



WIND VISION INDIA 2032

Evolving consensus through stakeholder engagement

A Multi Stakeholder Perspective





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Shakti Sustainable Energy Foundation works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. Based on both energy savings and carbon mitigation potential, Shakti focuses on four broad sectors: Power, Transport, Energy Efficiency and Climate Policy. Shakti acts as a systems integrator, bringing together key stakeholders including government, civil society and business in strategic ways to enable clean energy policies in these sectors.



Idam Infrastructure Advisory Private Limited, a part of 'Idam' group, is a company established by professionals with vast experience in energy and infrastructure domains. Since its inception in 2007, Idam team has gathered rich and valuable experience and gained deeper insights across the entire value chain of energy infrastructure. Idam has strong capability in design, development and implementation of energy efficiency, renewable energy and climate change policies at central and state government level.

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We would also like to acknowledge that while this document significantly benefited from inputs of different stakeholders, it does not necessarily reflect a shared vision around all aspects of wind energy development in the country. We received very rich and diverse set of inputs, and have applied professional judgement to finalize the document in its current version.



Background

“**Wind Discussion Forum**” is an initiative supported by Shakti Sustainable Energy Foundation with technical inputs from Idam Infrastructure Advisory Pvt. Ltd. (Idam), and guided by an Advisory Group consisting of sector experts, industry representatives and former electricity regulators. This report – **Wind Vision 2032: A Multi Stakeholder Perspective** – is an outcome of multiple discussions carried out under the aegis of the Wind Discussion Forum.

‘**Wind Vision 2032**’ covers the sector evolution, current landscape, critical issues that need attention, and proposes reaching 200 GW of wind capacity by 2032. It is aimed at providing industry’s perspective on the proposed National Wind Energy Mission.

Structure of the Report

The report follows the following chapter outline to cover the various issues facing the wind sector, and possible solutions:

- 1) **India's Electricity Sector:** This chapter briefly covers the background, key drives for the RE sector, wind sector, setting of target of 200 GW by 2032 and benefits of these targets.
- 2) **Regulatory, Policy and Tax Incentives:** This chapter broadly covers existing regulatory framework for wind sector in India, regulatory incentives, namely – FIT, RPO, REC Mechanism, Open Access in RE, Banking, etc. and fiscal incentives – GBI, AD, etc.
- 3) **Financing Wind Sector:** This chapter covers the financing requirement, debt financing, equity financing, barriers in availing financing in Indian market, and recommendations, including introduction of new investment structures.
- 4) **Wind Power Project Development:** This chapter largely covers issues and possible solutions in various stages of existing Wind Project Development Model, proposed a new Wind Project Development Model, with its benefits.
- 5) **Procurement of Wind Power:** This chapter covers learning from International experience on competitive procurement, APPC plus REC as proxy for competition, pre-requisites for introducing competition in wind, issues and recommendations.
- 6) **Grid Integration of Wind Energy:** This chapter briefly outlines key challenges for Grid Integration of Wind segregated into Planning, Construction and Operation stages, and the key intervention measures identified for each stage.
- 7) **Conclusion:** This chapter summarises the key recommendations emerging in all the themes required to scale up the Wind sector to 200 GW by 2032, categorising them into short-term, medium-term and long-term action points.



