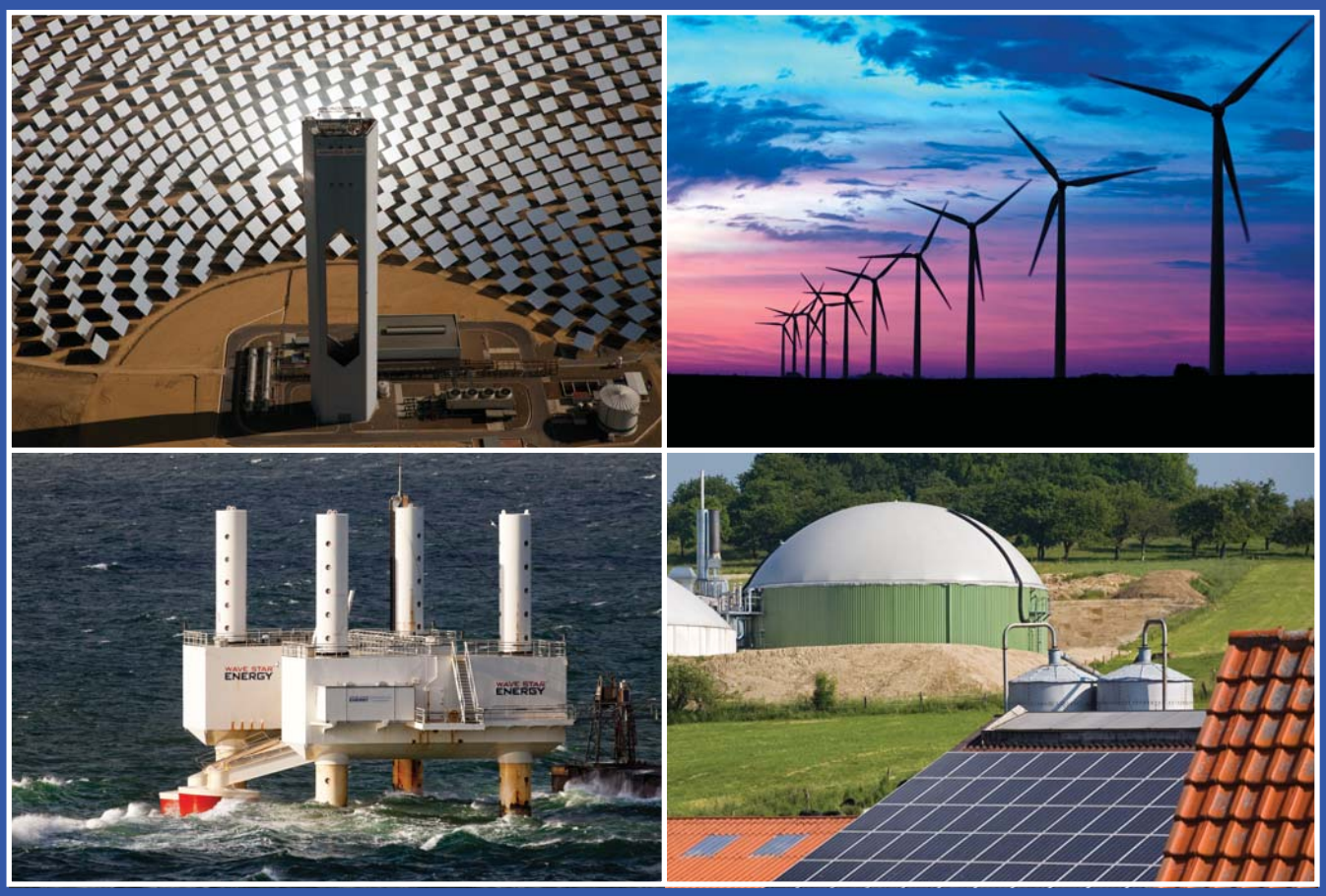
POWERING AHEAD WITH RENEWABLES
LEADERS & LAGGARDS



GREENPEACE
ग्रीनपीस

InfralineEnergy
Solution Driven

Acknowledgements:

Authors: Abhishek Pratap
Manish Ram
Anand Prabu Pathanjali

Research: Rohit Khatri, InfralineEnergy,
Simran Jeet Singh, InfralineEnergy

Report Produced By: Greenpeace India

April, 2013

Contact: Abhishek Pratap
abhishek.pratap@greenpeace.org

Design: Devdatt Kushwaha

Printed on 100% recycled paper.

Contents

Foreword

Increasing population, economic activity and rising income levels will further push the demand for energy in India. The Integrated Energy Policy estimates that India's primary energy supply will need to increase by 4 to 5 times and its electricity generation capacity by 6 to 7 times from its 2003-04 levels to deliver a sustained growth rate of 9% through 2031-32 with primary energy supply growth of around 5.8% per year. On the other hand, commercial energy supply would need to grow faster at about 6.8% per annum as it will incrementally replace non-commercial energy over this period.

In the last five years, India has averaged a growth rate of 8% and the demand for energy has been putting pressure on its supply sources. It is an established fact that if India continues to grow at 8% or so in the coming years, a higher than average demand for energy will persist. In such a scenario, it is expected that there will be continued pressure on supply sources in the next decade largely driven by increasing urbanization and increasing demand for consumption.

India faces formidable challenges of meeting its energy needs and in providing adequate energy of desired quality in various forms in a sustainable manner and at competitive prices. With coal & fossil fuels having dominated the energy mix for the last few decades, there is an urgent need to re-strategize the energy pathway of the country as these resources are fast depleting and are becoming extremely expensive. With the emergence of renewable energy technologies in proving not only quality power but also in scales of mega and giga watts, they are constantly challenging conventional technologies. Renewables are also being increasingly viewed as critical for providing access to energy, particularly in rural areas of the developing world. In 2012, UN Secretary-General Ban Ki-moon took up leadership of a global initiative called 'Sustainable Energy for All' aimed at mobilising action in support of three interlinked objectives to be achieved by 2030: providing universal access to modern energy services; doubling the global rate of improvement in energy efficiency; and doubling the share of renewable energy in the global energy mix.

In 2012, global investment in the renewable energy sector was close to $270 billion, which has been growing substantially despite global policy setbacks. The main driver propelling renewable energy policies is their potential to create jobs. Globally, an estimated 5 million people worked directly or indirectly in renewable energy industries. More and more governments around the world acknowledge the benefits of energy efficiency and renewable energy as central elements of any green economy strategy. Our governments, policy makers and corporations have to tap this opportunity whole-heartedly and transform the Indian energy sector. I appreciate the efforts of Greenpeace in trying to take a step in this direction.

The pre-requisite for achieving the goals in increasing the share of renewable energy is a combination of pro-active policies, positive regulations adequate financing and investments in research and development. India needs to show that transforming sustainable development from patchy progress into a reality for a population of one billion people is achievable when existing technologies are combined with inspiring policies and decisive leadership.

V. Subramanian
Secretary Genaral & CEO INWEA
Former Secretary MNRE, Govt. of India

Executive Summary

For over the past 10 years, India's energy planning has been primarily governed by two key drivers – the need to sustain GDP growth between 8-9% for longer period of time and to ensureuniversal access to modern electricity in the country. Until now, India hasfailed to achieve both these objectives. Withinthe last decade, the country has witnessed a sharp rise in energy and electricity demand and this trend is likely to continue in the foreseeable future. This poses a formidable challenge for the country to buildits required energy infrastructure fast enough to keep pace with the ever-growing economic and social changes. With perpetual peak time power deficit of 8-10%pushing businesses and industries to adopt inefficient means of power generation like diesel, there are now serious concernsregarding India'sover-dependence on electricity produced from fossil fuels to meet its rising economic and development aspirations.

In the world's largest democracy, there are growing inequities in the energy delivery system—both at urban-rural level as well as between different states. It raises serious questions about the efficiency and priority of the country's centralized energy delivery systemwhen around 300 million people in the rural areas are yet to see a bulb in their homeslightened up by modern electricity and when despite a 52 GW of capacity addition in 11thFive-Year Plan, as a country we are unable to provide 12 GW of electricity to electrify our entire un-electrified rural population. Various assessments clearly highlightastonishing rising gapsin the availability of electricity in developed and developing states. On the one hand, we have states like Delhi and Punjab where per capita electricity consumption is more than double the national average, on the other hand, we have states like Bihar where people are still struggling to get one-fifth of the electricity an average Indian consumes annually. The stark reality of India's centralized energy planning system, based pre-dominantly on conventional sources,is that it leaves most of the houses in darkness, mainly in regions that are coal-bearing, showing a clear mismatch with its objective.

With an ever-increasing demand for electricity, there is clearly a need for a fundamental rethink of India's power infrastructure and energy dependencies and to restructure them to address growing economic needs, critical social development and energy security. India needs to shift its current energy policy, which relies heavily on depleting and soon-to-be economically unviable fossil fuels& nuclear energy, to abundant, far more sustainable and increasingly economically competitiverenewable energy resources. If the development of renewable energy resources and technologies in the past few years is any indication, then it clearly suggests that the potential significance of renewables is far higher than currently envisaged in India's power and energy planning. However, growth and development of renewable energy resources and technologies as dominant source of energy and electricity supply, in particular, cannot be achieved in the near future without addressing some key critical barriers, which are mostly market-level, perception-related and political in nature.

The report, prepared by Greenpeace with its research partner Infraline Energy,tries to assess the efficacy of the existing Renewable Purchase Obligation (RPO) policy mechanism with regard to national renewable energy targets and its performance in all states. The report also looks into developing a new differential RPO mechanism based on three criteria — renewable energy potential; consumer profile / consumption pattern and purchasing capacity of each states to make the RPO mechanism far more rationalized and realistic; and suggesting realistic RPO targets for every state. Keeping in mind the recent technological and market-level development in the renewable energy sector,the report argues for increasing the country's renewable energy generation target by proposing a hike of 5% in the national renewable energy target from the present 15% set by the National Action Plan for Climate Change (NAPCC) in 2008. The report also looks into key reforms at policy and regulatorylevel to create the right enforcement and financial environment for effective implementation of differential RPO mechanism across the country with equity and responsibility at the core of its implementation.

Some of the key aspects that this report highlights are:

- Lack of coherency between national renewable energy target set by NAPCC and respective state RPO targets fixed by state electricity

regulators. The overall cumulative targets set by various state regulators is 5.44%, whereas the national target is set at 7% (with 5% as national RE target in 2010 and 1% increase annually till 2020) resulting in a deficit of 1.56%, which translates into nearly 14,268 million units of electricity from renewable energy projects.

- Out of a total of 29, 22 states' electricity distribution companies/electricity boards failed to meet their renewable energy target for 2012 set by their respective State Electricity Regulatory Commission. This lead to a shortfall of 18,300 Million units, that is, loss of more than 25% electricity that was expected to be generated from renewable energy sources in 2012.
- Tamil Nadu and Karnataka along with Meghalaya, Nagaland and Uttarakhand constitute the Top-five high-performing states in meeting their respective RPO targets. The other two states that achieved their RPO target for 2012 are Himachal Pradesh and Rajasthan.
- Gujarat and Bihar, though unable to reach their target for 2012, stand out for showcasing strong political leadership in development of renewable energy infrastructure in their respective states to meet the growing power demand and driving clean energy investment.
- Among the worst-performing states who failed to meet their already low RPO targets are Delhi, Maharashtra, Punjab, Andhra Pradesh and Madhya Pradesh. The national capital stands out as the worst state as it has virtually no renewable energy in its supply chain despite being a resourceful, developed state. Maharashtra's performance on renewable energy is also far from encouraging despite being the country's highest power consuming state and having a strong political leadership.
- One of the biggest barriers identified for effective implementation of RPO mechanism across the country is the lack of a strong compliance mechanism in place in the existing policy. Although some states like Bihar and Chhatisgarhhave proposed compensation / adjustment mechanism for power utilities in case of non-fulfilment of their RPO targets, there are overwhelmingly no penal measures adopted by other state electricity regulators except a few across the country.
- One of the reasons for ineffective and unambitious RPO target across the country is because of no clear standardized guideline or criteria for fixing targets at state-level. Almost everywhere, RPO targets are decided on the basis of unfeasible assessment of renewable energy potential in states, which are highly conservative and lack industry standards.
- REC mechanism, which was considered as tool for effective RPO implementation, has virtually no impact on bringing new renewable projects onto the grid as the number of certificates issued in the first year of operation is less than 4% of the technical REC demand potential.
- Renewable energy is not costly. From the point of view of change in tariff from 2013 till 2020, if higher RE target are considered, there will be only a marginal increase in tariff to the tune of 15-30 paisa nationally. In Tamil Nadu, Himachal Pradesh and Karnataka, the tariff will start to decrease below the current tariff and by 2020 per unit retail electricity price will be lower than that of today's tariff.

It is important to set an ambitious renewable energy target for the country based on viable criteria such as the potential of renewable energy available nationally, growth of the renewable energy sector, securing a sustainable energy supply and providing quick and reliable access to energy for the 300 million still waiting.To achieve such a target at the national level, each state must develop RPO targets on the basis of a framework that is equitable, ambitious and implementable and correlated tothe state's economic growth, corresponding energy demand, the profile of its consumers and, most importantly, social development of its people.

To ensure that India is able to achieve its twin imperatives of providing access to modern energy to over 300 million people without electricity and sustain its long-term high economic and development growth aspiration, Greenpeace recommends that the Government of India should implement the following policy reforms in the power, energy and allied sectors:

- India should have an aggregate target of at least 20 % renewable energy in the national grid by 2020.
- Each state should have an ambitious but mandatory Renewable Purchase Obligation (RPO) target based on renewable energy potential, consumer profile and economic status of the state. The RPO should have stringent compliance mechanism for effective implementation.

- Government through Forum of Regulators (FOR) should also set up a mandatory and uniform RPO compliance code for all states, which shall be adopted by SERCs across the country. The compliance code should have both elements of penalty as well as reward system.
- Government of India through CERC should formulate guidelines for the inclusion of off-grid and grid-interactive systems based on renewable energy within the RPO mechanism.
- Government of India should set a timeframe under which all SERCs set long-term RPO frameworks which include annual RPO targets for its electricity utilities and other obligated entities for a minimum period of 10 years up to the end of the 13th Five-Year Plan.
- Government of India through CERC should set guidelines that allow renewable energy developers from any state to undergo long-term power purchase agreements with other state power utilities in a similar manner as with conventional electricity power projects. Renewable energy projects of 5 MW and above should be allowed to be evacuated by the electricity grid under inter-state generation and transmission scheme.
- To help finance higher RPO targets in respective states, high-end domestic and commercial consumers should be charged 15 % higherover the average retail electricity tariff, right from the first unit of consumption. To further create financial streams for meeting higher RPO targets, Government of India should set guidelines for creating financing mechanisms like the clean energy cess charged on high-end industrial consumers consuming more than 1 MW of electricity. Further, all renewable energy projects, both grid-connected and grid-interface, should be provided with generation-based incentive.
- To improve the share of renewable energy in electricity grid for its distribution and supply, Government of India should make amendments in the existing grid code to allow priority access of renewable energy projects over conventional electricity at least in renewable resource rich states. By having higher amount of renewable energy evacuated on priority basis in renewable-rich states and allowing proper inter-state transmission, the cost of renewable energy will reduce considerably.

Solar Power Project in Jalka, Maharashtra
Girls from the Jalka village in Maharashtra, enjoy the shade under the newly installed solar panels that power the fans in their school.

1 INTRODUCTION

The Indian energy sector is grappling with new challenges, a result of rapid economic growth, which has become a hallmark of the development agenda of the country. In the last decade, the Indian economy has experienced growth at 7-8%, transforming the country into the ninth largest economy in the world.

However, in the last couple of years, there has been a slow-down, with growth rates having dropped to around 5% in FY 2012-13. In the past few years industrial production has dipped, and with a concurrent lack of quality service delivery, growth rates have flattened.

The struggling Indian power sector has much to do with this situation. With a perpetual power deficit of 8-10% for a decade, electricity available for industry and business has been insufficient. In order to sustain their production, they have resorted to inefficient diesel-fuelled back-up power. At the same time around 300 million people in rural India wait for a modern electricity connection in their homes. India's energy planning, which is based on the twin objectives of high economic growth and providing electricity to all, is failing to meet either.

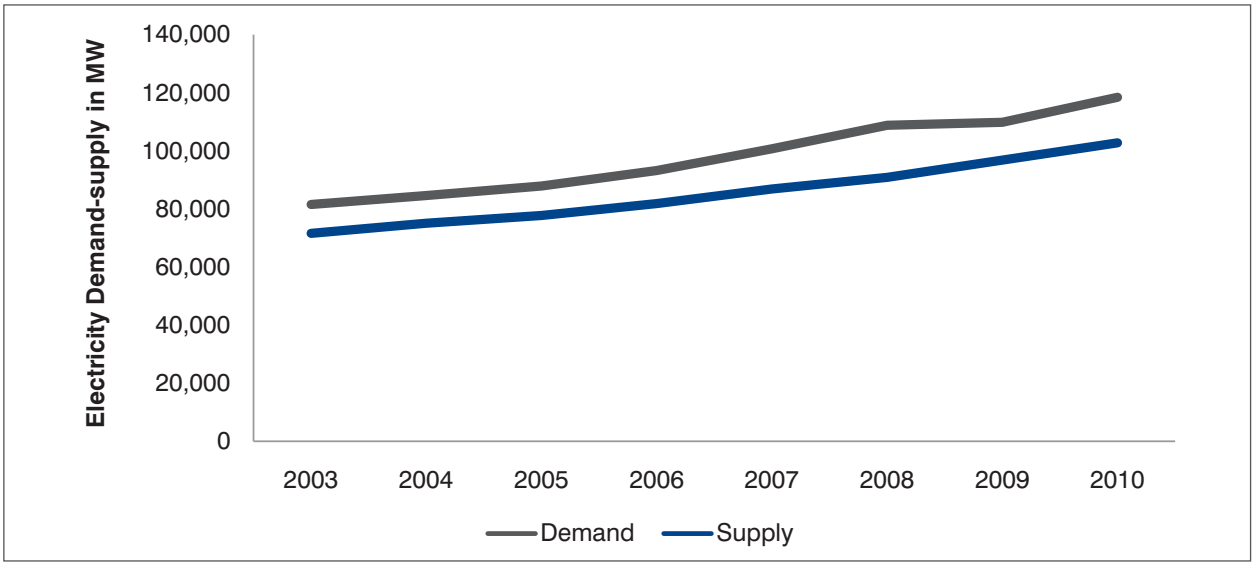
India's domestic power demand in 2012 was 918 billion units and is expected to reach 1,640 billion units by 2020 at 9.8% annual growth. At this count, India will have to almost double its current installed capacity of

"India's current centralised energy planning, which tilts heavily on coal and fossil fuel sources, quixotically leave most of the homes in these coal-bearing and forested regions in darkness"

210 gigawatts (GW) to 390 GW in the next eight years. This seems highly unlikely, given the over-dependence on conventional sources for electricity generation, and the apathetic view taken towards alternative renewable energy sources by the country's energy planners.

There is growing energy inequity between rural and urban areas and also between the developed and developing states. As stated, 300 million rural citizens are yet to benefit from electricity, there being a profound injustice in delivery through the centralised system. While the urban-rural divide in energy supply could be reduced through decentralised systems running on renewable energy, it is more difficult to bridge the widening gap between developed and not-so-developed states. Thus, to take an example, on one hand, Delhi and Punjab has a per capita electricity consumption which is more than double the national average, while in Bihar, the per capita consumption is still rooted at one-fifth the national average.

