

# Renewable energy development scenario in India

*It is now a well-recognized fact that availability of electric power is an essential requirement for the development of a nation and the fact is very much applicable to India. India depends vastly on fossil fuel based power generating stations to meet its ever growing power demand. To meet future energy demands over the next few years, enhance its energy security and also adhere to the international climate change commitment, India needs to strive for a cleaner energy mix with an increased dependence on renewables. As on 31st August 2016, the total installed power capacity in India is 3,06,383 MW out of which renewable energy accounts for merely 15% (45,065 MW). Thermal power contributes 69%, hydro 14% and nuclear 2% to the total installed capacity in India. These existing ratios of energy mix are inappropriate to have efficient and balanced grid operation. Development of renewable energy including large hydropower projects could bring enhanced stability and efficiency in the grid. Renewable energy is the best form of energy security. The renewable resources are getting wasted every day being not utilized as these sources cannot be stored for future use whereas the fossil fuel sources are getting depleted fast with fast and continuous extractions. These sources could be saved for the future generations to come and could be used at the time of need and emergency.*

*Therefore, there is a need to increase and shift dependence on renewable energy for the development and prosperity of the nation. Development of renewable energy projects at a faster pace is need of the hour to meet country's energy demand. This also warrants the need of sustainable development of renewable resources to ensure the continuous availability of power generation.*

*This paper addresses the current scenario of renewable energy development in India and way forward for accelerated development of renewable energy.*

## Introduction

India depends vastly on fossil fuel based power generating stations to meet its ever growing energy demand. To meet future energy demands over the next few years, enhance

its energy security and also adhere to the international climate change commitment, India needs to strive for a cleaner energy mix with an increased dependence on renewable energy (RE) including large hydropower. In India, hydropower projects of up to 25 MW installed capacity is considered as renewable energy. Govt of India is now considering reclassifying large hydropower projects as renewable energy projects.

The Government of India is currently targeting to increase renewable energy capacity to 175 GW by 2022. In the Indian RE space, solar energy is expected to emerge as an excellent source in the future due to India's very high solar insolation. It is due to this reason Government of India has set an ambitious target of achieving 100 GW of solar capacity by 2022, a target which is 5 times higher than the target set in Jawaharlal Nehru National Solar Mission (JNNSM) in 2012. Wind power is another area in RE sector where India has substantial potential. The installed capacity target set by Government of India for wind power by 2022 is 60,000 MW. The target for bio power and small hydro capacity by 2022 is 10,000 MW and 5,000 MW respectively.

## Installed power capacity in India

The total installed power capacity in India from all types of sources as on 31st August 2016 is 3,06,383 MW (source: CEA and MNRE). Thermal power contributes 69% of the total installed capacity. Contribution of renewable energy and hydropower is 15% and 14% respectively. The percentage of RE has been increasing steadily whereas the contribution of hydropower has been declining.

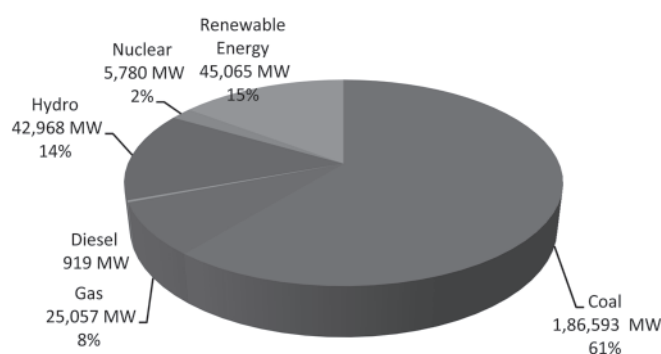


Fig.1 Installed power capacity (MW) from different type of power sources as on 31st August 2016 (source: CEA and MNRE)

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The energy requirement in India during 2015-16 was 11,14,408 MU while availability was 10,90,851 MU resulting in 2.1% shortage. The peak demand was 1,53,366 MW and peak met was 1,48,463 MW having a deficit of 3.2%.

