in 2010 to make the industry competitive and to make renewable energy generation supply self-sustainable and profitable. MNRE has raised budgetary support of Rs.920 core for R&D during the 12th Plan Period with continued emphasis on cost reduction and efficiency improvement[9].

Manufacturing

One of the objectives of JNNSM is to take a global leadership role in manufacturing in solar sector (across the value chain) with a target of 4-5 GW equivalent of installed capacity by 2020. The mission objectives included setting up of dedicated manufacturing capacities for poly silicon material to annually manufacture about 2 GW capacity of solar cells[10].

As per MNRE, the country had 52 PV manufacturers as of June 2014. While the installed cell manufacturing capacity stood at 1216 MW, the operational capacity is only 240 MW. Similarly, the nameplate PV module manufacturing capacity is 2348 MW, whereas the operational capacity is only 661 MW[11]. In case of solar cells, although the domestic C-Si PV cell capacity of 1.2 GW is comparable to overall PV installations during FY2014, the cell manufacturers also experienced low capacity utilization. This is because module manufacturers prefer imported PV cells on account of their low costs.

Figure 14: Domestic Cell & Module Manufacturing Capacity



The Ministry of Finance has so far desisted from imposing anti-dumping duty on imported solar cells so as to avoid any impact on the solar generation program. However mandatory domestic content requirement (DCR) is now part of most Government sponsored schemes on solar power generation irrespective of technology.

EPC and O&M

Amid the volatility in prices, most players globally have expanded their presence in the value chain and have geographically diversified their sales. In line with global trends India is witnessing increasing participation from players having both manufacturing and project development capability. The domestic market has increasingly witnessed greater participation from firms having EPC as well as in-house solar module manufacturing capability. A number of module manufacturers are active in downstream segments i.e. both as EPC services and O&M. Solar EPC contractors have gained prominence in the emerging solar energy market as project developers with limited experience in solar segment have relied heavily on their EPC contractors to support their projects.

[8] *Ministry of New and Renewable Energy (18th October 2010), Policy Guidelines of Research, Design, Development, Demonstration (RDD&D) and Manufacture of New and Renewable Energy*
[9] *Ministry of New and Renewable Energy, Annual Report 2014-15*
[10] *Ministry of New and Renewable Energy (2009), JNNSM Mission Document*
[11] *Ministry of New and Renewable Energy (04th June 2014), Manufacturing capacity of Solar Cells and Modules in India*

Future prospects and challenges

Recent initiatives

Solar Rooftop

Apart from promoting ground mounted solar PV projects, the JNNSM also has a mandate to encourage the rooftop solar segment. Under Phase I of JNNSM, a separate scheme called 'Rooftop PV and Small Scale Solar Generation Program (RPSSGP)' was implemented for developing solar PV projects with maximum capacity of 2 MW. A total of 91MW of rooftop projects have been installed under the program as of March 2015[12]. It was observed that this scheme garnered enthusiastic responses primarily in the ground-mounted segment, while it received almost negligible responses in the rooftop segment. However, under the revised 100GW targets set for solar technology, the government has set a specific target of 40GW grid connected rooftop capacity to be installed by 2022.

The 40 GW target for solar rooftop reflects the Govt.'s commitment and potential of rooftop solar energy

States like Gujarat, Madhya Pradesh and Odisha have initiated separate programs to promote rooftop solar power projects. Similarly SECI has allotted a number of rooftop projects as a part of its initiative for promotion of rooftop solar projects in the country. In order to facilitate rooftop solar, net-metering policies and regulations have been proposed by a number of states. Net-metering based rooftop solar projects would facilitate self-consumption of electricity generated and allow for feeding the surplus into the network of the distribution licensee.

Solar Cities

The Ministry has launched a Scheme on "Development of Solar Cities" Programme which aims at minimum 10% reduction in projected demand of conventional energy at the end of five years to be achieved through a combination of energy efficiency measures and enhanced supply from renewable energy sources. A total of 60 cities/towns are proposed to be supported for development as "Solar/ Green Cities". Under the program, sanctions have been issued for 48 Cities for Master Plans, solar city cells and promotional activities. The list includes Mysore and Hubli-Dharwad cities in Karnataka[13].

Solar Parks & Ultra Mega Solar Power Projects

JNNSM and state level solar policies provided the impetus for development of solar parks in the country. The development of Charanka solar park in Gujarat which already has an installed capacity of close to 345 MW was followed by Bhadla Solar Park in Rajasthan. Considering the cost and environmental advantages of large scale solar parks, MNRE has proposed a scheme for development of Solar Parks and Ultra Mega Solar power projects in the country[14]. The scheme proposes to develop 25 solar parks, each with a capacity of 500 to 1000 MW, thereby targeting around 20,000 MW of solar power installed capacity in a span of 5 years.