Acronyms

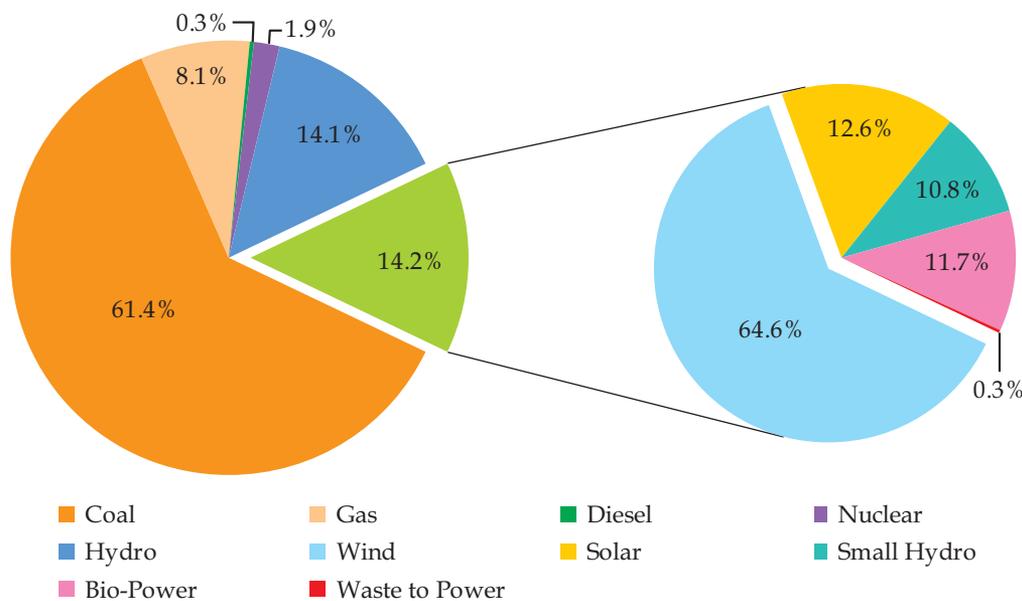
AD	Accelerated Depreciation
APPC	Average Power Purchase Cost
CBG	Competitive Bidding Guidelines
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CUF	Capacity Utilisation Factor
DDUGJY	Deendayal Upadhyaya Gram Jyoti Yojana
DISCOM	Distribution Company
EA 2003	Electricity Act, 2003
EPS	Electric Power Survey
FIT	Feed in Tariff
FOR	Forum of Regulators
FYP	Five Year Plan
GBI	Generation Based Incentive
GDP	Gross Domestic Product
GoI	Government of India
GW	Giga Watt
IREDA	Indian Renewable Energy Development Agency
LNG	Liquefied Natural Gas
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MW	Mega Watt
NAPCC	National Action Plan on Climate Change
NDC	Nationally Determined Contribution
NEP	National Electricity Policy
NIWE	National Institute of Wind Energy
OA	Open Access
PPA	Power Purchase Agreement
RE	Renewable Energy
REC	Renewable Energy Certificate
RGO	Renewable Generation Obligation
RPO	Renewable Purchase Obligation
SERC	State Electricity Regulatory Commission
TNERC	Tamil Nadu Electricity Regulatory Commission
TP	Tariff Policy

1 India's Electricity Sector

1.1 Introduction

India's impressive economic growth in the last decade has resulted in corresponding growth in the country's energy requirements. Although the total installed power capacity has increased from 1,05,046 MW in 2002 to 3,02,833 MW till April 2016, capacity addition has not been able to keep pace with the country's rapid industrialization. As per the Central Electricity Authority (CEA)¹, during FY 2015-16, the total energy (MUs) and peak (MW) deficits were reported at 2.1% and 3.2% respectively. According to the World Bank analysis², about 22% of India's population does not have access to electricity and the country's per capita consumption of electricity is lowest among the emerging large economies (Brazil, China, Russia, and South Africa). The electricity demand is expected to rise significantly in future. Figure 1 depicts that India's installed capacity mix is currently dominated by coal. The share of Renewable energy (RE) is just 14% of the total installed capacity.

Figure 1: Sources of Generation and their Share in Percentage (in Terms of Installed Capacity as on April 2016)



Source: MNRE and CEA

India has set an ambitious target of installing 175 GW of renewable capacity- including 100 GW of solar and 60 GW of wind power by 2022. Achieving this calls for US\$ 120 billion capital investment and equity infusion of US\$ 40 billion.

1.2 Key Drivers for the RE Sector

Electricity generation from RE is increasingly recognized to play an important role for achieving various goals, such as diversity and security of energy supply, economic security through reduced energy imports, reduction of pollutants and global greenhouse gas emissions, rural development, and support employment generation at the local and regional level. The key drivers that are likely to further promote RE in the country as follows.

¹ Load Generation Balancing Report 2015-16 Published by CEA in May 2015.

² <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>.



1.2.1 Energy Security Concerns

India is the fourth largest importer of crude oil and sixth largest importer of petroleum products and Liquefied Natural Gas (LNG) globally. Energy security takes a central position in government policy making as India relies on imports for 79% of its petroleum needs. Increasing dependence on imported energy sources, mainly crude oil, natural gas and coal, has resulted in greater government attention on the subject.

1.2.2 Climate Change

India is the third largest Green House Gas (GHG) emitter, next only to China and United States of America (USA) in absolute terms, though, at 2.44 metric tonnes of per capita emissions, India is only one-third and one-eighth of China and USA respectively. India is engaged in reducing carbon emissions and alleviating environmental degradation. In its recently announced Nationally Determined Contribution (NDC), India targets to reduce the emissions intensity of its Gross Domestic Product (GDP) by 33%–35% by 2030 as compared to 2005 levels. This can be possible by generating 40% of the electricity through non-fossil fuel sources such as solar, wind, hydro and biomass.

1.2.3 Cost Competitiveness

The cost competitiveness of renewable power generation has increased as compared to the cost of fossil fuel based power generation. Equipment prices have fallen due to technological innovation, increasing manufacturing scale and experience curve gains, especially for solar and wind technologies. While the price of coal-fired electricity has now exceeded INR 5 per unit³, levelized cost of wind energy are in the range from INR 4.16 per unit⁴ to INR 4.78 per unit⁵. This brings wind power at parity with conventional power, without considering the storage cost.