### Renewable energy installed capacity in India

The total renewable energy installed capacity in India as on 31st August 2016 is 45,065 MW (source: MNRE). Wind power is the biggest source of RE in India having share of 61% of total RE installed capacity followed by solar power (18%)

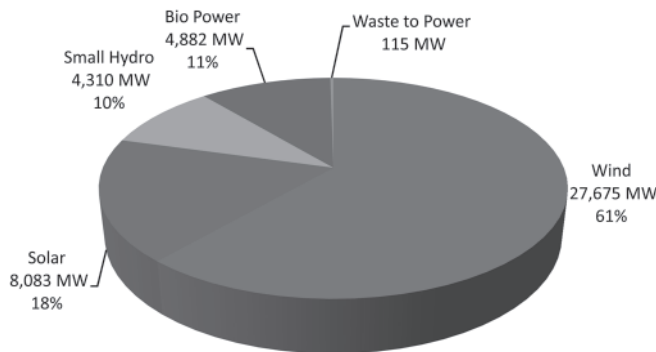


Fig.2 Installed renewable power capacity (MW) from different type of renewable power sources as on 31st August 2016 (source: MNRE)

### Renewable energy growth in India since 1990

In 1992, total renewable energy installed capacity in India was 32 MW excluding small hydro (small hydro was not included in renewable energy capacity but in hydropower capacity till 2007. During 2007-08, 1,168 MW of small hydropower capacity has been transferred to renewable energy sources).

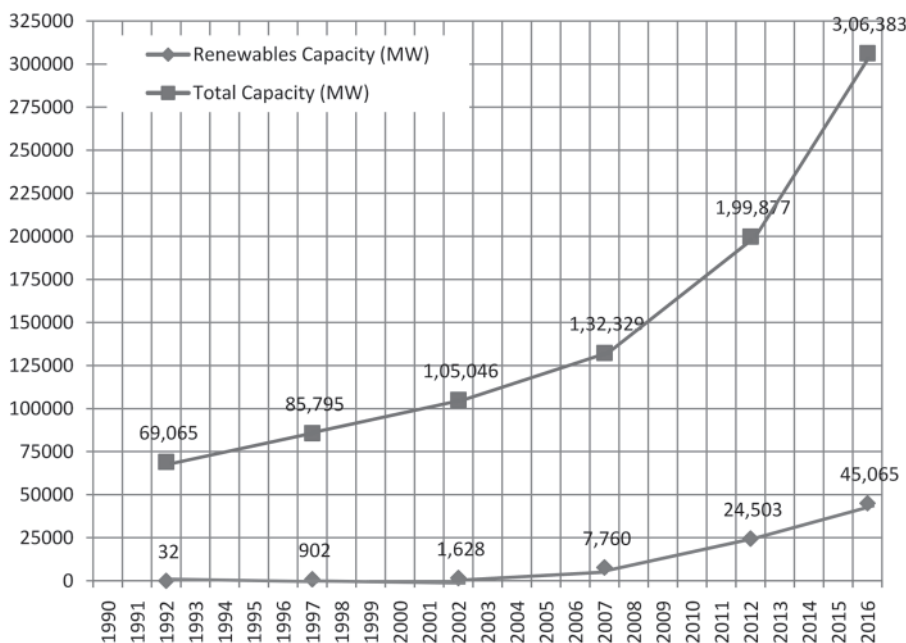


Fig.3 Growth in renewable energy installed capacity (MW) vis-à-vis total installed capacity in India since 1992 (source: CEA and MNRE)

At the end of 11th Five Year Plan in 2012, renewable energy capacity was 12% of the total installed capacity which is 15% as on 31st August 2016.

### Recent capacity addition trends in India

During the current 12th Five Year Plan, India has achieved capacity addition of 1,08,686 MW up to 31st August 2016 (in four years five months from April 2012 to August 2016) which translates into about 24,608 MW capacity addition per year. Thermal power capacity addition is quite impressive vis-à-vis target, renewable energy is also gaining momentum; but the capacity addition in hydro and nuclear sectors is falling behind.