Canal Top Solar Installations

After Gujarat's success with canal-top solar PV the MNRE on 5th December 2014 accorded administrative approval for the scheme with a target of 100 MW Grid Connected Solar PV Power Plants on Canal Banks and Canal Tops (50 MW on Canal Tops and 50 MW on Canal Banks)[15]. The Ministry has planned an outlay of

[12] *Ministry of New and Renewable Energy, Annual Report 2014-15*
[13] *Ministry of New and Renewable Energy (January 2015), Development of solar city Programme*
[14] *Ministry of New and Renewable Energy (September 2014),Draft scheme for development of solar power parks*
[15] *Ministry of New and Renewable Energy (December 2014) Pilot cum demonstration program for Development of Grid connected solar PV plants on canal banks and canal tops,*

Rs. 975 Crores over the 12th Plan Period and with a central financial assistance (CFA) of Rs. 225 Crores for the project. Projects have been proposed in 8 cities including a 10 MW Canal Top project planned in Karnataka[16].

Make in India

The recently launched Make in India Program by the Government aims to facilitate investment and build best in class manufacturing capabilities in the country. The NSM mission document targets to achieve 4-5 GW of manufacturing capability by 2020, including dedicated manufacturing capability for polysilicon material to annually make about 2 GW of solar cells.

With renewable energy being included as one of the identified sectors under the Government's Make in India Programme, the renewable energy manufacturing sector is also poised for incremental opportunities. To this effect, the MNRE has sought suggestion from solar manufacturers and investors to improve the manufacturing environment in the country[17].

Domestic content requirement in the 1,300 MW solar PV projects planned for PSUs, Govt. departments and defence sector is expected to provide a fillip to the solar equipment manufacturers in India.

Key Issues & Challenges

Grid Integration

Intermittency of RE generation is one of the key challenges to expanding the level of RE sources in the grid. In addition, development of adequate power evacuation infrastructure to manage renewable based capacity addition has not happened in several states. The state transmission utilities have not been able to provide the requisite focus as a result of their poor financial condition and the low priority accorded to RE in some of the states.

Timely availability of power evacuation continues to be a concern and has resulted in delay in commissioning of solar power projects. With increased emphasis on development of large scale solar plants as well as decentralised distributed generation, solving the grid-integration problem will significantly influence the future growth potential and scaling up of the technology.

The Power Grid Corporation in its report on 'Green Energy Corridors' has already identified the transmission infrastructure requirements for the renewable energy capacity addition till 2030. An investment of approximately $8 billion is anticipated for the development of this corridor.

Beleaguered local solar manufacturing environment & competition from foreign players

Indian solar PV manufacturing is restricted primarily to the lower value added segments – namely cells and modules – of the c-Si value chain. With Chinese and Taiwanese manufacturers cornering market share in c-Si solar PV globally through integrated operations and GW scale installations, Indian exports have declined significantly. Indian manufacturers have continually struggled to be price-competitive in the current environment.

Enforceability of RPOs and concerns around solar RECs

RPOs are administered by the State Electricity Regulatory Commissions who have so far been lenient in imposing penalties in the event of non-compliance of RPO, despite the presence of regulatory provisions for imposing such penalties. Meanwhile the poor financial health of the distribution companies restricts their ability to

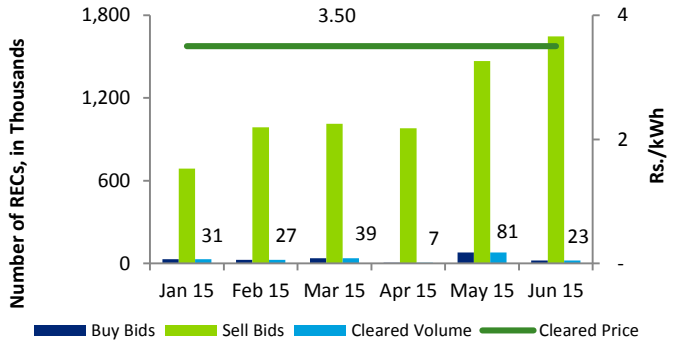
[16] *Ministry of New and Renewable Energy, Annual Report 2014-15*

[17] *Ministry of New and Renewable Energy (18th June 2015), Make in India – Suggestions sought from all Solar Manufacturers and Invertors*

purchase the desired quantum of power from renewable energy sources or for that matter renewable energy certificates (REC). These factors contribute to an artificial barrier on the investments in solar energy sector.