Figure 1: Graph depicting the power supply and demand in the country from 2003 till 2010



India's current centralised energy planning, which tilts heavily on coal and fossil fuel sources, quixotically leave most of the homes in these coal-bearing and forested regions in darkness. This fossil fuel addition also tends to be expensive, pushing fiscal deficits to dangerous levels. Thus, the main concern arises on how to protect our last reserves of forests, their dependent indigenous communities from destructive coal mining and yet ensure energy security.

Decentralised renewable energy systems is the proverbial silver lining in the Indian power sector's dark cloud. This sector is witnessing unprecedented growth, both in terms of capacity addition and cost reduction, domestically and globally. In 2009-10, renewable energy provided 25% of the country's gross energy consumption. In the last decade, installed capacity of renewable energy has grown from just 3% in 2002 to 12% in 2012, largely dominated by wind energy. Electricity generated from renewable energy sources have also become affordable, making it highly competitive with conventional sources. With wind having reached grid parity, the point at which subsidies or government support can be trimmed, and solar expected to reach that point in the next two to three years, positive market conditions have developed in favour of renewable energy in the country.

The threat of climate change, caused by rising global temperatures, has also had its its impact on India's energy planning. India has pledged to reduce its economy's greenhouse gas (GHG) intensity by 20-25% by 2020 from 2005 levels, and promised that its per capita emissions will not exceed those of developed nations. Further in this direction, the National Action Plan on Climate Change (NAPCC) was released in 2008 by the Government of India, which has set a target of 15% electricity to be generated from renewable energy sources by 2020. However this target is highly conservative and lacks realism, viewed in conjunction with existing potential, current cost reduction and past record on installed capacity. In light of growth within the renewable energy sector, and the gaps in power generation in context of India's needs, suggests that new targets need to be set beyond 2020.

In the past few years, the Government of India has introduced some specific regulations and schemes to boost the renewable energy sector in order to achieve its NAPCC targetsand fulfil its climate pledge to the international community. Of these, the Jawaharlal Nehru National Solar Mission (JNNSM) is the most significant.. A specific target of 20 GW by 2022 under JNNSM has improved market conditions for solar energy technologies which should create rapid diffusion of these technologies across the country . The JNNSM has already led to decrease in tariffs and overall project costs. There is growing expectation that the JNNSM's and corresponding state solar purchase obligation (SPO) targets will encourage the development of manufacturing capabilities in solar technology and equipment.

Another important government regulation in this context is the Renewable Purchase Obligation (RPO) whereby state electricity regulatory commissions (SERCs) are obligated by law to buy a certain percentage of electricity from renewable energy sources. The guidelines issued in 2010 by Central Electricty Regulatory Commission (CERC) had recommended a standardised RPO target of 5% in every state with linear increase of 1% annually till 2020 to achieve the NAPCC target of 15%.

In reality, the corresponding RPO targets across the different states range between 1 and 20%, the states having failed in achieving their objective. The current RPO regulation does not have a clear rationale for the formulation of RPO targets for the respective states. It only factors the capacity addition from locally available renewable energy resources and overlooks two important factors that govern power demand – the consumption pattern according to the consumer profile and purchasing capability of the respective states. The existing RPO regulation also lacks the presence of an abiding compliance mechanism for achieving its targets. With state regulators' hands tied with the lack of an effective penal mechanism and power utilities citing bad financial conditions as an excuse, there is hardly any compliance to the RPO regulation.

Introduction of the Renewable Energy Certificate (REC) mechanism by Government of India, which is a market based mechanism to facilitate the compliance of RPO's across states of the country and provides an alternative to obligated entities to fulfil their targets by purchasing REC's that are traded on the Indian energy exchanges. This was seen by many as a possible redemption for RPO implementation but with many sellers lined up and hardly any buyers, the REC has not been able to take a big flight and has failed miserably on the ground.

Although the business opportunities that lie in a massive shift towards renewable energy is well understood, the sector faces numerous critical barriers towards its development & deployment, largely regulatory in nature, perception related, technology-biased and political. To overcome these challenges, appropriate policy reforms at both the regulatory and market levels must be ensured. One of the critical

steps towards this, is the revision of the current RPO guidelines Set in this context, the present report, a joint effort of Greenpeace and Infraline Energy, in its first section brings out the ineffectiveness of the current RPO regulation by analysing the performance of each state with respect to its stipulated target in 2012 and highlighting the leader and laggard states in their quest to make India's energy supply truly sustainable. In the second section, the report proposes a revised RPO target for each state based on a differential mechanism that considers the principles of equity, responsibility and financial capabilities. In the final section, the report outlines a series of regulatory and fiscal policy reforms for strengthening the RPO guidelines for effective implementation across the country, in order to boost the renewable energy uptake to meet even an ambitious national target of 20% renewable energy by 2020.

Solar Systems on Hospital in Bihar

Electrician Chanesh Prasad inspects the steam outlet of the rooftop solar systems at Tripolia Hospital, Patna. The hospital has installed simple concentrated solar power (CSP) systems to create steam, with which they sterilise all their medical equipment and laundry. The hospital also has solar photovoltaic systems to generate electricity for some buildings and outdoor lights, and solar thermal systems to create hot water for bathing patients and preparing medicine. The various solar systems cater for the 200 staff who live on campus, as well as up to 250 inpatients.

2 ROLE OF RENEWABLES IN THE INDIAN POWER SECTOR

2.1 Indian power sector: demand, capacity and projection

India, which has to build up its energy infrastructure to keep pace with the economic and social changes, faces a formidable challenge. Energy and electricity requirements have risen sharply in recent years, and this trend is likely to continue in the foreseeable future. As on October 2012[1], India has a total installed capacity of 209.28 GW, with coal being the principal source of electricity, followed by large-scale hydro-electric power. Renewable energy takes third place at 12%, having jumped nearly four times in the last decade.[2] Of the total installed capacity, around 30% has been added by the private sector while over 40% is controlled or owned by state governments, the remaining coming under the ambit of the central power sector.

It is expected that by 2020, India's peak power demand will rise to 1,640 billion units with close to 8% growth rate, which means that in the next eight years India's peak power demand will almost double. With peak power deficit ranging between 8-10% and annual power demand growing at 9%, it will be a giant challenge for India to build its energy infrastructure fast enough to meet its twin objectives of sustaining a high economic growth rate in the range of 8-9 % for a longer period of time, while at the same time ensuring all of its citizens have access to modern electricity supply.

Figure 2: Installed Capacity in India

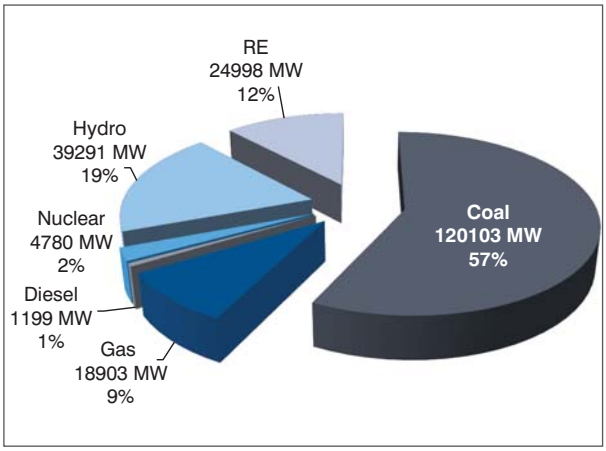
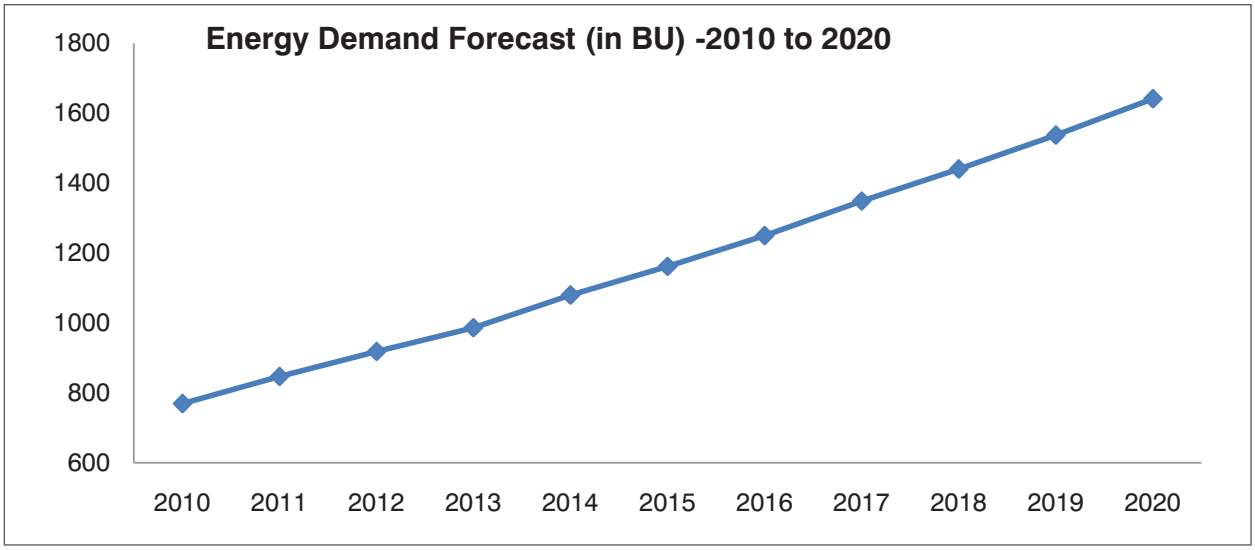


Figure 3: Electricity Demand projection in billion units from 2010 till 2020



[1] 'Annual Report - 2012', Central Electricity Authority, Government of India.

[2] 'India's performance in renewable energy', Energetica India, November-December, 2011

[3] http://www.nrel.gov/docs/fy11osti/48948.pdf

[4] http://articles.economictimes.indiatimes.com/2012-01-26/news/30666805_1_capacity-addition-power-ministry-power-capacity

There are various estimates on capacity addition in the Indian power sector in order to meet rising power demand as well as reducing the growing power deficit. While Greenpeace, the European Renewable Energy Council (EREC) and Global Wind Energy Council (GWEC) estimate that India needs 390 GW of installed capacity by 2020, Germany's GiZ, the US department of energy and the renewable energy policy network, REN 21 predicts that the requirement will be 415-440 GW by 2017.[3] The Union power ministry has proposed an addition of 76 GW in the current 12th five-year plan (2012-17) and another 93 GW in the 13th five-year plan (2017-22). However, in the 11th five-year plan, the Government of India missed its revised installed capacity target of 10 GW which is being carried forward to the current plan period.[4].

Even if we consider the Government of India's target of 76 GW capacity addition by 2017, the demand and supply gap will widen further, impacting economic growth and "access to all" objective. If the national energy planning continues to overtly depend on conventional sources like coal, as can be inferred from the last three plan periods (8th, 9th and 10th), the country will only be able to meet 50% of the capacity addition target due to environmental and land acquisition problems. Therefore, it is high time that Indian energy planning be diversified in a true sense, leveraging the massive potential of alternative renewable energy sources in the most pragmatic way.

2.2 Role of renewable energy in the power sector: potential, capacity and projection

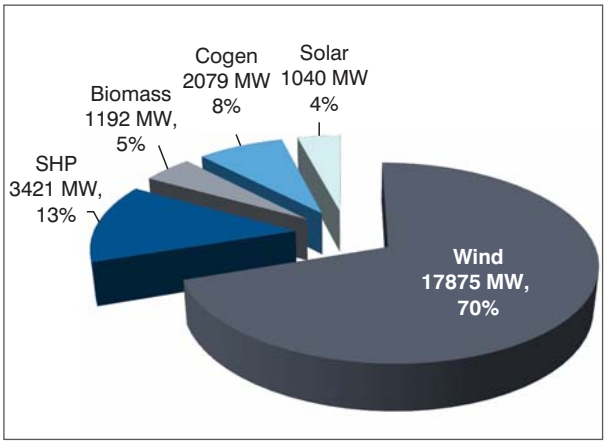
It is often considered that renewable energy technologies are immature, unreliable and lack potential to deliver cost advantages in terms of volume, in other words economies of scale. On the contrary, this is a complete misrepresentation, since these technologies are being adopted across the world including India. In 2002, renewable energy accounted for only 3% of the country's installed capacity at 3,497 MW, in the last 10 years, it has risen to 12%. In 2009, renewable energy provided 25% of India's total energy consumption, which clearly shows that it can deliver at economies of scale and become India's principal source of energy with the necessary policy, fiscal and regulatory support in place.

Amongst renewable energy technologies, wind is the most dominant with 70% of the share followed by small-hydro power with 13%. Most of the country's grid-connected installed renewable energy capacity – over 91% – exists across just eight states, Tamil Nadu, Gujarat, Karnataka, Maharashtra, Rajasthan, Andhra Pradesh, Uttar Pradesh and Himachal Pradesh. (See Annexure 1 for technology-wise installed capacity of renewable energy).

"Grid-connected installed renewable energy capacity – over 91% – exists across just eight states, Tamil Nadu, Gujarat, Karnataka, Maharashtra, Rajasthan, Andhra Pradesh, Uttar Pradesh and Himachal Pradesh"

In 2012, actual electricity generation from different renewable energy technologies stood at 46.04 billion units, accounting for 5.76% of the total electricity generation, half of this generated from wind energy. Among the states, Tamil Nadu, Karnataka, Maharashtra, Gujarat and Rajasthan account for nearly 80% of the total electricity generation from renewable energy technologies.

Figure 4: Share of renewable energy technologies in current installed capacity (MW)



In 2012 wind energy contributed 2% of the total electricity generated, in the country. The real potential of wind energy is yet to be realised. It can meet up to 25% of the country's future electricity demand by 2020. Wind energy potential in India ranges between 543 GW and 2006 GW at 80 metre hub height with turbine density of 9 MW/sq. km[5], more than 95% of this in the five southern and western states of Tamil Nadu, Karnataka, Maharashtra, Gujarat and Andhra Pradesh. Of this, just one state, Tamil Nadu already provides 40%

[5] 'Reassessing wind energy potential for India: Economic and policy Implication', Berkeley Lab, March 2012

[6] 12th Five Year Plan – MNRE 1st meeting of grid-connected renewable energy

of India's total wind installed capacity. However, quite typically, government estimates wind energy potential conservatively at 103 GW at 80 meter hub height and 50 GW at 50 meter hub height[6], which indicates that there is still a huge potential available to the Government of India to exploit.

Among other renewable energy technologies, solar power has the greatest potential and a long way to go, given the abundance of incident radiation on the Indian mainland. Currently, solar energy accounts for only 4% of the total renewable energy installed, with the Government of India under JNNSM seeking to increase capacity addition upto 20 GW by 2022. Now it seems that this target is highly conservative, given the current price churning in the Indian solar energy sector, with costs of solar energy having dropped to 40% of 2008 summer prices, and expected to reduce further. India will add nearly 34 GW of solar energy by 2020 particularly through massive deployment of solar photovoltaic (PV) and solar rooftop applications, taking solar energy's share to 8% of the installed capacity, according to the Greenpeace report, Energy [R]evolution India.

Other renewable energy technologies are also expected to play a vital role in the future growth of this sector, with small hydro-power (< 25 MW) tagged at a potential of around 25 GW. This will mostly be driven by private investments and by 2020 India will have added at least 5 GW of small hydro-power, even by the most conservative scenarios. Biomass-based electricity generation, on continuous flow of economical raw material is expected to hold a minimum potential of 24 GW, largely from non-productive agricultural residues and farm product wastes.

Clearly there needs to be a more serious effort in assessing the potential of these technologies as they will continue to play a vital role in rural electrification and small-scale renewable energy systems.

2.3 Renewable Energy Costs

Renewable energy technologies are not just on the cusp of being deemed mature technologies but also, the price for exploring these technologies is falling rapidly, as is evident from the proposed tariffs by CERC.

Renewable energy technologies fare decently well on learning rate standards, the cost of a technology which has a learning rate of 0.90 is expected to fall by 10% every time the cumulative output from the technology doubles. For solar PV this rate stands at 0.8 for the past 30 years and for wind it varies between 0.75-0.94.[8] In real market terms the price of PV modules per megawatt (MW) has fallen by 40% since the summer of 2008, while wind turbine prices have fallen by 18% per MW in the last two years.[9] This reduction in costs is largely attributed to deployment led cost reductions. This indicates that renewables have the potential to stabilise energy prices and create a healthy market compared to the exponentially rising costs of conventional sources leading to widespread disruptions in markets globally.

Table 1: Renewable energy projects, capital cost and levellised tariff for FY 2013-14 (lakh/MW) by CERC[7]

Technology	Capital Cost (Lakhs/MW)	Tariff (INR/KWh)
Wind Energy	595.99	3.6 to 5.7
Small Hydro Projects		
A) Himachal Pradesh, Uttarakhand and North Eastern States (less than 5 MW)	798.11	4.02
B) Himachal Pradesh, Uttarakhand and North Eastern States (5MW to 25 MW)	725.55	3.42
C) Other States (below 5 MW)	621.90	4.74
D) Other States (5MW to 25 MW)	570.08	4.01
Biomass Power Projects	462.33	5.4 to 6.1
Non-fossil fuel based co-generation Power Projects	436.36	4.8 to 5.96
Solar PV Power Projects	800.00	7.9
Solar Thermal Power Projects	1200.00	10.7
Biomass Gasifier Power Projects	421.42	5.8 to 6.6
Biogas Power Projects	842.85	6.7

Source: Infraline

[7] CERC order for generic levellised tariff for renewable energy technologies for FY 2013-14

[8] Global Trends in Renewable Energy Investment 2011', UNEP & Bloomberg New Energy Finance, 2011

[9] Global Trends in Renewable Energy Investment 2011', UNEP & Bloomberg New Energy Finance, 2011

2.4 Off-grid renewable energy

Although there is no clear and explicit assessment of the true potential of off-grid and grid-interactive distributed renewable energy, It is conservatively estimated that over 4 billion units of electricity is being generated from different off-grid applications since the period 2011-12 and it is expected that by 2020, this generation, even on an incremental basis will come up to around 27 billion units.

"Conservative estimates indicate that off-grid generation could reach to 27 billion units, even on an incremental basis"

Even though electricity generation from off-grid and grid-interactive distributed renewable energy systems are meagre, its real impact can be observed by the positive changes it has brought about in the lives and livelihood of the millions in remote villages of the country, where centralized electricity schemes like the Rajiv Gandhi Gramin Vidyutikaran Yojana (RGGVY) have failed to deliver quality electricity supply. A form of small-scale energy revolution, based on decentralised, distributed and application oriented renewable energy solutions can be witnessed in some developing but energy-poor states like Uttar Pradesh, Bihar, West Bengal and Madhya Pradesh. They have not only brought lights to the villages but transformed the entire village economy.

2.5 Growth and Development

Renewable energy has the potential to transform energy markets across the world but more so in the case of India. Globally, the clean technology industry is considered the next big high-tech revolution. Currently, the Indian power sector provides around 2.4 million jobs, in which renewable energy industry has a share of over 44%. While the total number of jobs by year 2020 will remain the same, there will be a big shift in terms of renewable energy becoming the dominant employer with 74% of the share. There are expectations of massive job cuts in the thermal power sector due to improved efficiencies in mining, installation and generation. On the other side, huge numbers of new jobs will be created in the solar energy sector alone because of expected high capacity additions.

Renewable energy development could also give a fillip to the economic development of states such as Arunachal Pradesh, Bihar, Himachal Pradesh, Odisha that have high renewable energy potential. Developing renewable energy in these states can provide secure electricity supply to foster domestic industrial development, attract new investments, create employment and generate additional income by allowing these states to sell the excess energy to other energy-deficit states.