The renewable power capacity addition during 12th Plan up to 31st August 2016 is 20,562 MW i.e. 4,656 MW per year.

The total capacity addition target from all types of sources for the 12th Five Year Plan is 1,18,537 MW which includes 88,537 MW from conventional sources i.e. thermal, hydro and nuclear and 30,000 MW from renewable energy (Table 1).

### Capacity addition target for renewable energy sector

During 'RE-INVEST', 1st renewable energy Global Investors Meet & Expo held on New Delhi on 15th-17th February 2015, Government of India has set an ambitious target of achieving renewable energy capacity of 1,75,000 MW by 2022 comprising 1,00,000 MW of solar power, 60,000 MW of wind power, 10,000 MW of bio power and 5,000 MW of small hydro power.

### Policy and regulatory framework for promotion of renewable energy in India

The existing policy and regulatory framework of India demonstrates focus on renewable energy and its need in India through the Electricity Act 2003, National Electricity Policy 2006, National Action Plan on Climate Change (NAPCC) 2008 and Renewable Purchase Obligation (RPO). The Electricity Act 2003 provides for an open access and mandates State Electricity Regulatory Commissions (SERCs) to take steps for promoting renewable and non-conventional sources of energy within their area of jurisdiction. It calls to promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures of connectivity with grid and sale of

TABLE 1: 12TH FIVE YEAR PLAN- CAPACITY ADDITION ACHIEVEMENT VIS-À-VIS TARGET (SOURCE: CEA AND MNRE)

| Type             | Target for 12th Plan (MW) | Achievement during 12th Plan till 31st August 2016 (MW) | % achievement till 31st August 2016 vis-à-vis target for the entire plan period |
|------------------|---------------------------|---|---|
| Thermal          | 72,340                    | 83,128  | 115%  |
| Hydro            | 10,897                    | 3,996   | 37%   |
| Nuclear          | 5,300                     | 1,000   | 19%   |
| Renewable energy | 30,000                    | 20,562  | 69%   |
| Total            | 1,18,537                  | 1,08,686  | 92%   |

**Region-wise Tentative Break up of Renewable Energy Capacity Target of 1,75,000 MW by 2022** (source: MNRE)

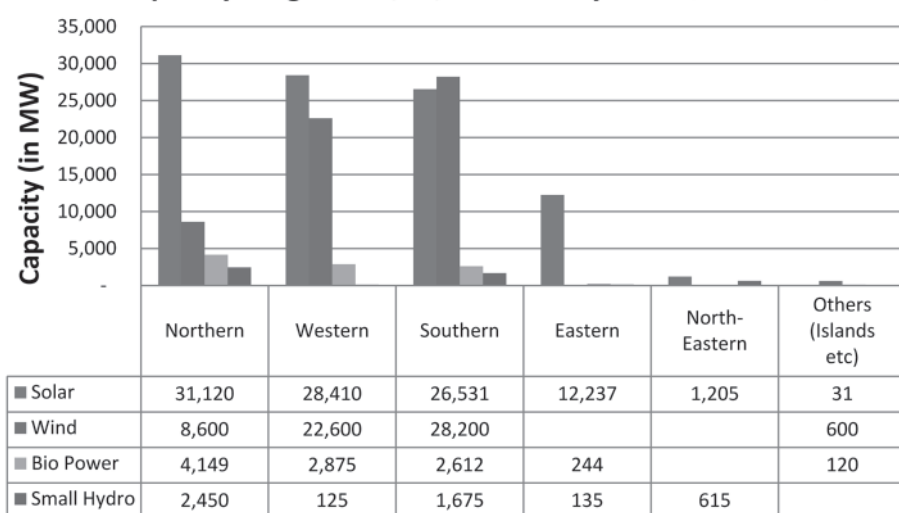


Fig.4 Region-wise tentative break up of renewable energy capacity addition target of 1,75,000 MW by 2022 (source: MNRE)

Government of India has set up Solar Energy Corporation of India Ltd (SECI) under the administrative control of Ministry of New & renewable energy (MNRE), the only Central Public Sector Undertaking dedicated to solar energy sector in India. The company's mandate has recently been broadened to cover the entire renewable energy domain.