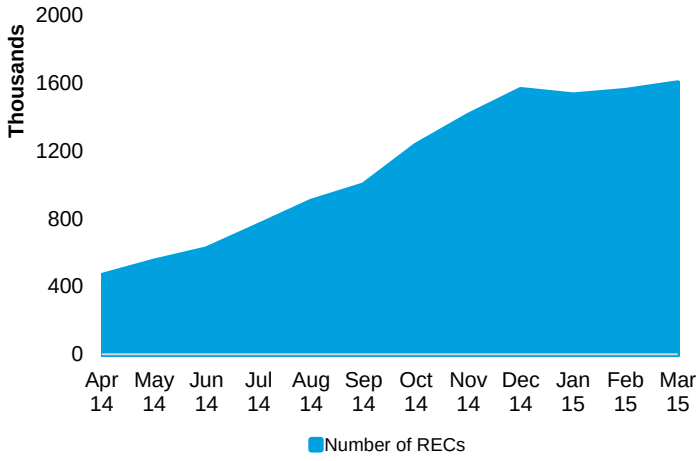
The laxity in enforcement of RPO has also led to low liquidity in REC market. With the build-up of solar REC inventory and continued trading at floor price, REC route is currently not considered as an attractive option for investments in the sector.

Figure 15: Solar REC trading in Indian Energy Exchange



Source: Indian Energy Exchange

Figure 16: Build-up of Solar REC inventory



Source: REC Registry of India

Lack of adequate low cost financing

India is one of the most costly countries in the work for RE financing. The country suffers from high interest rates and banks are still sceptical about financing solar projects, particularly in the absence of any risk-reducing mechanisms. Export credit agencies, multilateral financial institutions and some non-banking financial institutions accounted for the bulk of debt financing over Phase I of JNNSM. The continuing risk aversion of Scheduled Commercial Banks remains one of the key hurdles for successful implementation and scale-up of JNNSM. Further, the crowding out effect of concessional sources of financing in the form of supplier's credit and direct lending by development banks, without the availability of any concessional lines of credit for SCBs, poses a problem.

Issues related to net-metering

Having a clear regulatory and policy framework is an important element for promotion of rooftop solar PV under the net metering arrangement. Currently, many states provided clarity on the regulatory & policy framework for installing rooftop solar systems under net-metering, which creates a major bottleneck for promotion of net-metering. However, the rooftop solar segment faces challenges in the form of:

- Capacity limit for rooftop installations under net-metering regulations
- Local grid integration restrictions under net-metering arrangements
- Treatment of surplus energy at the end of settlement period as per the regulation/policy
- Limited incentives/subsidy for rooftop installations
- Lack of consumer awareness about installation procedures and incentives

Land Acquisition Process

Cumbersome land acquisition process is viewed as a key bottleneck in solar project execution. Land is a scarce resource, and therefore finding a suitable location that meets the technical, environmental and economic and financial requirements is major hurdle faced by projects developers. In addition, long approval and clearance procedures increase the difficulties in

acquiring land. Complex land acquisition policies in different states that impose various restrictions have long riddled the domestic solar sector.

Resource Assessment

Project structuring and feasibility assessment is dependent on information about resource availability. Limited availability of data on solar irradiation level, land availability, water availability, grid loading and availability, etc. create a major hurdle in mapping the project feasibility.

Coordination between Centre and States

Increasing the adoption of solar power will depend upon the ability of different RE focused institutions together with state and central governments to overcome various issues & challenged and to undertake/facilitate implementation of renewable energy projects.

In absence of an established framework for coordination between the state agencies and MNRE administered institutions (Solar Energy Corporation of India (SECI), Solar Energy Center (SEC) and Indian Renewable Energy Development Agency (IREDA) etc.), a clear mapping of responsibilities between the various agencies does not exist in the public domain. This has caused confusion amongst other stakeholders and consequently, delays.

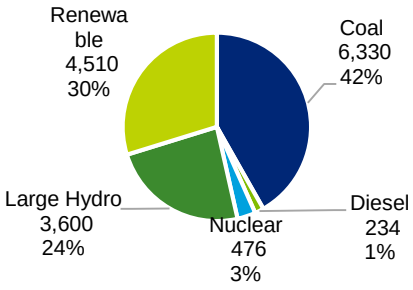
Karnataka – One State, Many Opportunities

Untapped potential

Karnataka's tryst with renewable energy started in 1902, when a 700 KW hydro-electric power plant was commissioned in Shivanasamudram to supply power to the Kolar gold fields. This was one of Asia's first major hydro-electric power plants.