1.2.4 Energy Access

Nearly 22%⁶ of the population in India lacks access to electricity. Peak demand in India still remains unmet, unlike most developed countries where energy demand has either reached or is close to its saturation level. In November 2014, the Government of India launched INR 43,033 crore rural electrification scheme – Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) to address the energy access problem with components to separate agriculture and non-agriculture feeders facilitating judicious rostering of supply to agricultural and non-agricultural consumers in rural areas.

1.2.5 World Class Technology Domestically Available

Until recently, most turbine manufacturers were dependent on imports for several turbine components, with China and Europe being the most attractive supplier markets for these inputs. As India increasingly turns to renewable energy to power its growing economy, the manufacturers are positioned to provide world-class wind turbines that are designed, tested and manufactured locally. Indian wind turbine manufacturers including various individual component manufacturers such as towers, rotor blades and nacelles are also increasingly engaging in the global market by taking advantage of lower manufacturing costs in India.

³ MERC Order in Case No. 65 of 2015 dated November 06, 2015.

⁴ TNERC Comprehensive Tariff Order on Wind Energy, March 2016.

⁵ MPERC Wind Tariff Order, March 2016 (Control Period till March 2019).

⁶ <http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>.

1.2.6 Massive Untapped Potential

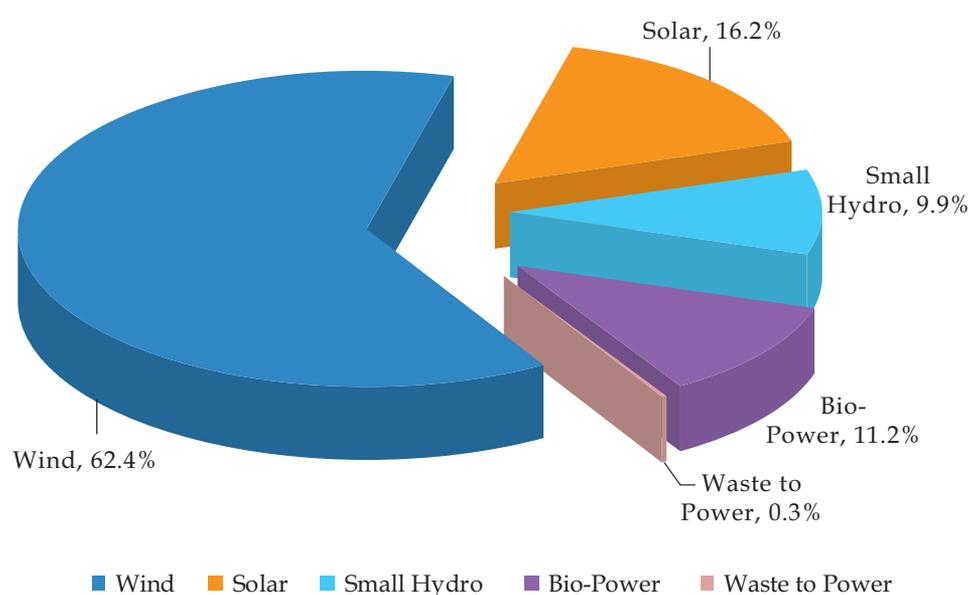
With about 302 Giga Watt (GW) of wind energy potential (as estimated by National Institute for Wind Energy [NIWE]), 4–7 kWh per square meter per day of solar incidence in most parts of the country throughout the year and abundant agricultural residues to be utilised as bio-energy, India's RE resource potential is huge. India has the potential to develop massive commercial wind farms to harness the strong onshore potential of its 7,500 kilometers long coastline. It also has enormous capacity to tap the offshore wind potential to boost the country's supply of renewable energy. However, to tap this vast resource, India should develop and implement smart business models and favourable policies as quickly as possible.

There has always been a realization for enhancing the use of RE as a primary instrument for achieving the objectives of energy security, sustainable development and climate change mitigation. In a country like India, increasing investment in the deployment of clean technologies will not only help in reducing carbon footprint but also help in mitigating energy requirements and in turn promote economic development. The possibility of wind energy becoming a cornerstone for meeting the country's future energy requirements are significantly high. India can become a world leader in the development of wind energy technologies by overcoming policy, regulatory, technical, financing and implementation barriers.

1.3 Wind Sector in India

India's wind power sector has progressed significantly in the past decade. Out of the total RE installed capacity of 43,086 MW⁷ in India, wind energy contributes 62% with an installed capacity of about 26,867 MW as on April 2016. Other RE technologies like solar contributes 16%, small hydro contributes about 10% and biomass contributes about 11% of the total RE share.