The undertaking, set up in 2011, to help deliver the targets of the Jawaharlal Nehru National Solar Mission (JNNSM) while supporting the development of solar interest in the country, has made tremendous strides with plans to develop a second suite of PV projects in India. Some of the important projects being executed by the undertaking are as follows:

electricity to any person. Further, the Electricity Act 2003 explicitly stated the formulation of National Electricity Policy, National Tariff Policy and plan thereof for development of power systems to ensure optimal utilization of all resources including renewable sources of energy. The National Electricity Policy aimed to exploit feasible potential of renewable energy resources, to reduce capital costs, promote competition and private sector participation. According to the National Tariff Policy 2006, procurement of RE through competitive bidding was made mandatory through preferential bidding determined by SERCs. The focus on renewable energy was extensively increased with the formulation of NAPCC in 2008. One of the eight missions of NAPCC states that a dynamic minimum renewable purchase standard be set, with escalation each year till a pre-defined level are reached. State Electricity Regulatory Commissions (SERCs) have also set targets for obligated entities like distribution companies, captive and open access consumers to purchase certain percentage of their total power requirement from renewable energy sources known as Renewable Purchase Obligation (RPO).

It has been designated as the nodal agency for the implementation of 750 MW solar PV projects under JNNSM Phase II, Batch I, wherein it has been entrusted with the responsibility of projects selection, monitoring and timely execution, handling VGF fund and trading of the power generated.

MNRE has also drawn a scheme to set up number of solar parks across various states in the country, each with a capacity of solar projects generally above 500 MW. As per the policy, these solar parks will be developed in collaboration with the state governments. The undertaking will handle funds to be made available under the scheme on behalf of GOI. The state shall designate a nodal agency for implementation of the solar park.

**Renewable purchase obligation (RPO)**

The Renewable Purchase Obligations (RPO) has been the major driving force in India to promote the renewable energy sector. Promotion of renewable energy sources has now been added as an objective of the revised tariff policy 2016 of Central Electricity Regulatory Commission. The Policy has

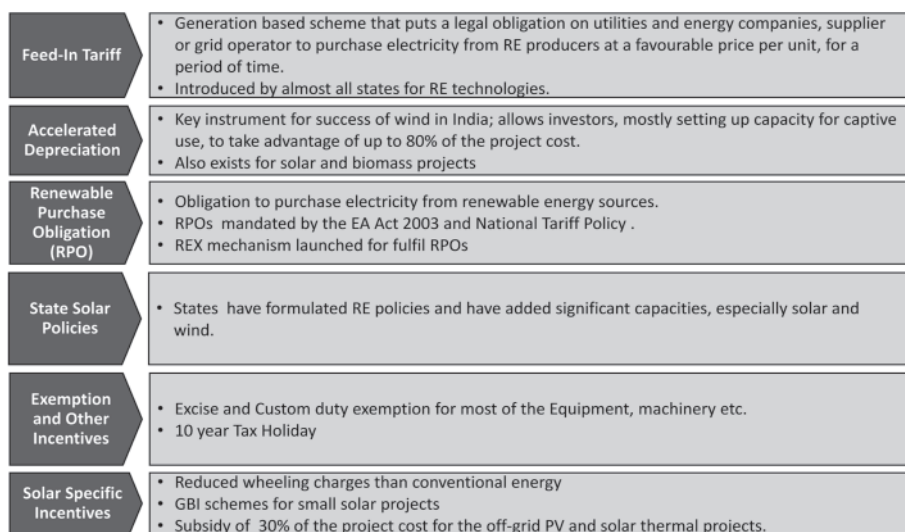


Fig.5 Support mechanism for renewables in India (source: EY analysis)

mandated that 8% of electricity consumption excluding hydro power, shall be from solar energy by March 2022. New coal or lignite-based thermal plants after a specified date shall be required to establish/procure renewable power under Renewable Generation Obligation (RGO). Captive power users, distribution licensees and open access consumers are obligated entities for RPO. SERCs across the states fix the RPO percentages.