The NAPCC was a decisive document outlining the existing and future policies and programmes addressing climate change mitigation and adaptation. The RPO target issued by CERC to increase uptake of renewable sources of energy envisaged production of 15% of the country's electricity with renewable energy sources by 2020. The NAPCC also specifies a 1% annual increase in renewable energy generation as part of the energy mix supplying the national grid, starting at a 5% uptake in FY 2009-10 and reaching a figure of 15% by 2020. In the five years since, the renewable energy industry has matured and grown immensely and there needs to be a revision of this target and a more ambitious target of 20% should be mandated.

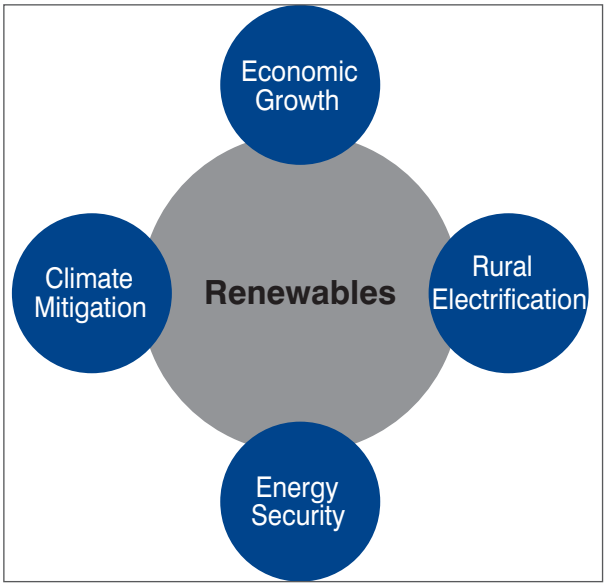
Table 2: Employment scenario in power sector: actual & projection[10]

Technology	Actual Jobs in 2010 (in '000)	Projection (in '000)	
		2015	2020
Coal	1142	582	467
Gas, Oil & Diesel	165	156	131
Nuclear	33	8	7
Wind	67	316	280
Solar	78.3	247	453
Biomass	825	754	654
Small Hydro	85	108	48
Total	**2405**	**2304**	**2412**

Source : Energy [R]evolution India', Greenpeace 2012

[10] 'Energy [R]evolution – India', 2nd edition, Greenpeace, November - 2012

Figure 5: Rationale for increasing renewable energy targets in the country



Source : Greenpeace

It is observed in the subsequent chapter that most states have either failed to achieve their targets, some have not set any targets at all. The lack of a specific compliance mechanism makes the RPO less effective than it was originally intended to be. Also, states that have been progressive have managed to achieve more than their set target and now have diminished their targets and halted the growth of renewables in their states realising that they have over achieved. This indicate that the RPO regulation and the methodologies used to formulate these targets need a relook.

Solar Systems on Hospital in Bihar

Solar systems on the roof at Tripolia Hospital, Patna. In the foreground are solar thermal hot water heaters, which the hospital uses to create hot water for bathing patients and preparing medicines.

3 RENEWABLE PURCHASE OBLIGATION: A REALITY CHECK

The notification of the NAPCC in 2008, which stipulated renewable energy injection of 5% into the national grid (for the year FY 2009-10) and an annual increase of 1% till a target of 15% was reached by 2020, was a result of India's commitment to reduce emission intensity by 20-25% (below 2005 levels) by 2020. Since then, the sector has matured immensely, renewable technologies have advanced further and the costs have reached levels that can compete with conventional sources head on. There is a need to have realistic long-term targets for renewable energy generation, not only from the view point of reducing carbon emissions but from an economic perspective as well as securing a sustained energy supply.

Table 3: Energy demand forecast and corresponding renewable energy requirement (FY 2009 -20)

Financial Year	Energy Demand (in MUs)*	Year-on-year growth in energy demand**	% RPO Target by NAPCC	RE Power Requirement (in MUs)	Year-on-year growth in RE power requirement***
FY 2010	769101		5%	38455	
FY 2011	847410	10.18%	6%	50845	32.22%
FY 2012	918280	8.36%	7%	64280	26.42%
FY2013	986464	7.43%	8%	78917	22.77%
FY2014	1079270	9.41%	9%	97134	23.08%
FY2015	1161679	7.64%	10%	116168	19.60%
FY2016	1249462	7.56%	11%	137441	18.31%
FY2017	1348515	7.93%	12%	161822	17.74%
FY2018	1439916	6.78%	13%	187189	15.68%
FY2019	1536679	6.72%	14%	215135	14.93%
FY2020	1640589	6.76%	15%	246088	14.39%

Source: CEA18th EPS (draft report) and Infraline Analysis

** As per energy demand forecast of CEA, 18th EPS draft report, ** Overall CAGR (Energy Demand) for the period is 7.87%*
****Overall CAGR (RE Power Requirement) for the period is 20.40%*

As can be observed from the table above, the NAPCC targets neither correlate with the growth in power demand nor sustaining a growth in the renewable energy sector. The renewable power required in 2011 is 32% and this decreases to around 14% by 2020 as per the NAPCC's stipulated targets. Thus, there is a need for revising this target based on the growth factor of the renewable energy sector, the need for energy security which can be enhanced to a great extent by adopting renewable technologies, and providing reliable electricity supply to all citizens of the country towards which renewables can play a major role as they are scalable. Decentralised or distributed renewable energy systems can ensure quicker and reliable access, to sustain economic growth and mitigate climate change.

3.1 Renewable purchase obligation regulation

The first major step towards enabling the sustainable development framework in terms of the Indian energy mix, the RPO, was initiated by mandating power distribution utilities with a fixed percentage of power purchase through renewable energy sources as per section 86 (1) (e) under Electricity Act, 2003. Further, renewable energy was promoted under sections 61 (h) wherein promotion of cogeneration

"The REC mechanism has failed to attract large amounts of investment, as was envisioned."

and generation of electricity from renewable energy was made the explicit responsibility of the SERCs. In addition, a National Tariff Policy also stipulated that appropriate state regulatory commissions shall fix a minimum percentage of purchase from such sources, taking into account availability in the region and its impact on retail tariffs. Consequently, various SERCs came out with their individual RPO-based targets, in accordance with the state renewable energy potential and expected capacity addition. However, the RPOs specified by state regulators were solely based on the state's renewable energy potential and consequently, the specified targets overlooked the national level target. To help reach the targets already set in a cost effective manner, India launched the market-based REC mechanism. However, in the couple of years of trading so far, participation in the REC markets and mainly solar has been low. The REC mechanism has failed to attract large amounts of investment, as was envisioned.

Till date, 27 states (except Arunachal Pradesh and Sikkim) have issued RPO/REC regulations and have specified RPO targets as can be ascertained from the table below

Table 4: Current RPO targets set by the CERC in accordance with the NAPCC target

S. No	State	Status /Year of Issue	Technology (Non-solar/ Solar)	RPO Trajectory (in percent)								
				FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
1	Andhra Pradesh	Final (2012)	Non-solar	4.75	4.75	4.75	4.75	4.75	4.75			
			Solar	0.25	0.25	0.25	0.25	0.25	0.25			
			Total	5.00	5.00	5.0	5.00	5.00	5.00			
2	Arunachal Pradesh	Not Issued										
3	Assam	Final (2010)	Non-solar	2.70	4.05	5.40	6.75					
			Solar	0.10	0.15	0.20	0.25					
			Total	2.80	4.20	5.60	7.00					
4	Bihar	Final (2012)	Non-solar	2.25	3.75	4.00	4.25					
			Solar	0.25	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
			Total	2.50	4.00	4.50	5.00					
5	Chhattis-garh	Final (2011)	Non-solar	5.00	5.25							
			Solar	0.25	0.50							
			Total	5.25	5.75							
6	Delhi	Final (2012)	Non-solar	1.90	3.25	4.60	5.95	7.30	8.65			
			Solar	0.10	0.15	0.20	0.25	0.30	0.35			
			Total	2.00	3.40	4.80	6.20	7.60	9.00			
7	JERC (Goa + UTs)	Final (2010)	Non-solar	1.70	2.60							
			Solar	0.30	0.40							
			Total	2.00	3.00							
8	Gujarat	Final (2010)	Non-solar	5.50	6.00							
			Solar	0.50	1.00							
			Total	6.00	7.00							
9	Haryana	Final (2011)	Non-solar	1.50	2.00	3.00						
			Solar	0.00	0.05	0.10						
			Total	1.50	2.05	3.10						
10	Himachal Pradesh	Final (2010)	Non-solar	10.00	10.00	10.00	10.0	11.0	12.0	13.0	14.0	15.0
			Solar	0.01	0.25	0.25	0.25	0.25	0.25	0.50	0.75	1.00
			Total	10.01	10.25	10.25	10.25	11.25	12.25	13.50	14.75	16.00
11	Jammu & Kashmir	Final (2011)	Non-solar	2.90	4.75							
			Solar	0.10	0.25							
			Total	**3.00**	**5.00**							
12	Jharkhand	Final (2010)	Non-solar	2.50	3.00							
			Solar	0.50	1.00							
			Total	**3.00**	**4.00**							
13	Karnataka	Final (2011)	Non-solar	10[12] / 7.0[13]								
			Solar	0.25								
			Total	**10.25 & 7.25**								
14	Kerala	Final (2010)	Non-solar	3.35	3.65	3.95	4.25	4.55	4.85	5.15	5.45	5.75
			Solar	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			Total	**3.60**	**3.90**	**4.20**	**4.50**	**4.80**	**5.10**	**5.40**	**5.70**	**6.00**

S. No	State	Status /Year of Issue	Technology (Non-solar/ Solar)	RPO Trajectory (in percent)								
				FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	FY 18	FY 19	FY 20
15	Madhya Pradesh	Final (2010)	Non-solar	2.10	3.40	4.70	6.00					
			Solar	0.40	0.60	0.80	1.00					
			Total	**2.50**	**4.00**	**5.50**	**7.00**					
16	Maharash-tra	Final (2010)	Non-solar	6.75	7.75	8.50	8.50	8.50				
			Solar	0.25	0.25	0.50	0.50	0.50				
			Total	**7.00**	**8.00**	**9.00**	**9.00**	**9.00**				
17	Manipur	Final (2010)	Non-solar	2.75	4.75							
			Solar	0.25	0.25							
			Total	**3.00**	**5.00**							
18	Mizoram	Final (2010)	Non-solar	5.75	6.75							
			Solar	0.25	0.25							
			Total	**6.00**	**7.00**							
19	Megha-laya	Final (2010)	Non-solar	0.45	0.60							
			Solar	0.30	0.40							
			Total	**0.75**	**1.00**							
20	Nagaland	Final (2011)	Non-solar	6.75	7.75							
			Solar	0.25	0.25							
			Total	**7.00**	**8.00**							
21	Odisha	Final (2010)	Non-solar	4.90	5.35	5.80	6.25	6.70				
			Solar	0.10	0.15	0.20	0.25	0.30				
			Total	**5.00**	**5.50**	**6.00**	**6.50**	**7.00**				
22	Punjab	Final (2011)	Non-solar	2.37	2.83	3.37	3.81					
			Solar	0.03	0.07	0.13	0.19					
			Total	**2.40**	**2.90**	**3.50**	**4.00**					
23	Rajasthan	Final (2011)	Non-solar	5.50	6.35	7.20						
			Solar	0.50	0.75	1.00						
			Total	**6.00**	**7.10**	**8.20**						
24	Sikkim	Not Issued										
25	Tamil Nadu	Final	Non-solar	8.95								
			Solar	0.05								
			Total	**9.00**								
26	Tripura	Final (2009)	Non-solar	0.90	1.90							
			Solar	0.10	0.10							
			Total	**1.00**	**2.00**							
27	Uttara-khand	Final (2010)	Non-solar	4.50	5.00							
			Solar	0.03	0.05							
			Total	**4.53**	**5.05**							
28	Uttar Pradesh	Final (2010)	Non-solar	4.50	5.00							
			Solar	0.50	1.00							
			Total	**5.00**	**6.00**							
29	West Bengal	Draft (2012)	Non-solar			3.75	4.70	5.60	6.50	7.40		
			Solar			0.25	0.30	0.40	0.50	0.60		
			Total	**3.00**	**4.00**	**4.00**	**5.00**	**6.00**	**7.00**	**8.00**		

Source: MNRE and Infraline

[11] State-wise RPO percent is kept as 5 for captive consumers and open access consumers

[12] RPO for BESCOM, MESCOM & CESC

[13] RPO for HESCOM, GESCOM & Hukkeri Society

The RPO targets set by states vary greatly – from a meagre 0.05% to as much as 10.2% (FY 2012), which indicates that there is significant disparity in the efforts of state regulators towards mandating their power utilities to purchase renewable-based power. And even more, the overall cumulative targets set by various state regulators is 5.44%, whereas the national target is set at 7% resulting in a deficit of 1.56% – which translates to nearly 14,268 million units of electricity from renewable energy projects. Clearly, with the lack of strong rationale and robust target formulation methodology associated with the RPO regulation, states have failed to formulate realistic and achievable targets.

Table 5: Cumulative Targets of SERC's

Source of target	Total Generation Target (MU)	Percentage Targets
Cumulative SERCs RPO targets in 2012	50080	5.44%
NAPCC national level target for 2012	64348	7.00%
Shortfall in Targets	14268	1.56%

Source : Infraline

3.2 Assessment ofstate-wise achievement of current RPO targets

With unambitious and unprecedented target setting practiced across SERCs, there is already a shortfall in the associated RPO targets. Further, on examining the achievement of various states across the country with regard to their RPO targets, it clearly emerges

"The lack of an effective compliance mechanism has effectively lead to a shortfall of nearly 2% with a cumulative achievement of targets at just 5.01%"

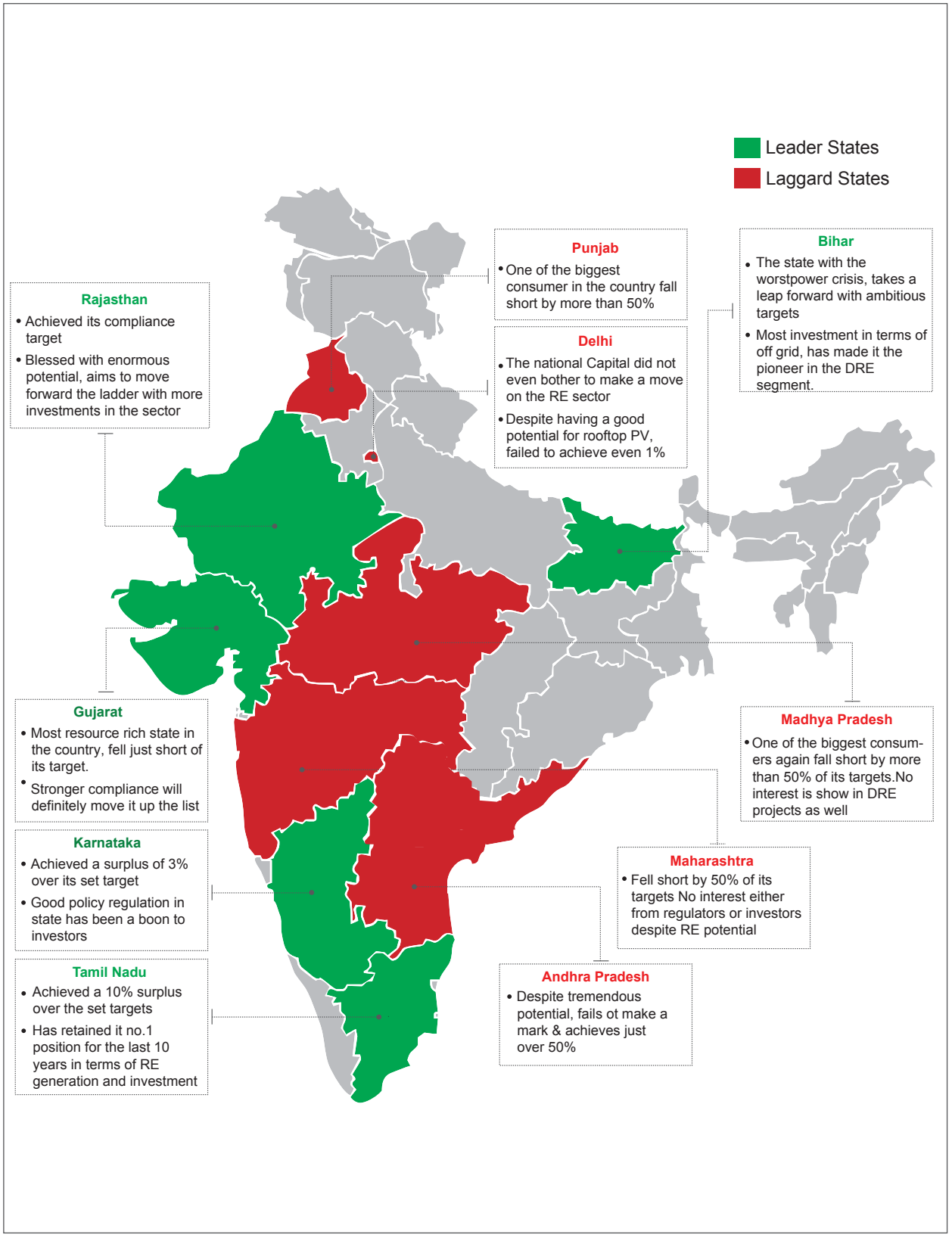
that 22 of the 29 states in the country have failed to meet their targets. There is a huge disparity even in terms of achieving the targets. There are states in the country that have achieved 0% of their target, some have just set targets for the sake of it, and there are also others that have gone beyond their target and achieved up to 10.14% more than the stipulated target. The lack of an effective compliance mechanism within the realm of the RPO regulation has resulted in this scenario, which in turn has effectively lead to a shortfall of nearly 2% with a cumulative achievement of targets at just 5.01%. This shortfall is around 18,300 million units of renewable based electricity, which is a significant impact mainly because the renewable energy sector is still in its nascent stage and in the context of creating a conducive environment for fostering growth in the sector this is a big failure on the part of the central electricity regulatory commission (CERC) and the respective SERCs and thus the perceived need for revisiting the drawing board for the electricity regulators in the country.

3.3 Leader and Laggard States

As can be observed from the table, there is a great disparity in the formulation as well as achievement of RPO targets across various states of the country. While some states such as Tamil Nadu, Karnataka, Rajasthan, Gujarat and Bihar have made serious and laudable efforts to boost renewable energy uptake in their energy mix, other states such as Maharashtra, Punjab, Madhya Pradesh, Andhra Pradesh and Delhi have merely set targets and made no real efforts at the state level to consider these targets. In most of the progressive states, specific policy formulation such as financial incentives have been worked out at the state level itself.