The state has always been a pioneer in the adoption of renewable energy, with the share of renewable energy standing at 30% in the total generation mix, along with another 24% of large hydro capacity, as on May 2015.

Figure 17: Source wise electricity generation capacity in Karnataka (in MW)

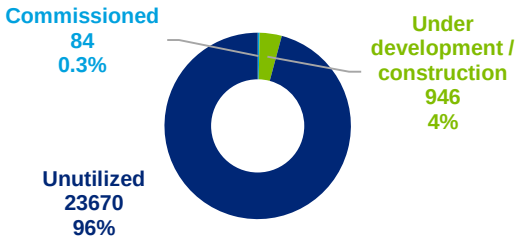


** As on May 2015. Source: Central Electricity Authority*

Karnataka has also been at the forefront in the adoption of solar energy. In 2010, Karnataka Power Corporation Ltd. became the only state government owned utility which qualified to develop a project in the first phase of JNNSM. In 2011, the state became the first among the southern states in India to notify a separate government policy for promotion of solar energy. However in terms of physical achievement, the progress has been slower.

As on May 2015, only 84 MW of solar power capacity has been commissioned in the state, and another 946 MW capacity allotted for commissioning against an overall solar power potential of 24,700 MW.

Figure 18: Utilization of solar power potential (MW) in Karnataka



** As on May 2015*
Source: National Institute of Solar Energy, Karnataka Renewable Energy Development Ltd.

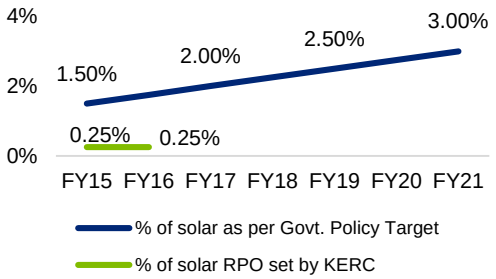
A liberal policy and regulatory framework

The Govt. of Karnataka, in its new Solar Policy 2014-2021, has set a target of installing 2,000 MW solar power by 2021, including grid connected rooftop projects of 400 MW.

Along with the usual project models, the policy also proposed setting up of projects of 1-3 MW capacity by land owning farmers, and setting up of projects by public sector undertakings to provide solar power bundled with thermal power. Though the solar policy of the state aims to achieve 3% contribution from solar sources out of the total energy consumption in the state by 2021, the Karnataka Electricity Regulatory Commission (KERC) has kept the solar renewable purchase obligation on the distribution licensees, constant at 0.25% since March 2011.

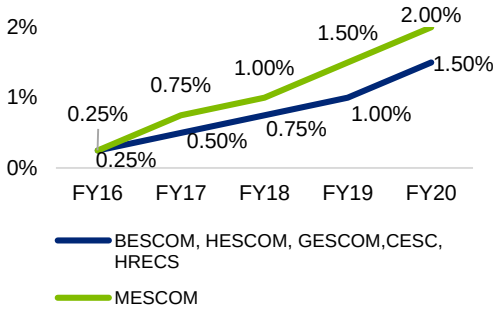
Even after considering 946 MW of solar capacity currently under development, the state will have a utilization of only about 4.2% of its solar power potential.

Figure 19: Variation in targets set by Government and Regulatory Commission for solar energy



However, in July 2015, KERC has come out with a draft amendment to the KERC (Procurement of Energy from Renewable Sources) Regulations, 2011, in which solar purchase obligation is proposed to be gradually increased in an annual basis.

Figure 20: Proposed solar RPO as per draft amendment of RPO regulations by KERC



In comparison to the delay in increasing the level of solar RPO, KERC offers a very liberal and predictable concessional open access regime for solar energy which includes exemption from wheeling charges, banking charges and cross subsidy surcharge for the first 10 years of operation of solar projects, which are not under REC mechanism.

Table 1: Promotional measures for solar energy in Karnataka

Wheeling charges	Exempted for first 10 years from date of commissioning
Banking charges	Exempted for first 10 years from date of commissioning
Cross subsidy surcharge	Exempted for first 10 years from date of commissioning
Availability of banking	Annual Basis
Payment for unutilized banked energy	85% of generic tariff determined by KERC

** In case of non-REC projects that achieve CoD before 31st March 2018, with both the generation and consumption within Karnataka*

The regulatory commission in the state has also been proactive in providing regulatory certainty to RE developers, by setting a control period of 5 years for the generic solar tariff determined in 2013, thereby enabling the generic tariff to be available for projects which are entering into PPAs with the distribution licensees from April 2013 to March 2018[18].