MNRE has asked the state governments/SERCs to prepare action plan including year-wise RPO trajectory so as to reach 17% in the total energy mix by the year 2022 including minimum 8% from solar.

The energy availability in India during 2015-16 was 10,90,851 MU and about 10,00,000 MU is produced from conventional energy sources. Considering 100% increase in energy availability from conventional sources in next 5 years, the conventional source would produce about 20,00,000 MU during the year 2021-21. To meet the requirement of the projected RPO of 17% by 2022, India would require about 3,50,000 MU energy from renewable sources i.e. about 1,75,000 MW installed capacity of renewable energy sources. The projected solar RPO of 8% by 2022 would require about 1,60,000 MU of solar energy i.e. about 1,00,000 MW installed capacity of solar power.

### Renewable energy certificate (REC)

Though India has more than enough RE potential to achieve RPO targets, availability of RE sources is widely dispersed, and the capacity to meet these targets varies widely from state to state. In some states, the potential for RE is insignificant whereas some other states have substantial RE sources. MNRE undertook a study (June 2009) and came up with conceptual framework for REC mechanism to address the issue of geographical dispersion of RE resources. The REC mechanism was based on the premise that the RE generation

entails reduction of certain environmental attributes like green house gases, apart from electricity generation. Thus, RE generator can sell two different products on account of renewable energy generation. These products are electricity and the associated environmental attributes, in the form of RE Certificate. One REC would be issued to the RE generator for one mega watt hour (MWh) electrical energy fed into the grid. The RE generator could sell electricity to the distribution company and associated RECs also to the distribution company or any other obligated entity within the state or outside the state. The REC mechanism would enable obligated entities in any

state to procure RECs generated in any of the states in India and surrender the same to satisfy its RPO target. Thus, REC mechanism is supposed to address the issues of scarcity of RE sources in some states which had negligible RPO targets in view of the limited RE potential in the state. RPO and REC mechanisms are designed as policy instruments to demonstrate commitment and create a demand incentive for the development of RE sources in India.

### Compliance to renewable purchase obligation (RPO)

RPO enforcement has been a challenge across the country because several states remain non-compliance on the pretext of poor financial health of distribution companies. RPO regulations issued by the SERCs across the states indicate the minimum quantity of electricity to be procured from renewable sources by obligated entity as percentage of total consumption. However, it is observed that a large number of obligated entities across the states do not comply with its renewable purchase obligations. Non-compliance of RPO is violation of the regulation and punishable under the provisions of Section 142 of the Electricity Act 2003. But, in reality, most of the defaulting obligated entities go scot free. The nodal agencies need to monitor the compliance of RPO by the obligated entities scrupulously and act against the defaulters.

### Sector-wise renewable energy scenario in India

#### WIND POWER

Wind power installed capacity in India as on 31st August 2016 is 27,675 MW which is 61% of the total renewable energy installed capacity and 9% of the total installed power capacity in India. During last two years i.e. 2014-15 and 2015-16 total capacity of 5,735 MW of wind power plants have been installed in the country. The total quantum of electricity generated during 2015-16 through wind is 33,029 MU. The



proposed capacity addition target for wind power for 2016-17 is 4,000 MW. Wind power projects are mainly developed by private sector under various modes including PPA, REC, captive use, third party sale etc. Government of India has implemented generation based incentive scheme for promotion of wind power.

#### SOLAR POWER

Solar power installed capacity in India as on 31st August 2016 is 8,083 MW which is 18% of the total renewable energy installed capacity and about 3% of the total installed power capacity in India. 315 MW has been installed under solar roof top scheme. During last two years i.e. 2014-15 and 2015-16, total capacity of 4,131 MW of solar power plants has been installed in the country. The total quantum of electricity generated during 2015-16 through solar is 7,448 MU. The proposed capacity addition target for solar power during 2016-17 is 12,000 MW.