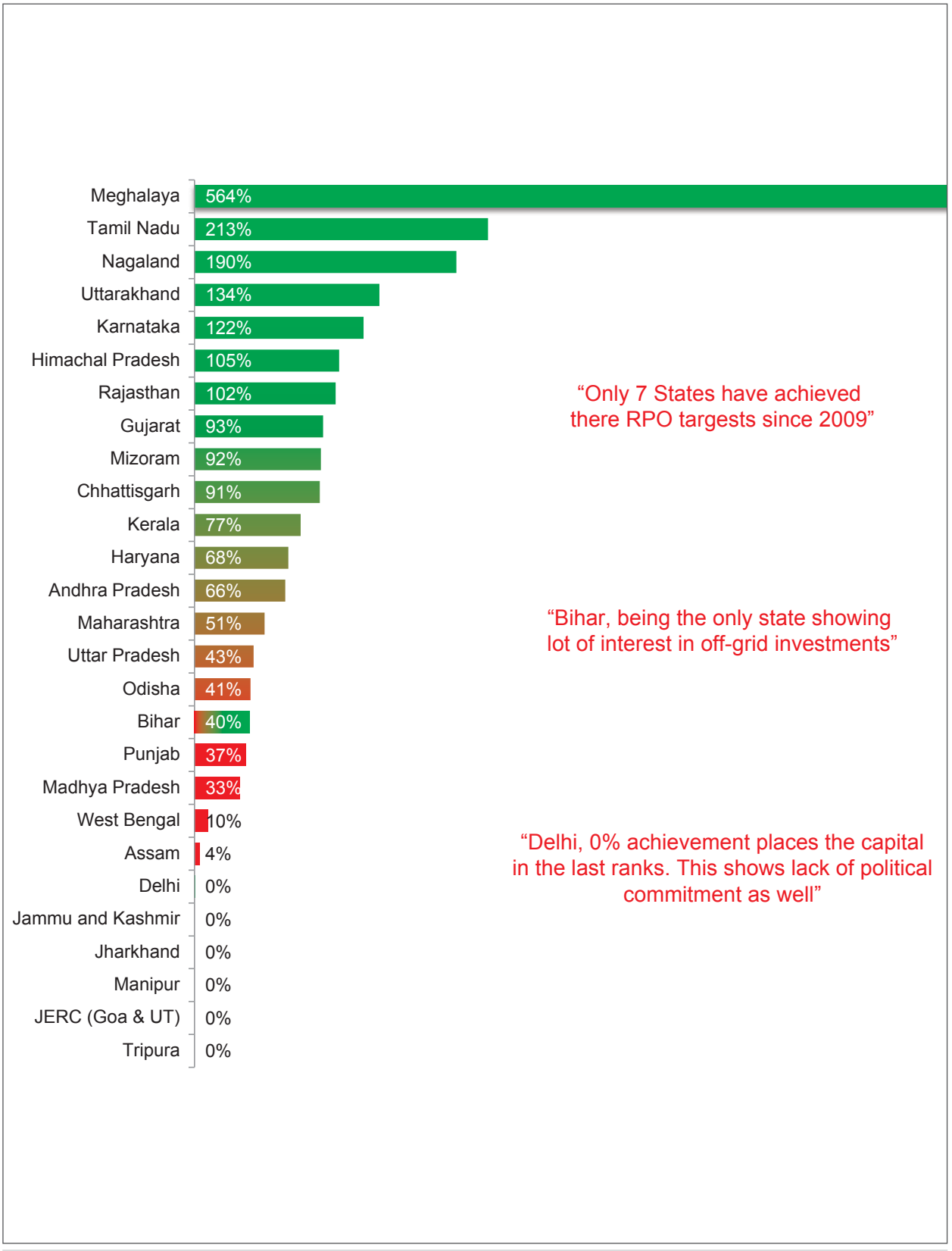
In the adjoining graphic, states are ranked according to their commitment towards fostering renewable energy growth. The five most progressive states as well as the five laggards are listed. Delhi is the worst in terms of performance, despite having a per capita energy consumption which is almost twice that of the national average. The Delhi Electricity Regulatory Commission (DERC) has formulated a very conservative RPO target with no serious efforts to meet it (with a meagre 10% achievement), and there are no state-level policies specific to renewable energy. Being the capital of the country, Delhi should lead the way in in renewable energy generation and in light of the growing power crisis in the state. However, the state has made no efforts in assessing renewable energy potential, especially the tremendous potential for Solar Rooftops, which the state should consider as a means to meet its peak demand.

Figure 6: Leader and laggard states as per the current performance scenario:



Source : Greenpeace

Figure 7: Renewable energy report card for the states



Source : Infraline and Greenpeace Analysis

3.4 Limitations in renewable purchase obligation regulation

Lack of standardised RPO target formulation: with the lack of a standard procedure to be applied across states to determine the targets, targets are formulated according to unfeasible assessments of renewable energy potentials in states. As can be observed from the state-wise ananlysis (see table above), Tamil Nadu, Karnataka, Gujarat which have plenty of renewable resources have performed fairly well, compared to Jharkhand, Manipur and Assam which have limited potential for renewables. The present potential assement of renewable energy technologies is mainly executed by the Ministry for New and Renewable Energy (MNRE). The current estimates are extremely conservative compared to industry standards, since the exercise is a top-down and largely driven from a central point of view the potential at the regional and state level needs to be considered contrarily the current RPO's are arrived at by assuming the renewable energy potential in the respective states as the only criteria, a highly unfeasible practice.

No long term trajectories for RPO's: A longer trajectory for the RPO may reduce the uncertainties in energy planning for state utilities since a state can plan renewable energy generation and renewable energy procurement accordingly. To take an example – Himachal Pradesh Electricity Regulatory Commission (HPERC) and Kerala State Electricity Regulatory Commission (KSERC) have provided a long-term RPO trajectory for their respective states till FY 2021-22 (end of 13th FYP). However, it is important to note that, whereas HPERC has laid out an ambitious RPO trajectory of 19% till FY 2022, KSERC has been reluctant to increase the RPO percentage for the period mentioned. A longer term trajectory, essentially long-term targets that increase periodically, should be mandatory for states to formulate.

Lack of an effective compliance mechanism: To ensure timely achievement of targets by state utilities and obligated entities, a penal provision should be associated with non-compliance of targets. Howevever, in some states with high potential for renewable energy technologies, targets have been achieved, but and as are no benefits for further efforts, targets have been reduced, thereby hindering the growth prospects for renewables. This it is clear that a twin carrot and stick policy needs to be evolved to stimulate growth.

Take the case of Tamil Nadu which achieved its RPO targets with wind power, but subsequently reduced its targets. This put brakes on the growth of this sector.

"The Delhi Electricity Regulatory Commission has formulated a very conservative RPO target with no serious efforts to meet it (with a meagre 10% achievement)"

In this case, incentives for further achievement above the stipulated targets must be introduced to enhance the compliance of states.

Some compensation/adjustment mechanisms have been devised to support distribution utilities to meet their RPOs. To take an example, the Bihar Electricity Regulatory Commission (BERC) has provided for adjustment mechanisms in their RPO regulations. The adjustment mechanism has been provided in the manner that if the distribution licensee is unable to fulfil its obligation the shortfall of the specified quantum of that year would be added to the specified quantum for the next year. However, credit for excess purchase from RE sources would not be adjusted in the ensuing year.

A similar adjustment mechanism has been provided by the Chhattisgarh State Electricity Regulatory Commission (CSERC) in its RPO regulations. The compensation mechanism has been provided in the manner that in the event of non-compliance of the RPO by any distribution utility/utilities by any of the modalities, from non-solar or solar energy plants in the state, the distribution utility whose purchase of renewables is maximum during the year shall be compensated by other distribution licensees so that percentage of renewable energy consumption by all the distribution licensees functioning in the state become equal.

It cannot be the task of state regulators to devise compliance mechanisms to suit the states, there has to be an evenly practiced compliance mechanism factor both penalties for non-compliance and incentives to encourage further achievements.

Lack of a monitoring system: Targets are set in a disruptive way and there is no system for time-bound status updates on these. Thus, initiatives taken by obligated entities are not measured effectively. To have a robust and effective compliance mechanism, a monitoring system that can be updated at regular time periods is a prerequisite.

Ineffective renewable energy certificate mechanism: The actual performance of the REC market trading shows that the number of certificates issued in the first year of operation is less than 4% of

the technical REC demand potential, indicating that the full potential of REC markets is far from being realised. Further, financial institutions and investors cannot rely upon revenues from the REC mechanism beyond the first few years of the projects which have lifetimes up to 20 years. This has resulted in a situation where the REC mechanism has had virtually no impact on bringing new renewable projects on to the grid. There are a number of issues that have contributed to the REC market failure, due to the lack of inter-state transactions there, substantial demand has not been created, low participation of renewable energy generators has added to this, the financial status of obligated entities is a concern and non-payment to developers cause lack of trust and high risk.

Lack of adequate financial measures: State electricity boards (SEBs) and government distribution companies own nearly 95% of the distribution network.[14] According to the power finance corporation, aggregate SEB losses in 2009-10 was around INR 6350 crore (Cr) and this is projected to reach INR 11,600 Cr by 2014-15. The financial conditions of the SEB's have raised questions about their ability to meet RPO's and also ensure payment to renewable energy project developers. Hence there is a need to have a financial mechanism in tandem with the RPO regulation to achieve the stipulated targets. Market forces and competition should be promoted, a market-based mechanism will create a large enough market to spawn competition and lead to excess potential supply that would drive cost reductions. Creating secondary markets for REC's to enable trading after initial auctions and transactions, with new instruments such as forward and futures contract and bilateral trading etc. will enhance the current mechanism and induce investor confidence.

Off-grid generation not included within RPO: As renewable energy technologies can be scaled down quite conveniently and the efficiency of decentralised and off-grid systems is much greater compared to centralised systems, the former plays a critical role in providing access to energy in the rural parts of the country and should be inclusive of the RPO targets of states. This measure would serve two advantages as in it will promote off-grid generation and will reduce the RPO burden on the utility for grid based generation as well.

Need to augment various state-level policies into a national framework: The presence of different state policies with different approaches to renewable energy development and multiple financial measures has created a chaotic scenario and sends mixed signals to investors. This has also been one of the reasons for uneven performances at the state levels towards achieving RPO targets, as the achieving of these depends on policies and financial measures issued by states. This presents the case for unification and augmentation of various policies across states and weaving them into a national framework and there is a need to align financial mechanisms according to this.

[14] KPMG 2010

Jharia Coal Mine Illegal Picker, Jharkhand

An illegal coal picker returns home raiding the open coal mines in Jharia amidst the toxic fumes that are released by the underground burning coal. Jharia is one of the most important coal mines in India and one of the largest in Asia.

4 DIFFERENTIAL RENEWABLE PURCHASE OBLIGATION: EQUITABLE AND IMPLEMENTABLE

As targets are formulated for renewable energy generation in India, they should not be rationalised from the perspective of carbon emission reduction but be based on viable criteria, such as the potential of renewable energy available nationally, the growth of the sector, the possibility of securing a sustainable energy supply and the provision of quick and reliable access to energy for the 300 million still awaiting. In this context, Greenpeace proposes a target of 20% renewable energy in the energy mix of the country by 2020 and calls on the government, regulators, policy makers, think tanks and civil society to work on creating a long-term road map for developing a secure and sustainable energy sector for the country.

It is just not enough to consider the locally available renewable energy potential in the respective states when formulating RPO targets. To have a national framework which is not only ambitious, equitable and implementable, it is vital to consider the states' economic growth, corresponding energy demand, the profile of its consumers and the social development of its people. In this regard Greenpeace proposes a differential RPO regulation which derives state-wise targets on consideration of three key factors – renewable energy potential, financial health and consumer profile of the respective states.

Renewable energy potential of corresponding states is a prime factor, but it should not be a limiting factor in deciding RPO targets. As is the case, states such as Gujarat, Tamil Nadu, Maharashtra and Karnataka with a high potential or availability of renewable energy resources are also among the economically progressive states in the country. On the contrary, states such as Bihar, Rajasthan, Uttar Pradesh, West Bengal and the north-eastern block are blessed with good renewable energy resources, but are still grappling with development challenges. There are also states such as Delhi, Punjab & Haryana which are economically progressive but limited in renewable energy potential. However, these states have better purchasing power and can invest in renewable energy generation in other states that are economically backward. Currently there is no provision for such investments.This is why factors like states' financial health and consumer profile should also be taken into account for formulating RPO targets.

As a result, an attempt has been made to derive more realistic RPOs on the basis of these three factors::

1. **Renewable energy potential of states:** The state nodal agencies along with the support of the MNRE should be mandated to exercise this on a timely manner with technological development into consideration. Creation of real-time databases for renewable energy potential will facilitate effective target formulation practice, and also present a opportunity for better future planning.
2. **Power purchasing capacity of states (financial health):** Given the fact that renewable energy generation requires large capital investments – particularly solar power – compared to conventional sources, it is essential that the financial health of states should be taken into account. States that have a fiscal deficit of less than 4% can be considered to be financially stable and should be mandated to take on higher targets. This would create an enabling environment by reducing the burden on financially weaker states. This can be further enhanced by making provisions whereby financially healthier states can make investments in financially weaker states. Deriving states' RPO mandate, with financial health as one of the key factors, would serve the objective of achieving national targets in a more equitable manner.
3. **Consumer profile of states:** As the consumer pattern varies vastly across the country, with some states having a higher share of industrial and commercial consumers with respect to agricultural and domestic consumers. Industrial and commercial tariffs are higher than domestic and agricultural tariffs and generate more income for state utilities. Factoring the consumer profile of state power utilities into the formulation of RPO targets for states assumes importance since a state having high industrial-to-domestic ratio would have a greater ability to invest in renewable energy generation in comparison to states that would have a lower industrial to domestic ratio.

With these factors playing a vital role in the determination of renewable energy generation targets for states, the following model presents a RPO framework that is more ambitious, equitable and implementable.

4.1 Derivation of differential RPO targets for states

This is an attempt to formulate state-wise targets based on a differential mechanism, correlating the three factors discussed above and cumulatively sums up to a national target of 20% renewable energy generation in the country's energy mix by 2020. However, prior to deriving the RPO, it is absolutely necessary to derive energy demand of states in a more rational manner. It owes to the fact of limitations of less rigorous approach in the methodology of energy demand forecasting done by Central Electricity Authority (CEA) in their Electric Power Surveys (EPS).[15]

Step 1 – State-wise energy demand forecasting till FY 2020

In order to forecast energy demand values of states in a more realistic fashion, an econometric demand forecasting model has been developed using bivariate linear regression approach. The first step is to select factors that will influence the electricity demand and will form the part of variables used in linear regression equation.

In context, it is pertinent to mention that electricity demand depends on macro-economic factors and as also issues specific to the electricity industry. With reference to macro-economic factors, broadly three sub-factors influence the electricity demand as follows:

– Gross State Domestic Product (GSDP)

– State Industrial Growth Rate (I_{gr})

– Population Growth Rate (P_{gr})

Similarly, in context of factors specific to the electricity industry, three sub-factors can be considered for forecasting electricity demand:

– Per Capita Electricity Consumption (PCEC)

– Rural Electrification (REf)

– Energy Efficiency (EE)

Step 2 – State-wise RE capacity addition forecast from FY 2012

State-wise capacity addition estimates on basis of state renewable energy potential is the most important exercise in our RPO derivation model. Since RPO framework in states has been developed and segregated into two categories: non-solar and solar RPO, different methodologies has been deployed to arrive at reasonable forecast

[15] As part of electric power surveys by CEA, energy demand forecasting is done through multiplying state electricity demand of base year with product of national-level GDP (%) and elasticity of electricity demand vis-à-vis national GDP for future years.

– State-wise non-solar capacity addition forecast from FY 2013-20 (grid-connected)

– State-wise solar capacity addition forecast from FY 2013-20 (grid-connected)

Step 3- State-wise off-grid capacity addition and new technologies capacity addition forecast from FY 2012-20

– State-wise renewable energy-based off-grid capacity addition forecast from FY 2012-20

– State-wise new technologies capacity addition forecast from FY 2012-20

Step 4: Analysis of purchasing capacity of states – RPO derivation on basis of financial health

While deriving state RPO percentage, it is imperative to consider the financial health of a state, given the fact that an already poor state might feel overburdened by the expensive renewable energy power procurement. Further, financial health of a state would also incorporate a state ability to procure power from distant renewable energy power plants through inter-state transfer or by procuring them through the REC mechanism.

With this perspective, the two most important financial parameters to assess a state's financial health is as follows:

a) Gross State Domestic Product (GSDP) – GSDP is sum of goods and services produced in the domestic territory of a state in a given year and takes into account its economic productivity.

b) Gross Fiscal Deficit (GFD) – GFD is defined as the difference between aggregate disbursements net of debt repayments and recovery of loans and revenue receipts and non-debt creating capital receipts. Consequently, it is an in-depth measure of assessing state financial health, which would automatically factor in revenue generation, investment and expenditure made in a year.

Accordingly, a five-point methodology is followed to assess a state financial health and it's renewable energy purchasing capacity as follows:

i. Assessment of state-wise GFD (as percentage of GSDP) and GSDP for assessment year, 2012. (Annexure 4.10)

ii. Assessment of state-wise GFD at baseline deficit of 4 percent for states having GFD less than 4%. (Annexure 4.10)

iii. Assessment of percentage distribution of expensive

renewable energy power by calculating ratio of GFD of states at 4% to the sum of GFD of all states having deficit less than 4% initially. (Annexure 4.10)

iv. Projection of additional units of renewable energy purchase required (in units) (Table 4.12) and total burden levied on state due to expensive renewable energy (in INR million) (Annexure 4.11)

v. Assessment of fiscal deficit of states after procurement of additional renewable energy purchase (in %) to identify the actual change that would be expected after procurement of additional renewable energy power. (Annexure 4.12)

Table 6: State-wise Actual Gross Fiscal Deficit, Gross State Domestic Product, Fiscal Deficit @4% and state-wise percent distribution of RE procurement:

S. No.	State	Gross Fiscal Deficit (as % of GSDP)	Gross State Domestic Product (INR bn)	Fiscal Deficit (INR bn)	Fiscal Deficit @ 4%	Deficit @ 4% - for states having less than 4% F.D. (INR bn)	% distribution of expensive RE
1	Andhra Pradesh	3.50%	5,676	198.673	227.05	28.38	10.03%
2	Arunachal Pradesh	3.80%	73	2.760	2.91	0.15	0.05%
3	Assam	11.50%	1,042	119.851	41.69	0.00	0.00%
4	Bihar	6.30%	299	18.820	11.95	0.00	0.00%
5	Chhattisgarh	2.90%	1,297	37.618	51.89	14.27	5.04%
6	Delhi	1.80%	2,588	46.585	103.52	56.94	20.13%
7	Goa	6.70%	299	20.015	11.95	0.00	0.00%
8	Gujarat	3.30%	4,818	158.983	192.71	33.72	11.92%
9	Haryana	4.00%	2,578	103.117	103.12	0.00	0.00%
10	Himachal Pradesh	5.40%	524	28.310	20.97	0.00	0.00%
11	Jammu & Kashmir	5.80%	477	27.671	19.08	0.00	0.00%
12	Jharkhand	2.10%	1,067	22.406	42.68	20.27	7.17%
13	Karnataka	3.80%	3,989	151.579	159.56	7.98	2.82%
14	Kerala	3.10%	2,682	83.137	107.27	24.14	8.53%
15	Madhya Pradesh	3.40%	2,402	81.681	96.10	14.41	5.10%
16	Maharashtra	3.70%	10,296	380.960	411.85	30.89	10.92%
17	Manipur	4.80%	92	4.415	3.68	0.00	0.00%
18	Meghalaya	5.60%	146	8.201	5.86	0.00	0.00%
19	Mizoram	9.10%	62	5.623	2.47	0.00	0.00%
20	Nagaland	12.10%	109	13.229	4.37	0.00	0.00%
21	Odisha	3.70%	1,864	68.952	74.54	5.59	1.98%
22	Punjab	3.40%	2,213	75.253	88.53	13.28	4.69%
23	Rajasthan	4.50%	3,034	136.511	121.34	0.00	0.00%
24	Sikkim	12.00%	57	6.782	2.26	0.00	0.00%
25	Tamil Nadu	3.40%	5,473	186.071	218.91	32.84	11.61%
26	Tripura	13.20%	163	21.553	6.53	0.00	0.00%
27	Uttar Pradesh	4.90%	5,885	288.349	235.39	0.00	0.00%
28	Uttarakhand	8.30%	776	64.391	31.03	0.00	0.00%
29	West Bengal	6.70%	4,436	297.241	177.46	0.00	0.00%

Source: Planning Commission and Infraline Analysis

Step 5: Analysis of consumer profile of states

RPO derivation on average cost of supply, industrial tariff and change in tariff of states

While deriving state RPO percentage, one more factor which assumes high importance is consumer profile of a state (utility). This owes to the fact that a state having high percentage of industrial consumers would be able to pass on any change in tariff of states due to expensive renewable energy procurement with ease. With this perspective, it is imperative to look on three sub-factors that will facilitate derivation of RPO based on consumer profile and are as follows:

a) Average cost of supply (ACS) – ACS is defined as the ratio of total cost incurred by the utility to the total units supplied by it to its consumers and is an important commercial indicator to assess its operational performance.

b) Industrial tariff (I_t) –Industrial tariff is the power tariff charged from industrial consumers and in the Indian context, it is generally higher than average cost of supply, given the prevalence of cross-subsidy, where consumers who have the ability to pay more for power supply (i.e. industrial consumers), are charged higher tariffs as compared to other consumers. Comparison of industrial tariff with average cost of supply would provide us the information on the profit generated by the utility on a per unit basis and would be useful to assess its commercial performance.

c) Change in overall tariff of states due to renewable energy procurement – In accordance with the RPO percentage derived post Step 3 (see above), state-wise change in tariff is calculated to assess the probable increase (in most cases) in tariff of a utility due to expensive renewable energy power procurement. (Annexure)

Based on the three sub-factors, the RPO percentage, derived after Step 3 has been increased/decreased. RPO percent is decreased through assessment of difference between the difference of industrial tariff and average cost of supply and difference of change in tariff for a state and change in tariff for nation, this is in correlation to RPO derived in previous steps. The following methodology of RPO change is adopted only in case of states as follows:

i. If (I_t -ACS)*Industrial consumption of a state> (Change in tariff $_{state}$ * Total demand of state), then RPO percentage target derived for a state would be increased.

ii. If (I_t -ACS)*Industrial consumption of a state< (Change in tariff $_{state}$ * Total demand of state) and (Change in tariff $_{state}$ – Change in tariff $_{nation}$) <0, then RPO percentage target derived for states would be increased.

iii. If (I_t -ACS)*Industrial consumption of a state< (Change in tariff $_{state}$ * Total demand of state) and (Change in tariff $_{state}$ – Change in tariff $_{nation}$) >0, then RPO percentage target derived for states would be decreased.