Salient features of Karnataka Solar Policy 2014-2021

- Target of achieving 2,000 MW of solar generation capacity by 2021
- Encouraging the development of 300 MW of feed in tariff based solar projects (1-3 MW) by farmers
- Encouraging the development of utility scale solar projects through competitive bidding
- Promotion of grid connected rooftop solar projects with net metering
- Encouraging off-grid solar street lights and rooftop solar systems
- Encouraging the use of solar powered agricultural pump sets
- Promotion of integrated solar parks and hybrid renewable energy projects
- Creation of land banks for development of solar projects under lease of land
- Supporting the deployment of grid connected canal top solar projects
- Imposing solar purchase obligation on HT consumers subject to consent of KERC
- Facilitation of deemed conversion of land for solar projects
- Time bound permissions for purchase of agricultural lands for setting up of solar power projects
- Exemption to solar PV projects from obtaining clearances from pollution control board

Table 2: Feed in tariff for solar energy determined by KERC

Type of Solar Plant	Tariff [Rs./kWh]
Solar PV Power Plants	8.40
Solar Thermal Power Plants	10.92
Rooftop & Small Solar PV Plants	9.56
Rooftop and Small Solar PV Plants with 30% capital subsidy	7.20

Karnataka and the rest of southern India

In comparison to other states in southern India, Karnataka offers a liberal regime for solar generation, including exemption of cross subsidy surcharge for third party open access transactions, and free of cost banking on an annual basis. In case of rooftop projects also, the tariff for excess generation is very attractive in comparison to the other southern states.

Table 3: Promotional measures for solar energy in south India

	Karnataka	Tamil Nadu	Andhra Pradesh	Telangana	Kerala
Availability of Banking	Annual basis	Monthly basis	Annual Basis, with restricted drawal	Annual Basis, with restricted drawal	Annual basis
Banking Charges	Zero	Zero	2% of injected energy	2% of injected energy	Zero
Concessional Wheeling and Transmission Charges	Zero	30% of applicable charges	Zero	Zero for captive use	5% of energy
Concessional cross subsidy surcharge	Zero	50% of applicable CSS	Exempted for the first 5 years of operation	Exempted for the first 5 years of operation	Zero
Net metering for rooftop solar	Yes, for all categories, for up to 1 MW capacity	Yes, for domestic and commercial consumers	Yes, for all consumers	Yes, for all three phase consumers	Yes, for all categories, for up to 1 MW capacity
Tariff for excess injection by rooftop solar	9.56	Carried forward to next month and lapses at end of settlement year.	No payment for excess injection	Payment at APPC	Payment at APPC
Electricity duty	No exemption	Exempted for captive use and sale to discom	Exempted	Exempted	Exempted
Pollution Board clearance	No clearance / NOC required for PV	Facilitation provided by TEDA	No clearance / NOC required for PV	Clearance within a week	-

Prospects for rooftop solar

Karnataka has a rooftop solar power potential of over 1000 MW[19], of which not even 5% have been utilized yet. As per MNRE, under the government sponsored schemes, only about 1.5 MW of grid connected solar rooftop projects have been commissioned in the state as on April 2015. However, the regulatory framework for rooftop solar projects in Karnataka is liberal, and provides the following promotional measures:

1. Applicable tariff for injection of excess power through net metering in Karnataka is the highest among the southern states.
2. The tariff for injection of excess power does not reduce even if accelerated depreciation benefit is claimed by the rooftop solar project owner.

Unlike states like Tamil Nadu, even industrial consumers can avail net metering facility.

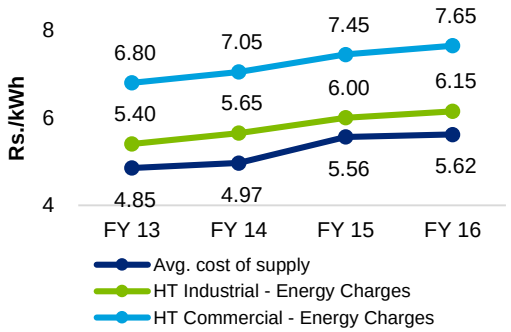
For the industrial and commercial consumers, solar power can help in mitigating the impact of future increases in their tariff.