Tenders for 20,766 MW solar power projects have been issued till 31st July 2016. Government of India has initiated several schemes to promote generation of solar power. These are scheme for development of solar parks and ultra mega solar power projects, scheme for development of solar PV power plants on canal banks/canal tops, scheme for setting up 300 MW of grid connected solar PV power projects by defence establishments under Ministry of Defense and Para Military Forces with Viability Gap Funding (VGF) under Batch-IV of Phase-II/III of Jawaharlal Nehru National Solar Mission (JNNSM), scheme of setting up 1000 MW of grid-connected solar PV power projects by CPSUs with VGF under Batch-V of Phase-II of JNNSM, scheme for setting up of 15000 MW of grid connected solar PV power projects under Batch II of Phase II of National Solar Mission (by NTPC/NVVN), setting up of 2000 MW grid connected solar power with VGF through Solar Energy Corporation of India (Source: PIB).

During 2011 the tariff quoted by the bidders for allotment of solar power projects was in the range of Rs.9.28 to Rs.12.24 which has come down drastically to the tariff range of Rs. 4.34 to Rs. 5.85 during 2016. About 12,000 MW of solar power projects under various state governments policies and 4,000 MW of solar power projects under central government policies have been allotted during this period.

#### FLOATING SOLAR PV

The world's first solar PV project was installed in 2008 at the far Niente Winery, California to save on the valuable vineyard acreage. The 400 kW project consisted of 1,000 solar panels on pontoons floating on the winery's vineyard irrigation pond combined with a section of about 1,300 panels located on land adjacent to the pond.

From those humble beginnings, floating solar PV is increasingly becoming attractive across the world. Though it is currently most expensive than land-based solar power, the

benefits of floating solar PV have started to put the technology on the limelight in the global clean energy market.

A large number of countries from Americas to the Asia-Pacific have already announced plan or are in the process of doing so which will lead to deployment of floating solar on a much wider scale. Projects are being built across the globe such as Australia, Brazil, China, India, Japan, South Korea, the UK and the USA. Lack of availability of large land masses in densely populated countries of Asia is expected to create strong opportunities for the growth of the floating solar PV market in the coming years.

The global solar PV market witnessed robust growth in 2015 driven primarily by falling technology costs, environmental considerations, and need to diversify energy generation mix. The growth outlook is positive with the global solar PV installations increasing to 66 GW in 2016, a 21% annual year-on-year growth.

While shift to renewable and clean energy generation is an encouraging sign, utility scale solar PV suffers from a major drawback - they need vast tracts of land. For several countries this may pose a significant challenge in developing solar energy projects as they may not have access to large available land area or the land may be employed for much more attractive economic and social causes (e.g. urban development and agriculture). These problems can be addressed with the advent of floating Solar panel technology.

The floating solar power technology, comprising floating system (floating structure and floater), utilizes water surface for the installation of solar panels and can be deployed on practically any type of water body like ponds, lakes, rivers, reservoirs and sea. The floating solar panels have several advantages over land-mounted solar panels which have fuelled their growth.

Some of these advantages are:

- ◆ Higher generation efficiency as compared to groundwater or roof-top PV systems
- ◆ Higher return on investment (ROI) due to savings on lease rents/land acquisition costs.
- ◆ Reduction in water evaporation (up to 90% reduction) and improvement in water quality by slowing algal growth.
- ◆ Minimal impacts on aesthetics and landscapes due to lesser visibility making them more acceptable to explain why it is more efficient.
- ◆ Increased government initiatives and stringent environmental regulations and can be deployed

Floating solar plant at nascent stage in India with only 10 kW capacity commissioned.

SECI has plan to develop two 10 MW floating solar arrays in Kerala and Andhra Pradesh. A 5 MW system is also being planned on the Lakshadweep islands.



Fig.6 10 kW floating solar plant with dual axis tracking capabilities at Dhanas Lake, Chandigarh installed by Yellow Tropus Pvt Ltd

#### BIO POWER

Bio power installed capacity in India as on 31st August 2016 is 4,882 MW which is 11% of the total renewable energy installed capacity and about 2% of the total installed power capacity in India.