RPO decrease would follow the trajectory such that change in tariff of the state equals to change in tariff of the nation. After they becomes equal for states (valid for iii), then the entire RE shortfall would be met through RPO increase for states (valid for step i and step ii).

As a result, based on the key criteria which were presented before and the formulation of the corresponding RPO target for each state of the country have been derived such that the cumulative sum of these targets is 20% renewable energy generation by 2020 nationally. The table below presents the annual state-wise, differential renewable purchase obligation (RPO) targets until 2020.

Table 7: State-wise Final RPO based on our proposed 3 criteria – RE Potential, Financial Health, Consumer Profile – to achieve 20% National Target

States	2012	2013	2014	2015	2016	2017	2018	2019	2020
Gujarat	11.27%	13.13%	15.84%	18.53%	21.76%	23.86%	28.79%	33.33%	35.88%
Karnataka	18.78%	19.80%	21.59%	22.49%	23.41%	24.96%	27.75%	30.08%	31.84%
Tamil Nadu	19.96%	20.59%	21.95%	22.32%	22.64%	23.51%	25.45%	27.15%	28.86%
Rajasthan	7.89%	8.76%	9.83%	10.70%	11.89%	13.65%	16.48%	20.89%	26.98%
Arunachal Pradesh	6.51%	7.78%	9.06%	10.85%	12.13%	13.66%	16.20%	21.23%	25.75%
Jharkhand	6.26%	6.79%	8.33%	10.88%	13.81%	15.10%	20.53%	24.24%	24.90%
Chhattisgarh	6.32%	7.68%	8.97%	10.20%	11.79%	13.45%	16.46%	19.71%	24.02%
Delhi	4.94%	7.07%	9.58%	11.26%	12.32%	13.87%	17.88%	23.24%	23.40%
Himachal Pradesh	17.85%	18.12%	18.69%	18.96%	19.37%	19.60%	19.97%	20.18%	20.58%
Kerala	6.58%	7.39%	8.62%	9.89%	11.15%	12.35%	14.27%	17.28%	20.46%
Mizoram	5.80%	6.29%	6.87%	7.53%	8.15%	9.56%	12.03%	15.68%	19.78%
Odisha	6.10%	7.31%	8.38%	9.22%	10.20%	11.01%	13.27%	15.05%	18.87%
Punjab	7.88%	8.59%	9.74%	10.61%	11.49%	12.68%	14.80%	16.71%	18.28%
Manipur	4.82%	6.51%	7.08%	7.73%	8.11%	9.56%	11.59%	15.44%	16.20%
Andhra Pradesh	6.90%	7.21%	7.81%	8.17%	8.58%	9.24%	11.11%	13.47%	15.86%
Meghalaya	5.31%	6.43%	7.96%	9.50%	11.04%	12.58%	15.21%	15.34%	15.28%
Nagaland	5.79%	6.48%	7.22%	8.00%	9.23%	10.73%	13.75%	15.66%	15.15%
Maharashtra	8.54%	9.85%	8.51%	10.02%	11.96%	12.30%	13.55%	14.47%	14.86%
Madhya Pradesh	3.74%	5.50%	7.55%	9.41%	9.64%	10.00%	11.18%	12.44%	14.29%
Bihar	3.24%	4.94%	5.76%	6.31%	6.55%	6.94%	7.80%	9.84%	14.03%
Uttar Pradesh	7.25%	7.79%	9.48%	9.84%	10.15%	10.62%	11.55%	12.16%	12.38%
Sikkim	4.76%	5.56%	6.11%	6.43%	6.73%	7.28%	8.33%	9.86%	10.39%
Uttarakhand	7.58%	8.02%	8.70%	8.89%	9.04%	9.40%	9.76%	10.05%	10.35%
West Bengal	3.84%	3.96%	5.24%	6.29%	7.27%	8.42%	9.56%	9.57%	9.59%
Haryana	3.06%	3.79%	5.32%	5.61%	5.91%	6.25%	7.37%	8.09%	8.78%
Assam	3.13%	4.66%	6.41%	7.87%	7.77%	7.88%	7.99%	8.03%	8.08%
Tripura	6.11%	7.29%	7.46%	7.24%	6.99%	6.92%	6.85%	6.71%	6.58%
J&K	3.21%	5.25%	5.47%	5.41%	5.33%	5.39%	5.44%	5.45%	5.47%
ALL INDIA*	**8.31%**	**8.81%**	**9.09%**	**9.49%**	**12.10%**	**13.06%**	**14.69%**	**16.76%**	**20.00%**

Source: Infraline Analysis

The all india RPO yearly increase till FY 2015-16 is an average 1% and after 2016 it is seen that the RPO increases from 1-3% yearly till 2020. It is expected that the market will open up after 2016 as there will be massive investment in offshore wind and all the grid-related problems regarding onshore wind will be resolved. This shift will bring in huge investments in this sector.

As can be observed, there is steady linear uptake of the RPO across all the states. The states that have already been performing well have been made to take up more amibitious targets. These are also the states that were on the top list of the three governing criterion viz. consumer profile, renewable energy potential and the financial health of the state. States that have lesser potential, a smaller consumer profile and low financial health have been given realistic achievable targets. States such as Delhi which are in the 'black list', so as to say, have been induced to have more ambitious targets since there is a negligence towards renewable energy in the state and the national capital should be seen as a gamechanger in the country. States such as Himachal Pradesh which are technologically bound to small-hydro have already maximised their utlisation and so their targets do not increase much over the timeframe (till 2020). In Bihar, Kerala and Odisha, states that have improved quite a lot

on their existing targets, markets are opening up as the consumer profile grows steadily. By 2016 thses states can be expected to match the tier-one states in terms of renewable energy growth and RPO targets. The north-eastern belt, which have a lower consumer profile and financial health, is expected to improve over the years and their RPO targets grow exponentially. When the country is assessed as a whole, its not much different from the 15% target set by NAPCC, as this target almost progresses on the same rate – about 1% or less – till 2016. After this, once the renewable energy market attains maturity, India can take on higher targets ranging upto 3% a year to achieve the ultimate proposed target of 20% by 2020.

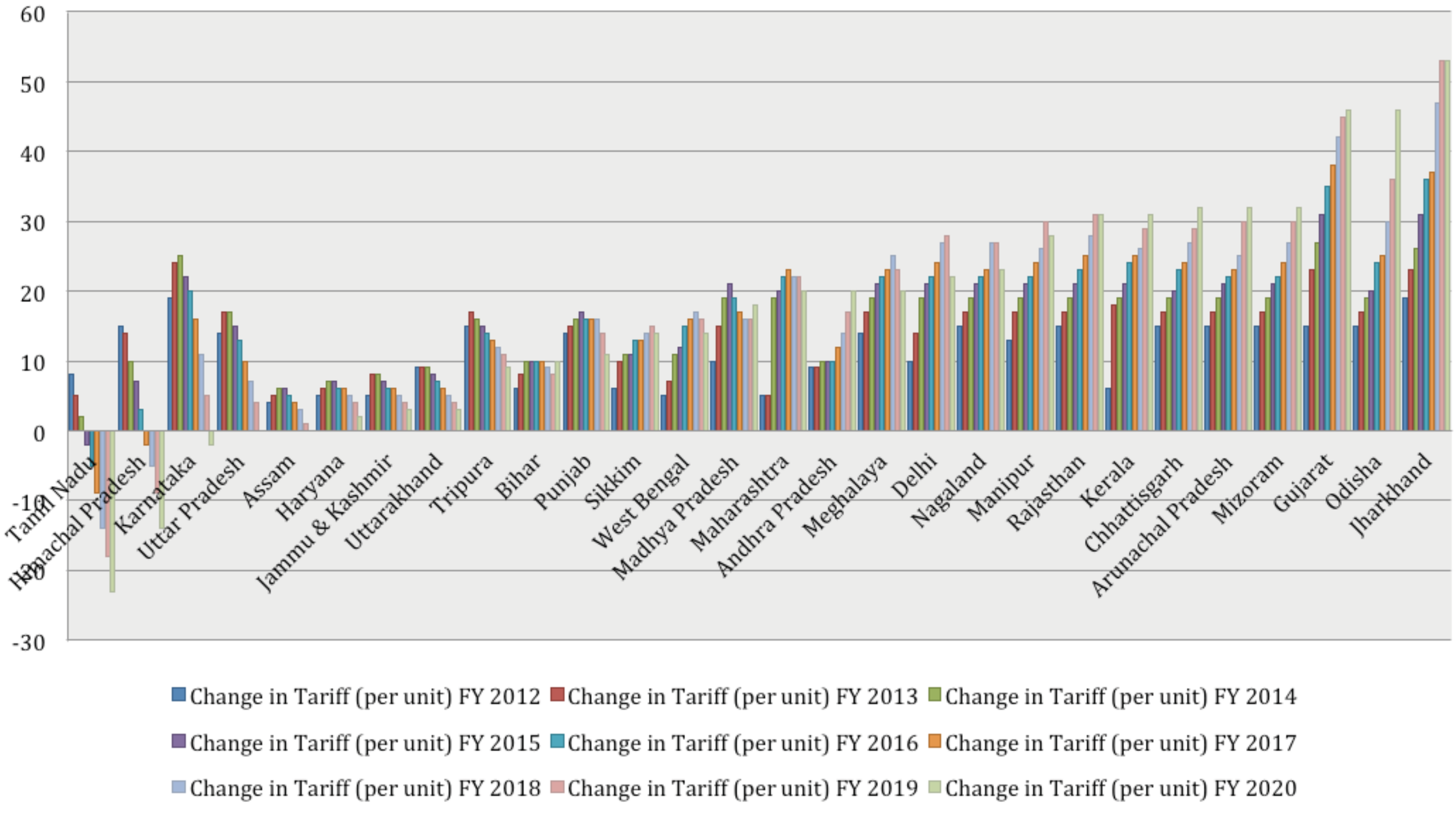
From the point of view of change in tariff from 2013 till 2020, it is seen that renewable energy will achieve grid parity by 2016, and from then on the change in tariff is quite marginal. Specifically,in certain states, the prices come down drastically. In Tamil Nadu , Himachal Pradesh and Karnataka the tariff starts to decrease below the current tariff. If we consider the entire nation, the overall change in tariff is very marginal – from 15-30 paise per unit at an average of 2 paise every year. This is quite marginal, considering the current scenario where the change in tariff is about 30 paise on an average, and on the rise due to expensive coal imports

Table 8: Change in Tariff (per- unit- basis)

S. No.	State	Change in Tariff (per unit)								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Delhi	10	14	19	21	22	24	27	28	22
2	Haryana	5	6	7	7	6	6	5	4	2
3	Himachal Pradesh	15	14	10	7	3	-2	-5	-9	-14
4	Jammu & Kashmir	5	8	8	7	6	6	5	4	3
5	Punjab	14	15	16	17	16	16	16	14	11
6	Rajasthan	15	17	19	21	23	25	28	31	31
7	Uttarakhand	9	9	9	8	7	6	5	4	3
8	Uttar Pradesh	14	17	17	15	13	10	7	4	0
9	Chhattisgarh	15	17	19	20	23	24	27	29	32
10	Gujarat	15	23	27	31	35	38	42	45	46
11	Madhya Pradesh	10	15	19	21	19	17	16	16	18
12	Maharashtra	5	5	19	20	22	23	22	22	20
13	Andhra Pradesh	9	9	10	10	10	12	14	17	20
14	Karnataka	19	24	25	22	20	16	11	5	-2
15	Kerala	6	18	19	21	24	25	26	29	31
16	Tamil Nadu	8	5	2	-2	-5	-9	-14	-18	-23
17	Bihar	6	8	10	10	10	10	9	8	10
18	Jharkhand	19	23	26	31	36	37	47	53	53
19	Odisha	15	17	19	20	24	25	30	36	46
20	Sikkim	6	10	11	11	13	13	14	15	14
21	West Bengal	5	7	11	12	15	16	17	16	14
22	Arunachal Pradesh	15	17	19	21	22	23	25	30	32
23	Assam	4	5	6	6	5	4	3	1	0
24	Manipur	13	17	19	21	22	24	26	30	28
25	Meghalaya	14	17	19	21	22	23	25	23	20
26	Mizoram	15	17	19	21	22	24	27	30	32
27	Nagaland	15	17	19	21	22	23	27	27	23
28	Tripura	15	17	16	15	14	13	12	11	9
29	India	14	15	16	17	21	23	25	28	32

Source: Infraline Analysis

Change in Tariff in Paise (2012-2020)



Wind turbines on the Story County 1 Energy Center, just north of Colorado, USA. Each turbine has a 1.5-megawatt capacity and contributes to generating electricity for up to 75,000 homes. The NextEra Energy-owned wind farm has been in operation since 2008.

5 BRIDGING THE GAP

Policy recommendations for a robust renewable purchase obligation regime

India is well endowed with natural resources which could enable the country to generate electricity from adopting renewable energy technologies,this, in a scenario where India faces a power deficit of over 10% which results in approximately $58 billion in economic losses. This is an opportunity lost for the country. Renewable energy provides not just a bridging solution to the present power crisis but also a permanent fix to India's ever increasing electricity requirements. This will boost the country's high economic growth aspiration and also benefit the millions still waiting for electricity connections. Renewable energy solutions are also way ahead when compared with conventional sources in the context of environmental degradation.

Greenpeace recommends that the Government of India implement the following policy reforms in the power, energy and allied sectors.

Ambitious National Renewable Energy Target

In order to tap the benefits of renewable energy and close the demand and supply gap in the power sector in fast-track mode, the government needs to have an ambitious, logical but stipulated national renewable energy target based on generation. Currently, there are multiple targets put forth by different agencies, of which the most ambitious is from the NAPCC, released in 2008, which targets 15% generation from renewable energy by 2020. However, given the massive churning in the power sector coupled with cost reductions in major renewable energy technologies, both globally and domestically, this current target from the government looks highly conservative. It is only logical that the current target under NAPCC be revised based on the high potential, rapid growth and economic viability of renewable energy and hence further scaled up.

The Government of India should fix an aggregate and stipulated generation-based national renewable energy target of at least 20% by the year 2020. This, as the national target would consolidate the multiple targets for renewable energy proposed by different government ministries and agencies into one.The timely revision of this target based on the performance and growth of the renewable energy sector would lead to a more robust framework and induce greater investor confidence. This target would translate to a total of 319 terawatt hour / annum of electricity produced through renewable energy sources by 2020, excluding large hydro-power plants. This would in turn translate into an installed capacity of 147 GW of renewable energy dominated by wind and solar technologies.

The Energy [R]evolution – India, 2012, a report released by Greenpeace suggests that 20% renewable energy uptake by 2020 will generate 1.8 million jobs in the renewable energy sector while thermal and nuclear power can only create 0.47 million and 7,000 jobs respectively. Moreover, a 5% increase in the national renewable energy generation target compared to NAPCC's target will induce a massive transformation in the energy sector's job scenario.

Equity in Energy Development: Rich States' Responsibility

While a generation-based national renewable energy target would certainly help build investors' confidence and create a domestic market, a realistic, rationalised and differential RPO would help to create energy equity in the country. Though, effective implementation of RPO mechanism in each state is essential to ensure that renewable energy projects actually produce electricity and do not turn into just tax evasion models, there is also a need to revise each state's RPO target with a more rational approach so that intra-country energy equity will be established in line with India's professed international position of "Common But Differential Responsibility." Rich and developed states in the country should lead the way in development of renewable energy infrastructure to meet India's international climate commitments and

thereby create more development space for poorer and developing states.

The existing RPO target set up by different SERCs for their electricity utilities, open access entities and captive power generators only factor capacity addition forecasts based on the potential of various renewable energy technologies. Although, RPO target is a factor of electricity demand of states, it ignores two important factors which influence it. Electricity demand of any state is highly influenced by its industrial and commercial activities which spurs up the demand, in turn increasing the purchasing capacity of the state, and in a spiralling effect leads to more expensive electricity. High industrial and commercial activities also lead to high domestic consumption of electricity as in the case of developed states such as Delhi, Maharashtra, Punjab and Gujarat. On the other hand, if the state has low commercial and industrial activity, the electricity demand is far less as high-end consumers are lesser in number, leading to low income flows and hence low domestic consumption. In such an economically inequitable scenario, it is illogical and irrational to have RPO targets based only on locally available renewable energy resources and projected capacity addition. The states which have fiscal deficits below 4% and have industrial consumption higher than 33% along with high renewable energy potential should have higher RPO targets compared to states that have fiscal deficits higher than 4% and lower industrial consumption.

Therefore, the Government of India through CERC should frame guidelines on differential RPO targets for all states based on criteria relevant to the state's own renewable energy potential based on existing technology, consumer profile of the state and financial status of the state. The respective SERCs, on the basis of assessment in accordance with prescribed criteria, should assign a specific RPO target for its electricity utilities which correlates with the state's renewable energy potential, consumption pattern and purchasing capacity.

Further, SERCs should ensure that all captive power users and open access entities should have specific RPO targets as part of their mandatory obligation. Currently, except a few states none of the state's regulators prescribe specific RPO targets for their open access entities and captive power users.