Investing for the future – opportunities in Karnataka's solar power sector

The solar power sector in Karnataka offers significant opportunities to both investors and consumers.

It may be noted that the average cost of supply of the distribution licensees are increasing year on year, which results in a corresponding increase in tariff. In the past four years, the average cost of supply of the licensees were growing at a compounded rate of 5.0% per annum, which has resulted in the energy charges of HT Industry consumers growing at the rate of 4.4% and the energy charges of HT Commercial consumers growing at the rate of 4.0% *(KERC has kept demand charges unchanged during these years)*.

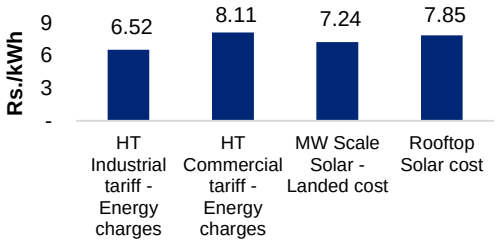
Figure 21: Cost and tariff trend in Karnataka



Source: Karnataka Electricity Regulatory Commission (KERC)

In comparison to the annual increases in electricity tariff of distribution licensees, solar energy offers an alternative, which will be cheaper in the longer run. The projects may be MW scale projects located far off, with the energy being wheeled to the consumers or may be smaller rooftop based projects.

Figure 22: Status of energy charge based grid parity for solar projects in Karnataka



** Solar energy cost displayed above is levelized tariff for 25 years, based on capital cost of 6.06 Rs. Cr/MW for MW scale, 70 Rs. Lakh per 100 KW for rooftop, and with a CUF of 19% . All rates are inclusive of electricity duty – 6% for ESCOM supply, 10 paise/kWh for captive*
Source: Deloitte Analysis

[19] *Preliminary estimation based on the methodology adopted by National Institute of Solar Energy of estimation of solar potential*

Given the current cost trends, it can be seen that for HT commercial consumers, both MW scale and rooftop solar power plants are a commercially viable option even at the existing level of tariffs.

In case of HT industrial consumers, if their tariff continues to grow at the historical CAGR of 4.4%, solar projects may become cheaper viz-a-viz supply from ESCOMs in 3-4 years. It may also be kept in mind that the existing attractive concessional regime with respect to wheeling charges, banking and cross subsidy surcharge is applicable only for projects that achieve commercial operation on or before the end of March 2018. Further, there is always the risk of regulatory commissions revising such benefits for new projects even before the estimated date. For example, KERC has already initiated the process for revision of generic tariff for new solar projects, even though the tariff was supposed to be valid till March 2018.

The solar market also offers sufficient avenues for investors, with options to further fine tune their market offerings and strategy, to provide the maximum returns. Along with the traditional models, there are emerging opportunities such as renewable energy service companies (RESCO) which can provide services such as equipment leasing, specialized forecasting services for solar power projects etc.

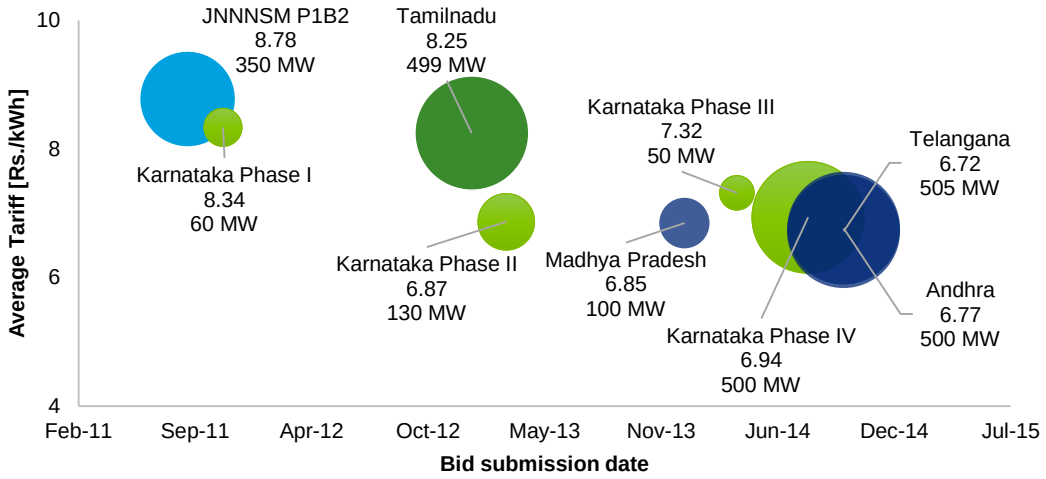
Table 4: Select examples of investment options in solar power sector in Karnataka