Biomass materials like bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, jute wastes, groundnut shells, saw dust etc. are used for power generation. Estimated surplus biomass availability in India is about 120 - 150 million metric tonnes per annum covering agricultural and forestry residues corresponding to a potential of about 18,000 MW.

#### SMALL HYDROPOWER

Hydropower projects up to installed capacity of 25 MW are considered as small hydro and are treated as renewable source of energy in India. Small hydropower installed capacity in India as on 31st August 2016 is 4,310 MW which is 10% of the total renewable energy installed capacity and about 1% of the total installed power capacity in India.

Ministry of New & renewable energy, Government of India has identified total small hydropower potential of 19,749 MW covering 6,474 sites across the country.

Small hydropower projects can play a very significant role in overall development scenario of hydro sector and in meeting energy requirement especially in rural electrification of far flung hilly areas where power supply from grid is

difficult and may not be very economical. Harnessing of small hydro potential will facilitate economic development of the states particularly north eastern states, Sikkim, Uttarakhand, Himachal Pradesh, and Jammu & Kashmir since large hydropower potential is located in these states. Natural streams, canal falls and dam toes mostly in Himalayan and other hilly regions where fast flowing and perennial streams can easily be exploited to tap this renewable source of energy. The small hydropower schemes can be developed economically by simple design of turbines, generators, and civil works. The small hydropower schemes have short gestation period, lesser financial needs, simple civil works, and minimum operation and maintenance expenses. Land requirement for the small hydropower project is very less. There is no rehabilitation and resettlement issue involved in developing small hydropower project. The small hydropower schemes are environment friendly. There is no requirement of environmental clearance for small hydro power project.

#### LARGE HYDROPOWER

Large hydropower projects (> 25 MW) is not treated as renewable energy in India. Government of India is now considering reclassifying large hydropower projects as renewable energy source. Adding large hydropower to RE sources would help India achieve clean power capacity of 225 GW by 2022.

Besides better projection of India's renewable energy capacities, it would help the hydro power sector as it would

be able to access incentives being provided to renewable energy projects by the government.

India is having about 1,50,000 MW of large hydropower potential, out of which 42,968 MW has been harnessed as on 31st August 2016. Large hydropower contributes 14% of total installed capacity in India. The percentage of hydropower has come down from 45% in 1970 to merely 14% in 2016.

Large hydropower projects totaling 13, 317 MW of installed capacity are under construction as on 31st August 2016 in India. The proposed large hydropower capacity addition target for 13th Five Year Plan (April 2017 to March 2022) is 12,000 MW.

#### THE WAY FORWARD

- ♦ The growing power demand in India warrants the need of increase in power generation which can be fulfilled by development of reliable energy sources which is also clean and green power. Over dependence of fossil fuel based power sources may not be sustainable in long run. The existing power mix scenario in India demands an urgent need of accelerated renewable energy development.
- ♦ Harnessing of all kind of renewable energy sources is must to achieve the goal of “Power For All”
- ♦ Promotion and development of renewable energy is the need of the hour to curb carbon emission envisaged in the COP21, Paris.

- ♦ The tax benefits given for development of renewable energy projects need to be continued under GST regime.
- ♦ Compliance of renewable purchase obligation (RPO) by the obligated entities should be strictly monitored and defaulting obligated entities need to be fined appropriately.
- ♦ Hydropower projects of more than 25 MW installed capacity should be reclassified as renewable energy and the benefits given to promote renewable energy should also be given to large hydropower projects.
- ♦ HPO (hydropower obligation) of 10% to 15% should be provided as incentive so that it becomes mandatory for the large industrial consumers procure power from hydro sources.
- ♦ The public at large must be made aware that there is no alternative to the increased availability of energy in generating economic growth commensurate with the target of welfare and upliftment desired by them and the sources of power that are capable of providing them without perpetual cost liabilities in terms of environmental degradation.

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## Indian Journal of Power & River Valley Development

### Special Issue on

## NEEPCO – SCALING NEW HEIGHTS IN PERFORMANCE

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