Compliance structure for a robust RPO mechanism

Assessment of current RPO mechanism suggests that electricity utilities of only seven states meet their RPO targets, while the majority of states fail to meet their renewable energy obligation. The major bottleneck that prevents state electricity utilities meeting their obligation is lack of a proper compliance mechanism. Electricity regulators of only two states, Maharashtra and Rajasthan have enforced penal provision of Section 142 of the Electricity Act, 2003 on its electricity utilities for shortfall of RPO target along with per unit enforcement charge as compensation. Rest of the state electricity regulators allow electricity utilities to pass on the shortfall to the following years or even give it a miss. Since there is no uniform and stringent compliance mechanism in place, there is no pressure nor mandate on electricity utilities in the states to meet their RPO target.

On the contrary, there are few states like Tamil Nadu, Karnataka, Himachal Pradesh and Nagaland which have renewable energy in their supply, beyond their stipulated RPO target. However, there have been neither financial nor any other incentives for these states to secure more renewable electricity in their supply than the stipulated target.

The Forum of Regulators (FOR), constituted under the Electricty Act, 2003, should also set up a mandatory and uniform RPO compliance code for all states which shall be adopted by SERCs across the country. The compliance code should have both penalty and reward elements. While the penalty system will deter electricity utilities from missing out on their annual RPO targets, the reward system will encourage electricity to enhance capacities. This will ensure in effective implementation of the RPO mechanism across the country.

Apart from enforcing penal provision of Section 142 of Electricity Act 2003, respective SERCs should also levy per unit of electricity surcharge for shortfall in RPO target to its electricity utilities, open access entities and captive power users similar to states like Maharashtra and Rajasthan.

As part of the compliance mechanism an incentive element should be encouraged to entice states for higher uptake of renewable energy if they have the resources and potential. To encourage electricity utilities and other obligated entities of

going beyond their stipulated annual RPO target, state government can reward them by providing per unit electricity transmission / wheeling cost exemption for renewable energy beyond the stipulated target.

Inclusion of off-grid renewable energy systems within the RPO mechanism

India's energy future will need to be driven, not just by large-scale generating facilities to power aspirational economic growth but also by providing access to over 300 million, who currently have little or no access to electricity. It is a well-known fact that India suffers from 'energy poverty', renewable energy technologies are well-suited to meet India's need for power in remote areas that lack the presence of grid and road infrastructure which is primarily due to the distributed nature of resources and the scalability of system designed. With decentralised micro-grids based on renewable energy generation, the country could very well plug in the terawatt challenge of providing millions with quality electricity supply.

While it is true that grid extension has a significant role to play in rural electrification, both technically as well as cost-effectively, grid-interactive and off-grid systems are proving to be much more feasible for rural electrification. We are already witnessing this in states such as Bihar, where off-grid and distributed grid systems are making a big impact on providing energy access to most of its villages and this is prevalent in other states like Uttar Pradesh, Rajasthan, and West Bengal. With this reality, it is important that a certain part of the RPO target for state electricity utilities should include off-grid and micro grid-interactive systems based on renewable energy. These off-grid and grid-interactive systems for village electrification should be owned by the community or community led processes and it should be operated and maintained by state electricity utilities. In return of operation and maintenance support provided, utilities should claim electricity generation from such system as part of its RPO target compliance. Therefore, the Government of India through the CERC, should formulate guidelines for the inclusion of off-grid and grid-interactive systems based on renewable energy within the RPO mechanism and consequently should be awarded tradeable RECs as well.

A social audit carried out by Greenpeace along with other non-government organisations on the effectiveness of the Rajiv Gandhi Gramin Vidyutikaran Yojana (RGGVY) brings out the fact that extension of the centralised grid network to provide electricity access in many areas is cost-prohibitive, while electricity seldom reaches these people when it's needed the most. Therefore, Government of India should allocate 50% of its funds available under the RGVVY to grid-interactive and off-grid decentralised renewable energy systems for ensuring quality, economical and affordable access to electricity by the rural population. This will not only help in speedy electricity connectivity of hundreds of thousands of villages across the country but it will also reduce the load on state electricity utilities that would otherwise result in the eventthe distribution grid is expanded to provide electricity to villages. Further, by having such systems as part of the RPO mechanism, these systems can be effectively operated, maintained and supported by utilities and in return claim benefits as part of RPO compliance. A percentage of the RPO should be set by SERC's to be met through grid-interactive/off-grid systems depending on the electrification rates of the state. If the state has a higher percentage of un-electrified population then the share of decentralized systems as part of the RPO should be higher.

A tariff structure for decentralised systems has to be worked out by SERC's depending on local/ regional realities.

Moreover, reducing load on centralised grid and ensuring quality access of electricity at affordable rate in urban areas, Government of India should enact a national solar rooftop policy with a feed-in-tariff mechanism, even for small quantum of excess supply to the grid from urban areas.

Longer trajectory for RPO targets

The current RPO mechanism lacks uniformity in provisions for a longer trajectory for RPO targets in different states. Only Andhra Pradesh, Delhi and West Bengal have longer RPO trajectory up to end of the 12th FYP while Himachal Pradesh and Kerala have targets that go beyond, till the end of the 13th FYP. Most of the other states have short-term RPO trajectory ranging anywhere between two to five years. It is a well-understood fact that longer trajectories of RPO's have an inherent advantage of reducing uncertainties for state utilities as plan for renewable energy supply and procurement can be made accordingly. This in turn would also have a positive impact on the pricing and tariff for electricity from renewable energy sources.

Therefore, the Government of India should set a timeframe under which all SERC's should set long-term RPO frameworks which should include annual RPO targets for its electricity utilities and other obligated entities for a minimum period of 10 years upto end of the 13th FYP.

Inter-state transmission of renewable energy

The MNRE, in its report on transmission infrastructure for renewable energy, clearly outlined lack of inter-state transmission of renewable energy as a major bottleneck for the growth of this sector. As states rich in renewable energy resurces cannot be expected to consume huge amounts of the energy generated, due to the lack of clarity on inter-state generation and transmission of renewable energy these states are not able to realise their potential, while on the contrary renewable energy resource-poor states are not even able to meet their renewable energy targets despite available financial resources. Renewable energy policy of different states are designed and governed by the National Electricity Policy, 2005 which outlines that only locally available non-conventional energy resources should be harnessed for electricity supply in the respective state. This restricts significant development of renewable energy infrastructures under inter-state generation and transmission scheme because renewable energy projects commissioned under state's renewable energy policy cannot enter into a long-term electricity agreement with other states.

Further, clustering of different renewable energy projects into one pooling sub-station under the Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012, acts as an inhibitor for large scale deployment of renewable energy electricity as it restricts the power generated from such sources to 50 MW and above. Normally one developer does not have multiple projects of 50 MW and above in one single state, and there is no clarity on whether Regional Load Dispatch centre's (RLDC's) or State Load Dispatch Centre's (SLDC's) will act to facilitate the electricity evacuation under single pooling in case of multiple projects spread across different states or regions.

To achieve the national target of renewable energy generation and facilitate states which are poor in terms of renewable potential and are unable to meet their RPO target, issues associated with transmission and evacuation of renewable energy needs to be sorted out. Also, the state-owned power corporations should be allowed to invest in renewable energy projects in other states as in the current regime with respect to conventional power plants, since this would lead to increased investments across all states and not just limited to a few.

The Government of India should facilitate significant deployment of renewable energy based electricity in the power grid and create a conducive environment for states to meet their RPO targets. Renewable energy projects of 5 MW and above should be allowed to be evacuated by the electricity grid under inter-state generation and transmission scheme.

The Government of India through CERC should set guidelines that allow renewable energy developers from any state to undergo long-term power purchase agreements with other state power utilities in a similar manner as with conventional electricity power projects.

Financing the differential RPO mechanism

Several years of populism, corruption and sheer mismanagemen.t of the power sector has driven electricity utilities into humongous debts that have accumulated to sums in tune of INR 926 billion by end of the FY 2011. Except for Gujarat, all state electricity utilities reported financial loss during this period which clearly indicates that there is a need for complete overhaul of the financial framework for the power sector and particularly of electricity distribution companies and SEBs.

Financial reform of electricity utilities and SEBs becomes important and in fact urgent not only for implementation of the differential RPO mechanism and setting ambitious RPO targets across the country but, also for making the entire power sector financially viable and build investor's confidence. As a matter of fact, higher differential RPO targets will have little impact on overall electricity tariff as it raises the cost of electricity supply marginally by only around 6-8% across the country.

Therefore, to create a viable financial framework for electricity utilities to adopt ambitious and higher RPO targets and to avoid further financial burden, the following reforms need to be enacted urgently.

- **Rationalised restructuring of electricity tariffs**

The Shunglu Committee in its findings on financial position of distribution utilities which was submitted to the Planning Commission in year 2011, has clearly

outlined irrational tariff fixation by SERCs as a major cause for bad financial condition of distribution utilities. It is now high time that retail electricity tariffs in the country be linked with market price of electricity. Although, given the overall economic scenario and electricity access as an important component of the modern lifestyle support system, the economically weaker sections and small and marginal farmers should be protected from market pricing of electricity through well-designed electricity subsidy. High-end domestic and commercial consumers should be charged 15% higher than average costs of electricity supply per unit of electricity, right from the first unit of consumption. This will help in reducing losses incurred in cases of bulk electricity consumption.

- **Collateral fund for electricity utilities and SEBs**

In order to improve implementation of differential RPO mechanism and help electricity utilities and SEBs meet their high RPO target, the Government of India needs to create a collateral fund for state electricity boards with clear terms of lending. This will ensure enough financial resources at the disposal of electricity utilities and SEBs to meet their high renewable energy portfolios while project developers will gain confidence of viable returns on their investments in renewable energy projects. This will also help in risk mitigation and providing bank guarantees.

- **Clean energy cess on high-end industrial consumers**

To further create financial streams for meeting higher RPO targets, while at the same time not creating additional burden on average consumers, Government of India can set guidelines for creating financing mechanisms like the clean energy cess charged on high-end industrial consumers consuming more than 1 MW of electricity. RPO cess for every state should be decided by respective SERCs after due consideration of overall RPO target, amount of electricity consumed by such consumers and impact of RPO cess on overall revenue of the electricity utilities and SEBs.

- **Standardised feed-in-tariffs across the country with digression rate**

The introduction of standardised feed-in-tariffs for renewable energy across the country with digression rate, where it reduces over a period of time, will help in creating strong competition in renewable energy sector which in turn acts as an incentive for introduction of state of the art renewable energy technologies in India. This in turn reduces overall cost of renewable energy electricity.

- **Generation-based incentive for all Renewable energy projects**

Currently, there is an argument whether the wind energy sector should receive Generation based incentive (GBI) or not, the GBI should be made available for all renewable energy projects over a certain capacity predominantly in the off-grid and grid assisted project. This is mainly to support all renewable energy projects and not be biased to certain technologies.

- **Priority lending status for the renewable energy sector**

Lack of dedicated financial framework and adequate funds have made renewable energy projects high risk investments which in turn is having a negative effect on its bankability. Despite the fact that lending rate standards for renewable energy is on the decline and the rate of equity return is on high, not many banks and financial institutions have shown great interest in funding renewable energy projects. By declaring the renewable energy sector as a priority lending sector, some of the perceived risks can be safeguarded by government guarantees which in turn improves investor confidence. Furthermore, the renewable energy sector becoming a priority lending sector will also create dedicated financial flows which will assist the take-off of some of the critical and stranded renewable energy projects.

In the end, higher and cost-effective clean energy generation will have positive impact on overall compliance of RPO targets.

- **A single window clearance**

States should establish single window clearances and fast-track processes for setting up renewable energy projects, this would lead to timely completion of projects and hence meeting targets in a time bound manner, and also reduce capital costs incurred by developers and hence reduction in cost of electricity.

Preferential grid access for renewable energy projects

Lack of adequate evacuation infrastructure and proper grid inter-connection is one of the major barriers to renewable energy projects. These are largely located in remote areas and due to the distances from load dispatch centres, quite a lot

of these projects are unable to get access to the grid. Further to this, renewable energy projects also suffere from a lack of priority access to the grid in areas where surplus electricity is available for evacuation. In Tamil Nadu, many of the wind energy projects are sitting idle as the electricity generated is not evacuated by the state transmission company due to inadequate grid capacity.

To improve the share of renewable energy in electricity grid for its distribution and supply, the Government of India should make amendments in the existing grid code to allow priority access of renewable energy projects over conventional electricity at least in renewable resource rich states, by having higher amount of renewable energy evacuated on priority basis in renewable-rich states and allowing proper inter-state transmission, cost of renewable energy will reduce considerably.


USES OF THE GLOBE

Biogas Plant at Bagepalli, Karnataka

A newly built biogas unit in Kammavaripalli Village, Bagepalli Taluk. The community in Bagepalli has pioneered the use of renewable energy in its daily life thanks to the biogas Clean Development Mechanism (CDM).

APPENDIX

Table 10: State-wise Required Renewable Power Procurement for Assessment Year FY 12

S. No.	State	Energy Demand (in MUs)	Non-solar RPO (%)	Solar RPO (%)	Non-solar Renew-able Power Procurement (in MUs)	Solar Renew-able Power Procurement (in MUs)	Total Renew-able Power Procurement (in MUs)
1	Andhra Pradesh	91,730	4.75%	0.25%	4357	229	4587
2	Arunachal Pradesh	600	0.00%	0.00%	0	0	0
3	Assam	6,034	2.70%	0.10%	163	6	169
4	Bihar	14,311	2.25%	0.25%	322	36	358
5	Chhattisgarh	15,013	5.00%	0.25%	751	38	788
6	Delhi	26,751	1.90%	0.10%	508	27	535
7	JERC (Goa & UT)	11,993	1.70%	0.30%	204	36	240
8	Gujarat	74,696	5.50%	0.50%	4108	373	4482
9	Haryana	36,874	1.50%	0.00%	553	0	553
10	Himachal Pradesh	8,161	10.00%	0.01%	816	1	817
11	Jammu and Kashmir	14,250	2.90%	0.10%	413	14	428
12	Jharkhand	6,280	2.50%	0.50%	157	31	188
13	Karnataka	60,830	10.00%	0.25%	6083	152	6235
14	Kerala	19,890	3.35%	0.25%	666	50	716
15	Madhya Pradesh	49,785	2.10%	0.40%	1045	199	1245
16	Maharashtra	141,382	6.75%	0.25%	9543	353	9897
17	Manipur	544	2.75%	0.25%	15	1	16
18	Mizoram	397	5.75%	0.25%	23	1	24
19	Meghalaya	1,927	0.45%	0.30%	9	6	14
20	Nagaland	560	6.75%	0.25%	38	1	39
21	Odisha	23,036	4.90%	0.10%	1129	23	1152
22	Punjab	45,191	2.37%	0.03%	1071	14	1085
23	Rajasthan	51,474	5.50%	0.50%	2831	257	3088
24	Sikkim	390	0.00%	0.00%	0	0	0
25	Tamil Nadu	85,685	8.95%	0.05%	7669	43	7712
26	Tripura	949	0.90%	0.10%	9	1	9
27	Uttarakhand	10,513	4.50%	0.03%	473	3	476
28	Uttar Pradesh	81,339	4.50%	0.50%	3660	407	4067
29	West Bengal	38,679	3.00%	0.00%	1160	0	1160
	Total (as per state-wise SERCs specified RPO target)	**919,264**			**47787**	**2302**	**50079**
	Total RE power procurement required as per NAPCC	**919,264**	**7.00%**	**64348**			

Source: Greenpeace and Infraline Analysis

Table 11: Assessment of Non-solar Installed Capacity and Generation (Assessment Year - FY 12)

S. No	State	Wind (MW)	Small Hydro (MW)	Bio-energy (MW)	Total (MW)	Wind (MU)*	Small Hydro (MU)	Bio-energy (MU)	Total (MU)
1	Andhra Pradesh	246	217	406	**869**	470	167	2294	**2931**
2	Arunachal Pradesh		79		**79**		3		**3**
3	Assam		31		**31**		7		**7**
4	Bihar		64	15	**79**		30	114	**144**
5	Chhattisgarh		20	249	**269**		8	708	**716**
6	Delhi			16	**16**				**0**
7	JERC (Goa & UT)				**0**				**0**
8	Gujarat	2966	16	20	**3002**	3961		47	**4008**
9	Haryana		70	35	**105**		309	65	**374**
10	Himachal Pradesh		527		**527**		856		**856**
11	Jammu and Kashmir		130		**130**				**0**
12	Jharkhand		4		**4**				**0**
13	Karnataka	1934	882	442	**3258**	3661	1836	2129	**7626**
14	Kerala	35	149		**184**	69	453	29	**551**
15	Madhya Pradesh	376	86	11	**473**	407	5	412	
16	Maharashtra	2733	281	608	**3622**	3296	124	1607	**5027**
17	Manipur		5		**5**				**0**
18	Mizoram		36		**36**		22		**22**
19	Meghalaya		31		**31**		79		**79**
20	Nagaland		28		**28**		74		**74**
21	Odisha		64	20	**84**		300	122	**422**
22	Punjab		154	99	**253**		150	250	**400**
23	Rajasthan	2071	23	83	**2177**	1778		463	**2883**
24	Sikkim		52		**52**				**0**
25	Tamil Nadu	6988	123	537	**7648**	9869	130	6389	**16389**
26	Tripura		16		**16**				**0**
27	Uttarakhand		170	10	**180**		602	64	**646**
28	Uttar Pradesh		25	649	**674**		26	1703	**1729**
29	West Bengal		98	16	**114**	116	116		
		17348	3381	3216	**23945**				**45415**

Source: Greenpeace and Infraline Analysis

Table 12: Assessment of Solar Installed Capacity and Generation (Assessment Year - FY 12)

S.No	State	Solar Power Capacity in MW	Solar Power Generation in MU
1	Andhra Pradesh	21.75	86
2	Arunachal Pradesh		
3	Assam		
4	Bihar		
5	Chhattisgarh	4.00	0
6	Delhi	2.53	2
7	JERC (Goa & UT)	1.59	0
8	Gujarat	604.89	167
9	Haryana	7.80	2
10	Himachal Pradesh		
11	Jammu and Kashmir		
12	Jharkhand	4.00	0
13	Karnataka	9.00	8
14	Kerala	0.03	0
15	Madhya Pradesh	2.10	0
16	Maharashtra	20.00	8
17	Manipur		
18	Mizoram		
19	Meghalaya		
20	Nagaland		
21	Odisha	13.00	46
22	Punjab	9.33	4
23	Rajasthan	197.65	276
24	Sikkim		
25	Tamil Nadu	15.05	8
26	Tripura		
27	Uttarakhand	5.05	1
28	Uttar Pradesh	12.38	13
29	West Bengal	2.05	0
		932.20	621