Business Models	Remarks
Renewable energy services under equipment leasing model	Attractive to consumers who want to set up rooftop projects without initial capital commitments. Possibility for investors to benefit from higher tariff.
Forecasting services	New market opportunity. Possibility to cease the early mover advantage.
Setting up of captive power plants	Attractive to consumers who want to purchase from MW scale projects with minimal capital commitments. Possibility for investors to benefit from higher tariff.
Setting up of independent power plants	By participating in competitive bidding conducted by KREDL / SECI / other agencies for independent projects or for projects inside solar power parks.
Turnkey EPC solutions	Possibility for investors to benefit through optimization of procurement and erection costs

Clearing the hurdles in the path

The state has conducted four rounds of competitive auction over the past four years, during which a total of 760 MW of solar power projects were allotted. Tariffs discovered in these bidding rounds were competitive, and comparable with bids conducted at state and central levels during the same period.

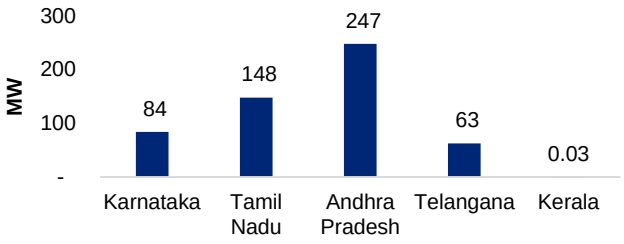
Figure 23: Comparison of tariffs discovered under competitive bidding for solar



** Average tariff for TN & AP are calculated levelized values. Karnataka Phase I consisted of another 20 MW of solar thermal capacity.*
Source: KREDL, MNRE, TANGEDCO, MPPMCL, APSPDCL, TSSPDCL

However in spite of the four rounds of bidding totalling to 760 MW capacity, it can be seen that the state has not progressed much in terms of capacity addition in solar power when compared to most of its neighbouring states. As of now, the state has a total solar power capacity of 84 MW, out of which only about 70 MW has come from the competitive auction rounds, with the rest being capacity commissioned by state owned Karnataka Power Corporation Ltd.

Figure 24: Installed capacity of grid connected solar power plants in southern states



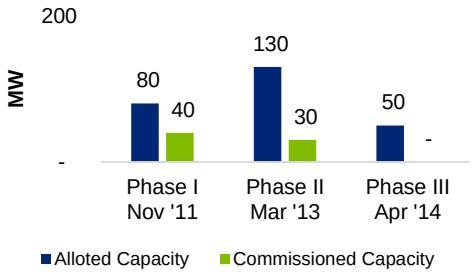
** As on May 2015 Source: MNRE, KREDL*

The slow pace of progress in physical achievement points to deficiencies and challenges in the sector, which will need to be overcome through multiple interventions, if the state is to make good use of its solar power potential. Some of the interventions that may be considered are discussed in the following subsections.

Improved competitive bidding and project monitoring process

The slow progress of projects allotted through competitive bidding is a major cause of concern for the state. Based on the allotted capacity and timelines for commissioning, as of now, at least about 210 MW of solar capacity should have been commissioned. However, only 70 MW out of this 210 MW have been commissioned so far.

Figure 25: Physical progress of projects allotted through competitive bidding



** Dates show above are bid due dates. Source: KREDL*

A significant amount of projects were cancelled due to reasons such as non-compliance of terms of LoA, failure to sign PPA etc. which in turn may be due to financial and other difficulties faced by the bidders, unrealistic bidding etc.

In comparison to the experience in Karnataka, it has been observed in various phases of JNNSM that at least about 75-95% of the allotted solar PV

projects has got commissioned, albeit with minor delays. This indicates that there are either shortcomings in the bidding and project monitoring process adopted for solar projects in the state or that there are considerable barriers in front of the developers that prevent successful commissioning of solar power projects on time. The state may consider undertaking a detailed study on the underlying reasons for delays and failures of solar power projects allotted through competitive bidding. The findings of the study may be used to fine tune the bidding and project monitoring processes in the state.