Source: Greenpeace and Infraline Analysis

Table 13: Analysis of State-wise Success/Failure in Fulfilment of Non-solar RPO

S. No	State	Total Non-solar power Require-ment (MUs)	Total Non-solar Genera-tion (MUs)	Non-solar Power Deficit (+)/ Surplus(-) (MUs)	Non-solar RPO Targets (%)	Non-solar RPO Com-pliance Achieved (%)	Non-solar RPO Deficit (+)/ Surplus (-) (%)
1	Andhra Pradesh	4357	2931	1426	4.75%	3.20%	**1.55%**
2	Arunachal Pradesh	0	3	-3	N.A.	0.50%	N.A.
3	Assam	163	7	156	2.70%	0.12%	2.58%
4	Bihar	322	144	178	2.25%	1.01%	1.24%
5	Chhattisgarh	751	716	35	5.00%	4.77%	0.23%
6	Delhi	508	0	508	1.90%	0.00%	1.90%
7	JERC (Goa & UT)	204	0	204	1.70%	0.00%	1.70%
8	Gujarat	4108	4008	100	5.50%	5.37%	0.13%
9	Haryana	553	374	179	1.50%	1.01%	0.49%
10	Himachal Pradesh	816	856	-40	10.00%	10.49%	-0.49%
11	Jammu and Kashmir	413	0	413	2.90%	0.00%	2.90%
12	Jharkhand	157	0	157	2.50%	0.00%	2.50%
13	Karnataka	6083	7626	-1543	10.00%	12.54%	-2.54%
14	Kerala	666	551	115	3.35%	2.77%	0.58%
15	Madhya Pradesh	1045	412	633	2.10%	0.83%	1.27%
16	Maharashtra	9543	5027	4516	6.75%	3.56%	3.19%
17	Manipur	15	0	15	2.75%	0.00%	2.75%
18	Mizoram	23	22	1	5.75%	5.54%	0.21%
19	Meghalaya	9	79	-70	0.45%	4.10%	-3.65%
20	Nagaland	38	74	-36	6.75%	13.21%	-6.46%
21	Odisha	1129	422	707	4.50%	1.83%	2.67%
22	Punjab	1071	400	671	2.37%	0.89%	1.48%
23	Rajasthan	2831	2883	-52	5.50%	5.60%	-0.10%
24	Sikkim	0	0	0	N.A.	0.00%	N.A.
25	Tamil Nadu	7669	16389	-8720	8.95%	19.13%	-10.18%
26	Tripura	9	0	9	0.90%	0.00%	0.90%
27	Uttarakhand	473	646	-173	4.50%	6.14%	-1.64%
28	Uttar Pradesh	3660	1729	1931	4.50%	2.13%	2.37%
29	West Bengal	1160	116	1044	3.00%	0.30%	2.70%
	Achievements vis-a-vis SERCs RPO targets	**47787**	**45415**	**2361**	**5.19%**	**4.94%**	0.26%
	Achievements vis-a-vis NAPCC & NTP target	**62050**	**45415**	**16635**	**6.75%**	**4.94%**	1.81%

Source: Greenpeace and Infraline Analysis

** Figures colored in red shows that respective states have not been able to meet their non-solar RPO targets.*

Table 14: Analysis of State-wise Success/Failure in Fulfilment of Solar RPO

S. No	State	Total Solar Power Requirement (MUs)	Total Solar Generation (MUs)	Solar Power Deficit (+)/ Surplus (-) (MUs)	Solar RPO Targets (%)	Solar RPO Compliance Achieved (%)	Solar RPO Deficit (+)/ Surplus (-) (%)
1	Andhra Pradesh	229	86	143	0.25%	0.09%	0.16%
2	Arunachal Pradesh	0	0	0	N.A.	0.00%	N.A.
3	Assam	6	0	6	0.10%	0.00%	0.10%
4	Bihar	36	0	36	0.25%	0.00%	0.25%
5	Chhattisgarh	38	0	38	0.25%	0.00%	0.25%
6	Delhi	27	2	25	0.10%	0.01%	0.09%
7	JERC (Goa & UT)	36	0	36	0.30%	0.00%	0.30%
8	Gujarat	373	167	206	0.50%	0.22%	0.28%
9	Haryana	0	2	-2	0.00%	0.01%	-0.01%
10	Himachal Pradesh	1	0	1	0.01%	0.00%	0.01%
11	Jammu and Kashmir	14	0	14	0.10%	0.00%	0.10%
12	Jharkhand	31	0	31	0.50%	0.00%	0.50%
13	Karnataka	152	8	144	0.25%	0.01%	0.24%
14	Kerala	50	0	50	0.25%	0.00%	0.25%
15	Madhya Pradesh	199	0	199	0.40%	0.00%	0.40%
16	Maharashtra	353	8	345	0.25%	0.01%	0.24%
17	Manipur	1	0	1	0.25%	0.00%	0.25%
18	Mizoram	1	0	1	0.25%	0.00%	0.25%
19	Meghalaya	6	0	6	0.30%	0.00%	0.30%
20	Nagaland	1	0	1	0.25%	0.00%	0.25%
21	Odisha	23	46	-23	0.10%	0.20%	-0.10%
22	Punjab	14	4	10	0.03%	0.01%	0.02%
23	Rajasthan	257	276	-19	0.50%	0.54%	-0.04%
24	Sikkim	0	0	0	N.A.	0.00%	N.A.
25	Tamil Nadu	43	8	35	0.05%	0.01%	0.04%
26	Tripura	1	0	1	0.10%	0.00%	0.10%
27	Uttarakhand	3	1	2	0.03%	0.01%	0.02%
28	Uttar Pradesh	407	13	394	0.50%	0.02%	0.48%
29	West Bengal	0	0	0	0.00%	0.00%	0.00%
	Achievements vis-a-vis SERCs RPO targets	**2,302**	**621**	1681	0.25%	0.07%	0.18%
	Achievements vis-a-vis (NTP) (Amendment) target	**2,298**	**621**	1677	0.25%	0.07%	0.18%

Source: Greenpeace and Infraline Analysis

** Figures colored in red shows that respective states have not been able to meet their solar RPO targets.*

Table 15: State wise Wind Power Annual Capacity Additions

State	Till 2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total (till 2012)
Andhra Pdh.	93	0	6	22	0	1	0	0	14	55	54	246
Gujarat	181	6	29	52	85	284	616	314	297	313	790	**2,966**
Karnataka	69	56	85	202	144	266	190	316	145	254	207	**1,934**
Kerala	2	0	0	0	0	0	9	17	1	7	0	35
Madhya Pdh.	23	0	0	6	11	16	130	25	17	47	101	376
Maharashtra	400	2	6	49	545	485	268	183	139	239	417	**2,733**
Rajasthan	16	45	118	106	73	112	69	200	350	437	546	**2,071**
Tamil Nadu	877	134	371	676	858	578	381	431	602	997	1,084	**6,988**
West Bengal	1	-	-	-	-	-	-	-	-	-	-	1
Odisha	-	-	-	-	-	-	-	-	-	-	-	0
Others	3	-	-	-	-	-	-	-	-	-	-	3
Total	**1,667**	**242**	**615**	**1,112**	**1,716**	**1,742**	**1,663**	**1,485**	**1,565**	**2,349**	**3,197**	**17,353**

Source: Greenpeace and Infraline Analysis

Table 16: State-wise Current Status of Solar Power Development in India (September 2012)

State	Commissioned Capacity (MW)			Under Construction Capacity (MW)		
	JNNSM	Other than JNNSM	Total	JNNSM	Other than JNNSM	Total
Andhra Pradesh	14.8	0.3	15.0	80.8		80.8
Bihar	-	-	-	-	75.0	75.0
Chhattisgarh	4.0	-	4.0	-	-	-
Delhi	-	2.3	2.3	-	-	-
Gujarat	-	534.0	534.0	20.0	462.5	482.5
Haryana	7.8	0.3	8.1	1.0	-	1.0
Jharkhand	10.0	-	10.0	6.0	-	6.0
Karnataka	5.0	9.0	14.0	-	-	-
Madhya Pradesh	-	1.9	1.9	5.3	-	5.3
Maharashtra	16.0	4.3	20.3	30.0	8.5	38.5
Odisha	5.0	0.0	5.0	8.0	-	8.0
Punjab	8.0	0.9	8.9	7.5	-	7.5
Rajasthan	127.5	45.2	172.7	750.5	-	750.5
Tamil Nadu	5.0	5.2	10.2	17.0	1.0	18.0
Uttar Pradesh	5.0	0.4	5.4	8.0	-	8.0
Uttarakhand	5.0	0.1	5.1	-	-	-
West Bengal	-	1.7	1.7	-	-	-
Others	-	0.2	0.2	-	-	-
Total	213.1	605.8	818.8	934.0	547.0	1481.0

Source: Greenpeace and Infraline Analysis

Table 17: State wise Annual Capacity Addition of SHP (MW)

State	2008	2009	2010	2011	2012	Till 2012
Andhra Pradesh	2	0	6	5	26.4	217
Arunachal Pradesh	0	16	12	5	0.58	79
Assam	25	0	0	0	4	31
Bihar	0	4	0	5	4.8	64
Chhattisgarh	0	0	1	0	1	20
Goa	0	0	0	0	0	0.05
Gujarat	0	0	5	3	1	16
Haryana	0	0	8	0	0	70
Himachal Pradesh	**21**	**68**	**100**	**63**	**133**	**527**
J&K	0	0	18	0	1	130
Jharkhand	0	0	0	0	0	4
Karnataka	**48**	**99**	**77**	**143**	**99.1**	**882**
Kerala	25	10	0	3	13	149
Madhya Pradesh	20	0	0	15	0	86
Maharashtra	2	0	34	30	6.2	281
Manipur	0	0	0	0	0	5
Mizoram	0	7	12	0	0.27	36
Meghalaya	1	0	0	0	0	31
Nagaland	8	0	0	0	0	28
Odisha	25	12	20	0	0	64
Punjab	0	0	9	22	0.05	154
Rajasthan	0	0	0	0	0	23
Sikkim	0	8	0	5	0	52
Tamil Nadu	0	1	0	7	26.5	123
Tripura	0	0	0	0	0	16
Uttarakhand	**30**	**22**	**5**	**2**	**36.3**	**170**
Uttar Pradesh	0	0	0	0	0	25
West Bengal	0	0	0	0	0	98
Andaman & Nicobar	0	0	0	0	0	5
Total	**207**	**247**	**307**	**307**	**353**	**3,386**

Source: Ministry of New & Renewable Energy & Infraline Renewable Energy Knowledge base

Table 18: Bio Energy (Biomass/Cogeneration) Capacity Addition (MW)

State	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	Till 2012
Andhra Pradesh	22	33	9	20	0	0	**406**
Bihar	-	0	0	0	9.5	6	**15**
Chhattisgarh	85.8	33.5	9.8	43.8	32	17	**249**
Delhi	-	0	0	0	0	16	**16**
Gujarat	-	0	0	0	0	20	**20**
Haryana	-	0	0	1.8	28	0	**35**
Karnataka	29.8	8	31.9	42	29	77	**442**
Madhya Pradesh	-	0	0	0	0	7	**11**
Maharashtra	40	38.5	71.5	33	184.5	200	**608**
Odisha	-	0	0	0	0	20	**20**
Punjab	-	0	0	34.5	12	15	**99**
Rajasthan	8	0	8	0	42	10	**83**
Tamil Nadu	42.5	75	43.2	62	92.5	43	**537**
Uttarakhand	-	0	0	0	10	0	**10**
Uttar Pradesh	-	79	172	194.5	25.5	56	**649**
West Bengal	-	0	0	16	0	0	**16**
Total	**228.1**	**266**	**345.4**	**447.6**	**465**	**486**	**3,216**

Source: Greenpeace and Infraline Analysis

Table 19: Thermal Characteristics of Potential Geothermal Provinces

Provinces	Surface Temp (Degree Celsius)	Reservoir Temperature (Degree Celsius)	Heat Flow (MW/m2)	Thermal Gradient
Himalaya	>90	260	468	100
Cambay	40-90	150-175	80-93	70
West Coast	46-72	102-137	75-129	47-59
Sone-Narmada -Tapi	60-95	105-217	120-290	60-90
Godavari	50-60	175-215	93-104	50

Source: Infraline Renwable Energy Knowledge base

Table 20: State-wise Electricity Demand Forecast from FY 2012-20

S. No.	State	State-wise Electricity Demand Forecast from FY 2012-20								
		2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Delhi	26,622	27,735	28,959	30,304	31,783	33,410	35,200	37,170	39,338
2	Himachal Pradesh	8,392	9,156	9,976	10,856	11,802	12,817	13,907	15,076	16,331
3	Haryana	37,618	40,442	43,496	46,800	50,374	54,241	58,427	62,959	67,866
4	Jammu & Kashmir	15,255	16,416	17,644	18,943	20,315	21,767	23,301	24,924	26,639
5	Punjab	49,289	51,815	54,481	57,295	60,265	63,401	66,713	70,211	73,906
6	Rajasthan	48,489	51,638	54,980	58,529	62,296	66,295	70,542	75,051	79,839
7	Uttarakhand	11,018	12,403	13,954	15,690	17,633	19,808	22,243	24,968	28,019
8	Uttar Pradesh	83,471	88,642	94,124	99,937	106,102	112,640	119,574	126,928	134,730
9	Gujarat	72,111	74,475	76,960	79,573	82,322	85,218	88,269	91,487	94,884
10	Chhattisgarh	11,223	11,239	11,227	11,182	11,100	10,977	10,809	10,589	10,311
11	Madhya Pradesh	50,632	53,096	55,695	58,438	61,333	64,390	67,617	71,025	74,624
12	Maharashtra	142,941	153,431	165,121	178,134	192,606	208,688	226,544	246,356	268,323
13	Andhra Pradesh	86,344	91,879	97,788	104,099	110,839	118,042	125,739	133,969	142,769
14	Karnataka	50,845	53,608	56,590	59,808	63,280	67,027	71,071	75,434	80,143
15	Kerala	19,277	20,269	21,337	22,487	23,727	25,062	26,500	28,051	29,722
16	Tamil Nadu	88,356	95,313	102,921	111,238	120,329	130,265	141,123	152,987	165,947
17	Bihar	13,183	13,995	14,860	15,784	16,770	17,823	18,948	20,149	21,434
18	Jharkhand	6457	6,892	7,349	7,831	8,339	8,873	9,436	10,029	10,653
19	Odisha	23,339	25,059	26,936	28,983	31,217	33,654	36,313	39,213	42,377
20	West Bengal	38450	41,088	43,909	46,926	50,152	53,602	57,291	61,236	65,453
21	Sikkim	486	548	617	693	779	875	983	1103	1237
22	Assam	5,919	6,213	6,519	6,839	7,171	7,518	7,879	8,256	8,648
23	Manipur	581	596	612	629	646	664	683	703	723
24	Meghalaya	1,694	1,801	1,916	2,038	2169	2,,309	2,458	2,618	2,789
25	Nagaland	621	676	736	801	872	949	1,032	1,122	1,220
26	Tripura	903	934	968	1,005	1,044	1,086	1,132	1,181	1,234
27	Arunachal Pradesh	562	618	676	738	803	871	942	1,016	1,092
28	Mizoram	376	396	416	439	463	488	516	546	579
29	Others (Goa+UTs)	11,252	11,953	12,705	13,508	14,370	15,292	16,264	17,299	18,406
30	**All India**	**908261**	**965013**	**1026303**	**1092509**	**1164052**	**1241383**	**1324981**	**1415392**	**1513208**

Source: Greenpeace and Infraline Analysis

Table 21: State-wise Cumulative Wind Power Capacity Addition Forecast from FY 2012-20 (Grid-connected)

S. No.	State	Year-wise Wind Energy Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	246	335	457	623	850	1,160	1,583	2,159	2,946
2	Gujarat	2,966	3,395	3,886	4,448	5,092	5,828	6,671	7,636	8,741
3	Karnataka	1,934	2,224	2,559	2,944	3,387	3,897	4,483	5,158	5,934
4	Kerala	35	50	72	102	146	208	297	424	605
5	Madhya Pradesh	376	413	453	496	544	597	655	718	787
6	Maharashtra	2,733	2,931	3,143	3,370	3,614	3,875	4,155	4,456	4,778
7	Rajasthan	2,071	2,369	2,709	3,099	3,545	4,056	4,639	5,307	6,071
8	Tamil Nadu	6,988	7,687	8,456	9,303	10,234	11,258	12,385	13,624	14,988
9	Total	17,348	19,404	21,735	24,386	27,412	30,878	34,868	39,481	44,848

Source: MNRE, CWET and Infraline Analysis

Table 22: State-wise Cumulative Small Hydro Power Capacity Addition Forecast from FY 2012-20 (Grid-connected)

S. No.	State	Year-wise Small Hydro Power Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	217	227	238	249	261	273	286	299	313
2	Arunachal Pradesh	79	85	91	98	105	112	121	130	139
3	Assam	31	34	38	43	47	52	58	65	72
4	Bihar	64	68	73	77	82	88	93	100	106
5	Chhattisgarh	20	28	39	55	76	107	149	209	292
6	Delhi	0	0	0	0	0	0	0	0	0
7	Gujarat	16	16	16	16	16	16	16	16	16
8	Haryana	70	71	73	74	75	77	78	80	81
9	Himachal Pradesh	527	572	621	674	731	794	862	935	1015
10	Jammu & Kashmir	130	133	136	139	142	146	149	152	156
11	Jharkhand	4	6	8	11	16	22	31	43	61
12	Karnataka	882	904	927	951	975	999	1,025	1,050	1,077
13	Kerala	149	160	171	183	196	209	224	240	257
14	Madhya Pradesh	86	91	96	101	106	112	118	124	131
15	Maharashtra	281	294	308	323	339	355	372	389	408
16	Manipur	5	5	6	6	6	7	7	8	8
17	Mizoram	36	36	36	37	37	37	37	38	38
18	Meghalaya	31	31	31	31	31	32	32	32	32
19	Nagaland	28	29	29	30	30	31	32	32	33
20	Odisha	64	70	76	83	91	99	108	118	129
21	Punjab	154	161	169	176	184	193	202	211	221
22	Rajasthan	23	23	23	23	23	23	23	23	23
23	Sikkim	52	55	58	61	64	68	71	75	79
24	Tamil Nadu	123	128	132	137	142	148	153	159	165
25	Tripura	16	16	16	16	16	16	16	16	16
26	Uttarakhand	170	197	229	267	310	360	418	485	564
27	Uttar Pradesh	25	25	25	25	25	25	25	25	25
28	West Bengal	98	106	114	123	133	144	155	168	181
29	**Total**	**3,381**	**3,571**	**3,779**	**4,008**	**4,261**	**4,543**	**4,861**	**5,222**	**5,638**

Source: MNRE and Infraline Analysis

Table 23: State-wise Cumulative Bio-energy Capacity Addition Forecast from FY 2012-20 (Grid-connected)

S. No.	State	Year-wise Bio-energy Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	406	427	450	474	498	525	552	581	612
2	Bihar	15	22	33	49	73	108	161	238	354
3	Chhattisgarh	249	269	291	315	341	369	399	432	467
4	Delhi	16	19	22	26	30	35	41	48	56
5	Gujarat	20	31	47	71	109	167	255	390	596
6	Haryana	35	50	71	102	146	208	297	425	607
7	Karnataka	442	482	526	574	627	684	747	815	889
8	Madhya Pradesh	11	18	29	46	75	121	195	314	507
9	Maharashtra	608	685	772	871	981	1,106	1,247	1,405	1,584
10	Odisha	20	25	30	37	46	57	70	86	106
11	Punjab	99	126	159	202	256	325	412	522	662
12	Rajasthan	83	102	126	155	190	234	288	354	436
13	Tamil Nadu	537	575	616	660	707	757	811	868	930
14	Uttarakhand	10	11	11	12	13	14	15	16	17
15	Uttar Pradesh	649	719	797	884	980	1086	1204	1334	1479
16	West Bengal	16	22	30	41	56	77	106	145	199
17	**Total**	**3,216**	**3,583**	**4,012**	**4,519**	**5,128**	**5,872**	**6,798**	**7,974**	**9,501**

Source: MNRE and Infraline Analysis

Table 24: State-wise Cumulative Solar Power Capacity Addition Forecast from FY 2012-20 (Grid-connected)