Solar parks

In 2012, though there was a proposal for developing a 500 MW solar park spread across 1,000 hectares at Mannur village in Bijapur district, the proposal seems to have been rejected later. However, the state is now moving slowly ahead with new plans for solar parks and has established a new company - Karnataka Solar Power Development Corporation. Land has been identified in Tumkur District for development of a 2,000 MW solar park. A streamlined land acquisition process and early initiation of bidding process for projects in the park can result in providing a much needed impetus for solar power in the state.

Government Policy

One of the interventions that the Government can possibly consider, is to make it mandatory to dedicate a certain percentage of rooftop space in new industrial, commercial and large residential installations towards the installation of rooftop solar. It may be noted that a similar initiative on rain water harvesting initiated by Govt. of Tamil Nadu has been widely hailed as a success.

Government can consider making it mandatory to install a solar rooftop plant for certain categories of consumers.

Regulatory Framework

As per the target set by the Government in its solar policy, about 1.75% of the total electricity consumption in the state in FY 2015-16 should be met by solar energy sources. In comparison, the solar RPO fixed by KERC remained unchanged at 0.25% till now. On 02nd July 2015, KERC has notified the Draft KERC (Procurement of Energy from Renewable Sources) (Third Amendment) Regulations, 2015 which has proposed a gradual increase of solar RPO for the distribution licensees, with solar RPO increasing to 2% by FY 20 in case of MESCOM and to 1.5% by FY 20 in case of other licensees. However, even if these regulations are finalized and notified in its present form, it will still fall short of the policy target of 3% solar by FY21. It could as well be that the low capacity of solar energy in the state is deterring the Hon'ble Commission from revising the solar RPO levels. However, it might also be possible that a higher level of RPO will provide sufficient signals for new investments in this sector.

Grid integration of renewable energy

The difficulties being faced by the neighbouring state of Tamil Nadu in terms of evacuation constraints and concerns on grid safety provides a pointer to the state on the issues it may also face as it keeps on increasing the level of renewable energy in its grid. Considering the lower gestation period of solar power projects, the system strengthening and RE grid integration schemes may be initiated at the earliest. This is more significant considering that several of the ongoing evacuation schemes in the state are delayed due to the issues related to right of way.

For grid integration of RE, it is necessary to increase the quantum of flexible generation sources in its grid. It may be noted that while the state does not have any major gas based generation projects, flexibility offered by the hydro power projects are also under stress due to the inadequate governor mode operation response offered by the thermal power plants in the state. In spite of the cost concerns, the state might still have to consider moving forward with its planned

gas based projects such as Yelahanka 350 MW CCPP and Bidadi 700 MW CCPP.

Other issues and challenges

A study[20] conducted by Deloitte for the Planning Commission in 2014 found that Karnataka ranks in the lowest 33.33 percentile among the states in terms of ease of obtaining land and building related approvals. Several of the existing intra-state and inter-state transmission lines in the state are delayed due to severe right of way (RoW) problems such as in the case of Hiriyur-Gowribidanur, Malur-Somanahalli, Ramanagar-Channapattana, Mysore - Kozhikode, Neelamangala - Hoodi, Dharmapuri - Madhugiri and Gooty - Madhugiri lines. Such difficulties have the potential to stifle the growth of solar sector in the state.

Evacuation constraints are also expected to happen in the state with the high targets set for wind and solar based power generation. Though there are no easily implementable solutions on issues related to land acquisition, focused effort and support from the Government can go a long way in assuaging the concerns of investors and developers.

Promise of a bright future for Karnataka

During FY 2014-15, energy deficit in the state was 4.3%, with an overall energy shortfall of 2,717 MU[21]. For such a state, any source of additional energy generation offers opportunities to bridge its energy deficit. At the existing cost of solar power, it can no longer be viewed as a costly solution for a power deficit state. An addition of even about 1,000 MW of solar power will be able to deliver more than 1,500 MU of energy which is more than 50% of the existing energy deficit levels. Compared to meeting this 1,500 MU by adding thermal generation, use of solar power will result in avoiding annual carbon emissions to the tune of more than one million tonne. Meanwhile, rooftop solar power plants provides additional benefits due to their distributed generation nature in terms of reduction in energy losses.

In addition to the overall benefits to the state in terms of reduction in energy deficit and carbon emissions, the individual consumers also have potential to benefit from solar energy through the use of solar power for optimization of their power procurement costs.

With dedicated efforts of the stakeholders, especially Government and the Regulatory Commission, the state has the potential to chart the course towards bright future by tapping its solar power potential.

[20] *Planning Commission, Govt. of India (March 2014), Survey on Business Regulatory Environment for Manufacturing*

[21] *Central Electricity Authority (April 2015), Executive summary of power sector*

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