S. No.	State	Year-wise Solar Power Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	15	29	55	104	199	381	727	1387	2647
2	Bihar	1	2	5	11	24	52	116	255	564
3	Chhattisgarh	4	7	12	22	38	67	117	205	361
4	Delhi	2	3	4	4	5	7	8	10	12
5	Gujarat	534	778	1,133	1,650	2,404	3,501	5,099	7,427	10,817
6	Haryana	8	12	17	25	37	54	78	114	167
7	Jharkhand	10	14	19	26	35	48	65	89	122
8	Karnataka	14	23	38	64	105	175	289	478	792
9	Madhya Pradesh	2	4	10	23	52	117	267	609	1,386
10	Maharashtra	20	36	62	109	191	335	587	1,029	1,803
11	Odisha	5	10	21	44	90	186	383	788	1,621
12	Punjab	9	12	17	23	32	45	62	86	118
13	Rajasthan	173	278	447	719	1,157	1,862	2,996	4,821	7,756
14	Tamil Nadu	10	21	43	87	179	366	749	1,532	3,134
15	Uttar Pradesh	5	9	15	24	40	67	111	183	304
16	Uttarakhand	5	7	10	14	19	26	36	50	70
16	West Bengal	2	3	4	6	9	13	19	29	43
17	**Total**	**821**	**1,249**	**1,914**	**2,958**	**4,621**	**7,306**	**11,716**	**19,101**	**31,729**

Source: MNRE and Infraline Analysis

Table 25: State-wise Cumulative Solar Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Solar Power Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	1.28	4.97	10.50	17.88	25.26	34.48	45.54	56.61	67.68
2	Arunachal Pradesh	0.03	0.12	0.25	0.42	0.59	0.81	1.07	1.32	1.58
3	Assam	0.37	1.43	3.02	5.14	7.25	9.90	13.08	16.26	19.44
4	Bihar	1.36	5.27	11.14	18.97	26.79	36.58	48.32	60.06	71.80
5	Chhattisgarh	8.02	31.11	65.75	111.93	158.11	215.84	285.11	354.39	423.66
6	Delhi	0.14	0.56	1.18	2.01	2.83	3.87	5.11	6.35	7.59
7	Goa	0.00	0.01	0.02	0.04	0.06	0.08	0.11	0.13	0.16
8	Gujarat	0.66	2.55	5.38	9.16	12.94	17.67	23.34	29.01	34.68
9	Haryana	1.18	4.60	9.71	16.53	23.36	31.88	42.12	52.35	62.58
10	Himachal Pradesh	0.35	1.37	2.89	4.93	6.96	9.50	12.55	15.60	18.65
11	Jammu & Kashmir	0.54	2.10	4.44	7.55	10.67	14.57	19.24	23.91	28.59
12	Jharkhand	0.41	1.60	3.39	5.77	8.15	11.13	14.70	18.27	21.84
13	Karnataka	0.45	1.73	3.65	6.22	8.79	12.00	15.85	19.70	23.55
14	Kerala	0.10	0.39	0.83	1.41	1.99	2.72	3.59	4.47	5.34
15	Madhya Pradesh	1.01	3.91	8.26	14.06	19.86	27.12	35.82	44.52	53.23
16	Maharashtra	1.60	6.21	13.13	22.35	31.57	43.09	56.92	70.75	84.58
17	Manipur	0.26	1.01	2.13	3.62	5.11	6.98	9.22	11.46	13.70
18	Meghalaya	0.09	0.34	0.73	1.24	1.74	2.38	3.15	3.91	4.67
19	Mizoram	0.19	0.74	1.57	2.67	3.77	5.14	6.79	8.44	10.09
20	Nagaland	0.25	0.98	2.07	3.52	4.97	6.79	8.97	11.15	13.33
21	Odisha	0.15	0.57	1.21	2.07	2.92	3.99	5.26	6.54	7.82
22	Punjab	0.32	1.23	2.60	4.43	6.25	8.54	11.28	14.02	16.75
23	Rajasthan	6.19	24.00	50.72	86.35	121.98	166.51	219.96	273.40	326.84
24	Sikkim	0.05	0.20	0.43	0.73	1.03	1.40	1.85	2.30	2.75
25	Tamil Nadu	0.26	1.02	2.15	3.67	5.18	7.07	9.34	11.61	13.89
26	Tripura	0.06	0.24	0.50	0.86	1.21	1.65	2.18	2.71	3.24
27	Uttar Pradesh	5.23	20.28	42.86	72.97	103.08	140.71	185.87	231.04	276.20
28	Uttarakhand	0.32	1.22	2.59	4.40	6.22	8.49	11.22	13.94	16.67
29	West Bengal	1.42	5.51	11.65	19.83	28.02	38.25	50.52	62.80	75.07
30	**Total**	**34.257**	**132.91**	**280.89**	**478.20**	**675.50**	**922.13**	**1218.09**	**1514.05**	**1810.01**

Source: MNRE and Infraline Analysis

Table 26: State-wise Cumulative Waste-to-Energy Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Waste-to-Energy Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	8.71	14.70	21.55	29.25	37.81	47.23	57.50	68.63	80.61
2	Arunachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Assam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Bihar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chhattisgarh	0.33	0.56	0.82	1.11	1.43	1.79	2.18	2.60	3.05
6	Delhi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Goa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Gujarat	14.43	24.36	35.70	48.46	62.64	78.24	95.26	113.69	133.55
9	Haryana	4.00	6.75	9.90	13.43	17.36	21.69	26.41	31.52	37.02
10	Himachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Jammu & Kashmir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Jharkhand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Karnataka	4.40	7.43	10.89	14.78	19.10	23.86	29.05	34.67	40.72
14	Kerala	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Madhya Pradesh	0.11	0.19	0.27	0.37	0.48	0.60	0.73	0.87	1.02
16	Maharashtra	13.83	23.34	34.22	46.45	60.04	74.99	91.30	108.97	127.99
17	Manipur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Meghalaya	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	Mizoram	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Nagaland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Odisha	0.02	0.03	0.05	0.07	0.09	0.11	0.13	0.16	0.19
22	Punjab	1.81	3.06	4.48	6.08	7.86	9.81	11.95	14.26	16.75
23	Rajasthan	3.00	5.06	7.42	10.08	13.02	16.27	19.80	23.64	27.76
24	Sikkim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Tamil Nadu	10.04	16.95	24.84	33.72	43.59	54.44	66.28	79.10	92.92
26	Tripura	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	Uttar Pradesh	37.06	62.55	91.69	124.47	160.88	200.95	244.65	291.99	342.98
28	Uttarakhand	4.02	6.79	9.95	13.50	17.45	21.80	26.54	31.67	37.20
29	West Bengal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	**Total**	**101.76**	**171.76**	**251.76**	**341.76**	**441.76**	**551.76**	**671.76**	**801.76**	**941.76**

Source: MNRE and Infraline Analysis

Table 27: State-wise Cumulative Biomass Gasifiers Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Biomass Gasifiers Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	134.78	137.51	140.25	142.98	145.72	148.46	151.19	153.93	156.66
2	Arunachal Pradesh	4.93	5.03	5.13	5.23	5.33	5.43	5.53	5.63	5.73
3	Assam	12.37	12.62	12.87	13.12	13.38	13.63	13.88	14.13	14.38
4	Bihar	60.84	62.07	63.31	64.54	65.78	67.01	68.25	69.48	70.72
5	Chhattisgarh	7.95	8.11	8.27	8.43	8.60	8.76	8.92	9.08	9.24
6	Delhi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Goa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Gujarat	139.48	142.31	145.14	147.98	150.81	153.64	156.47	159.30	162.13
9	Haryana	12.90	13.16	13.42	13.68	13.94	14.21	14.47	14.73	14.99
10	Himachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Jammu & Kashmir	1.31	1.34	1.37	1.39	1.42	1.45	1.47	1.50	1.53
12	Jharkhand	3.29	3.35	3.42	3.49	3.55	3.62	3.69	3.75	3.82
13	Karnataka	48.93	49.92	50.91	51.91	52.90	53.89	54.89	55.88	56.87
14	Kerala	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Madhya Pradesh	58.53	59.71	60.90	62.09	63.28	64.47	65.65	66.84	68.03
16	Maharashtra	46.98	47.93	48.88	49.84	50.79	51.74	52.70	53.65	54.60
17	Manipur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Meghalaya	1.64	1.68	1.71	1.74	1.78	1.81	1.84	1.88	1.91
19	Mizoram	1.64	1.68	1.71	1.74	1.78	1.81	1.84	1.88	1.91
20	Nagaland	13.80	14.08	14.36	14.64	14.92	15.20	15.48	15.76	16.04
21	Odisha	1.77	1.81	1.85	1.88	1.92	1.95	1.99	2.03	2.06
22	Punjab	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	Rajasthan	16.19	16.52	16.85	17.17	17.50	17.83	18.16	18.49	18.82
24	Sikkim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Tamil Nadu	77.28	78.85	80.41	81.98	83.55	85.12	86.69	88.26	89.83
26	Tripura	6.90	7.04	7.18	7.32	7.46	7.60	7.74	7.88	8.02
27	Uttar Pradesh	154.59	157.73	160.87	164.01	167.14	170.28	173.42	176.56	179.70
28	Uttarakhand	7.23	7.37	7.52	7.67	7.81	7.96	8.11	8.25	8.40
29	West Bengal	171.92	175.41	178.90	182.39	185.88	189.37	192.86	196.35	199.84
30	**Total**	**985.23**	**1005.23**	**1025.23**	**1045.23**	**1065.23**	**1085.23**	**1105.23**	**1125.23**	**1145.23**

Source: MNRE and Infraline Analysis

Table 29: State-wise Cumulative Biomass Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Biomass Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	296.31	305.74	315.17	324.61	334.04	343.47	352.90	362.34	371.77
2	Arunachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Assam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	Bihar	21.02	21.69	22.36	23.03	23.70	24.37	25.04	25.71	26.38
5	Chhattisgarh	16.43	16.95	17.47	17.99	18.52	19.04	19.56	20.09	20.61
6	Delhi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Goa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Gujarat	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Haryana	137.64	142.02	146.40	150.79	155.17	159.55	163.93	168.31	172.70
10	Himachal Pradesh	47.30	48.81	50.32	51.82	53.33	54.83	56.34	57.85	59.35
11	Jammu & Kashmir	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	Jharkhand	7.88	8.13	8.39	8.64	8.89	9.14	9.39	9.64	9.89
13	Karnataka	46.98	48.47	49.97	51.46	52.96	54.45	55.95	57.44	58.94
14	Kerala	4.73	4.88	5.03	5.18	5.33	5.48	5.63	5.78	5.94
15	Madhya Pradesh	81.14	83.72	86.31	88.89	91.47	94.05	96.64	99.22	101.80
16	Maharashtra	55.19	56.94	58.70	60.46	62.22	63.97	65.73	67.49	69.24
17	Manipur	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Meghalaya	90.67	93.55	96.44	99.32	102.21	105.10	107.98	110.87	113.76
19	Mizoram	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Nagaland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Odisha	16.23	16.74	17.26	17.78	18.29	18.81	19.33	19.84	20.36
22	Punjab	464.76	479.56	494.35	509.15	523.94	538.74	553.53	568.33	583.12
23	Rajasthan	13.14	13.56	13.98	14.39	14.81	15.23	15.65	16.07	16.49
24	Sikkim	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	Tamil Nadu	86.40	89.15	91.90	94.65	97.40	100.15	102.90	105.65	108.40
26	Tripura	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	Uttar Pradesh	905.35	934.17	962.99	991.81	1020.63	1049.45	1078.27	1107.09	1135.91
28	Uttarakhand	128.12	132.19	136.27	140.35	144.43	148.51	152.59	156.66	160.74
29	West Bengal	93.75	96.74	99.72	102.71	105.69	108.68	111.66	114.65	117.63
30	**Total**	**2513.03**	**2593.03**	**2673.03**	**2753.03**	**2833.03**	**2913.03**	**2993.03**	**3073.03**	**3153.03**

Source: MNRE and Infraline Analysis

Table 30: State-wise Cumulative Aero-generators Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Aero generators Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08
2	Arunachal Pradesh	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
3	Assam	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
4	Bihar	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Chhattisgarh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Delhi	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Goa	0.43	0.48	0.53	0.58	0.63	0.68	0.73	0.78	0.83
8	Gujarat	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05
9	Haryana	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05
10	Himachal Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	Jammu & Kashmir	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08	0.08
12	Jharkhand	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Karnataka	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.19	0.20
14	Kerala	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
15	Madhya Pradesh	0.06	0.07	0.08	0.08	0.09	0.10	0.11	0.11	0.12
16	Maharashtra	2.72	3.03	3.35	3.66	3.98	4.29	4.61	4.92	5.23
17	Manipur	0.29	0.32	0.36	0.39	0.42	0.46	0.49	0.52	0.56
18	Meghalaya	0.04	0.04	0.05	0.05	0.06	0.06	0.07	0.07	0.08
19	Mizoram	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	Nagaland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Odisha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	Punjab	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.25
23	Rajasthan	0.04	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.07
24	Sikkim	0.04	0.05	0.05	0.05	0.06	0.06	0.07	0.07	0.08
25	Tamil Nadu	0.06	0.07	0.08	0.09	0.09	0.10	0.11	0.12	0.12
26	Tripura	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
27	Uttar Pradesh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	Uttarakhand	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02
29	West Bengal	0.19	0.22	0.24	0.26	0.28	0.31	0.33	0.35	0.37
30	**Total**	**4.32**	**4.82**	**5.32**	**5.82**	**6.32**	**6.82**	**7.32**	**7.82**	**8.32**

Source: MNRE and Infraline Analysis

Table 31: State-wise Cumulative Micro-hydel Capacity Addition Forecast from FY 2012-20 (Off-grid)

S. No.	State	Year-wise Micro-hydel Capacity Addition from FY 2012-20 (Cumulative) in MW								
		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
1	Andhra Pradesh	0.00	0	0	0	0	0	0	0	0
2	Arunachal Pradesh	8.76	9	10	10	11	12	13	14	15
3	Assam	0.00	0	0	0	0	0	0	0	0
4	Bihar	0.00	0	0	0	0	0	0	0	0
5	Chhattisgarh	0.00	0	0	0	0	0	0	0	0
6	Delhi	0.00	0	0	0	0	0	0	0	0
7	Goa	0.00	0	0	0	0	0	0	0	0
8	Gujarat	0.00	0	0	0	0	0	0	0	0
9	Haryana	0.00	0	0	0	0	0	0	0	0
10	Himachal Pradesh	0.00	0	0	0	0	0	0	0	0
11	Jammu & Kashmir	0.35	0	0	0	0	0	1	1	1
12	Jharkhand	0.00	0	0	0	0	0	0	0	0
13	Karnataka	1.85	2	2	2	2	3	3	3	3
14	Kerala	0.00	0	0	0	0	0	0	0	0
15	Madhya Pradesh	0.00	0	0	0	0	0	0	0	0
16	Maharashtra	0.00	0	0	0	0	0	0	0	0
17	Manipur	0.09	0	0	0	0	0	0	0	0
18	Meghalaya	0.00	0	0	0	0	0	0	0	0
19	Mizoram	0.00	0	0	0	0	0	0	0	0
20	Nagaland	1.72	2	2	2	2	2	3	3	3
21	Odisha	0.00	0	0	0	0	0	0	0	0
22	Punjab	0.00	0	0	0	0	0	0	0	0
23	Rajasthan	0.00	0	0	0	0	0	0	0	0
24	Sikkim	0.00	0	0	0	0	0	0	0	0
25	Tamil Nadu	0.28	0	0	0	0	0	0	0	0
26	Tripura	0.00	0	0	0	0	0	0	0	0
27	Uttar Pradesh	0.00	0	0	0	0	0	0	0	0
28	Uttarakhand	10.84	11	12	13	14	15	16	17	19
29	West Bengal	0.00	0	0	0	0	0	0	0	0
30	Total	23.89	25	27	28	30	33	35	38	41

Source: MNRE and Infraline Analysis

Table 32: Analysis of state-wise success/failure in terms of fulfilment of RPO targets

State	Total RE Requirement (MUs)	Total RE Generation (MUs)	RE Power Deficit (+)/ Surplus (-) (MUs)	RPO Targets (%)	RPO Compliance Achieved (%)	RPO Deficit (+)/ Surplus (-) (%)
Maharashtra	9897	5035	4862	7.00%	3.56%	3.44%
Jammu and Kashmir	428	0	428	3.00%	0.00%	3.00%
Jharkhand	188	0	188	3.00%	0.00%	3.00%
Manipur	16	0	16	3.00%	0.00%	3.00%
Odisha	1152	468	684	5.00%	2.03%	2.97%
Uttar Pradesh	4067	1742	2325	5.00%	2.14%	2.86%
West Bengal	1160	116	1044	3.00%	0.30%	2.70%
Assam	169	7	162	2.8%	0.12%	2.68%
JERC (Goa & UT)	240	0	240	2.00%	0.00%	2.00%
Delhi	535	2	533	2.00%	0.01%	1.99%
Andhra Pradesh	4587	3017	1570	5.00%	3.29%	1.71%
Madhya Pradesh	1245	412	833	2.50%	0.83%	1.67%
Punjab	1085	404	681	2.40%	0.89%	1.51%
Bihar	358	144	214	2.5%	1.01%	1.49%
Tripura	9	0	9	1.00%	0.00%	1.00%
Kerala	716	551	165	3.60%	2.77%	0.83%
Chhattisgarh	788	716	72	5.25%	4.77%	0.48%
Haryana	553	376	177	1.5%	1.02%	0.48%
Mizoram	24	22	2	6.00%	5.54%	0.46%
Gujarat	4482	4175	307	6.00%	5.59%	0.41%
Rajasthan	3088	3159	-71	6.00%	6.14%	-0.14%
Himachal Pradesh	817	856	-39	10.01%	10.49%	-0.48%
Uttarakhand	476	647	-171	4.53%	6.15%	-1.62%
Karnataka	6235	7634	-1399	10.25%	12.55%	-2.30%
Meghalaya	14	79	-65	0.75%	4.10%	-3.35%
Nagaland	39	74	-35	7.00%	13.21%	-6.21%
Tamil Nadu	7712	16397	-8685	9.00%	19.14%	-10.14%
Arunachal Pradesh	0	3	-3	N.A.	0.50%	N.A.
Sikkim	0	0	0	N.A.	0.00%	N.A.
Achievements vis-a-vis SERCs RPO targets	50080*	46036	4044	5.44%	5.01%	0.43%
Achievements vis-a-vis NAPCC national level target	64348*	46036	18312	7.00%	5.01%	1.99%

Source: CEA18th EPS (draft report) and Infraline Analysis

**There is clear mismatch in the decision making between the NAPCC and the SERC on estimating the total renewable energy generation targeted.*

Greenpeace is a global organisation that uses non-violent direct action to tackle the most crucial threats to our planet's biodiversity and environment. Greenpeace is a non-profit organisation, present in 40 countries across Europe, The Americas, Asia and the Pacific.

It speaks for 2.8 million supporters worldwide, and inspires many millions more to take action every day. To maintain its independence, Greenpeace does not accept donations from governments or corporations but relies on contributions from individual supporters and foundation grants.

Greenpeace has been campaigning against environmental degradation since 1971 when a small boat of volunteers and journalists sailed into Amchitka, an area north of Alaska, where the US Government was conducting underground nuclear tests.This tradition of 'bearing witness' in a non-violent manner continues today, and ships are an important part of all its campaign work.

GREENPEACE
ग्रीनपीस

Greenpeace India Society

Head Office - Bengaluru
#60, Wellington Street
Richmond Town
Bengaluru 560 025, India
T: +91 80 42821010
F: +91 80 41154862

Regional Office – New Delhi
A-23, Second Floor, Green Park
Near Aurobindo Place Market
New Delhi 110 016, India
T: + 91 11 66665000, 66665106
F: +91 11 66665010

Toll Free No.: 1800 425 0374
E: supporter.services.in@greenpeace.org
www.greenpeace.org/india

Printed on 100% recycled paper