Figure 2: Breakup of RE Installed Capacity in India (up to April 2016)



Source: MNRE

The growth of wind power sector in India can be grouped into the following phases:

- Phase-I: Before FY 1994-95 (prior to initiation of structured policy program of the Ministry of New and Renewable Energy [MNRE]).

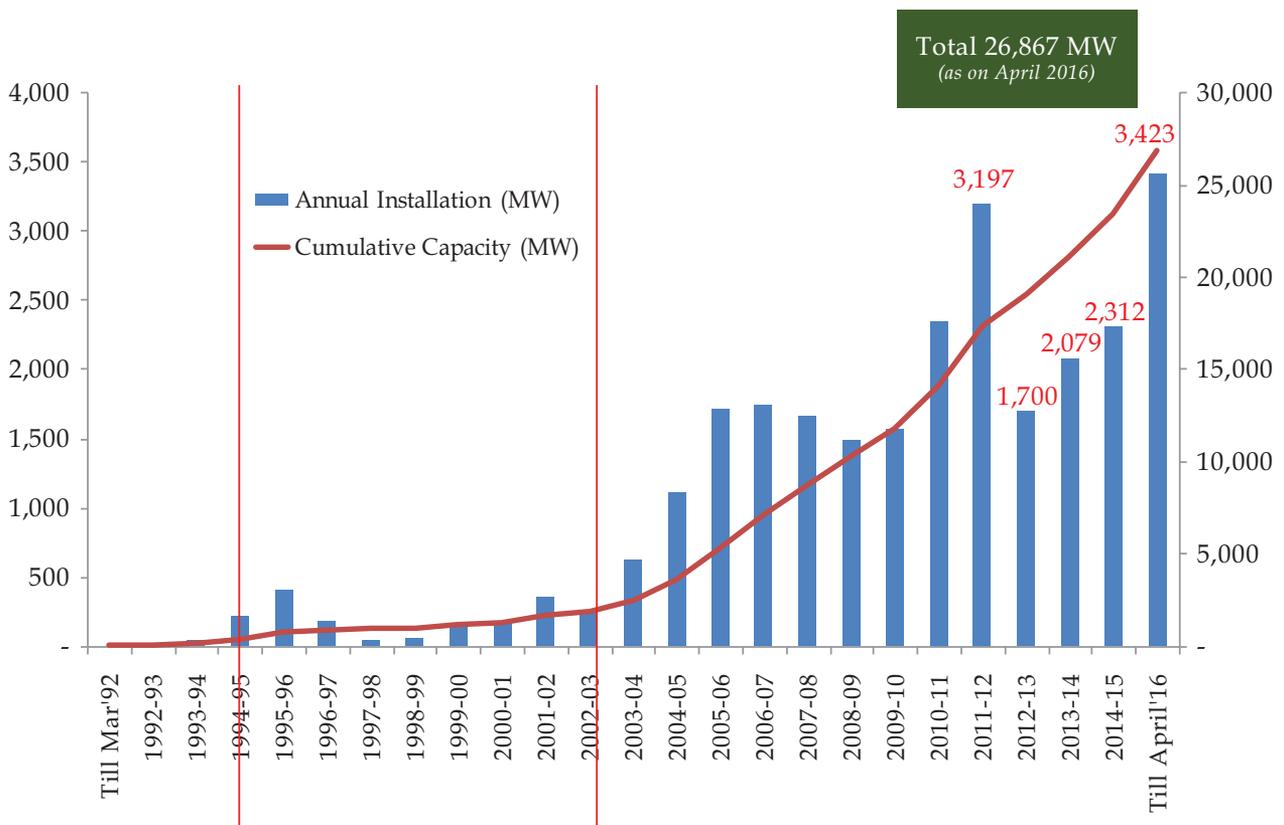
⁷ Ministry of New and Renewable Energy Website April 2016.



- b) Phase-II: Between FY 1994-95 and FY 2002-03 (with MNRE’s policy programme and prior to the Electricity Act [EA, 2003]).
- c) Phase-III: After FY 2002-03 (post-enactment of EA 2003).

The wind sector in India got the much deserved boost in 2003, with the enactment of Electricity Act, 2003. This was followed by introduction of several conducive policy and regulatory initiatives such as National Tariff Policy (TP), Feed in Tariff (FIT) regime, Renewable Purchase Obligations (RPO), Renewable Energy Certificate (REC) mechanism and Accelerated Depreciation (AD) benefits, introduction of Generation Based Incentive (GBI), which resulted in the sector witnessing impressive annual growth of around 30% per annum. The annual capacity addition reached its peak at 3.3 GW in FY 2015-16.

Figure 3: Development of Wind Power



Source: MNRE

To understand various market segments for wind power, it is critical to assess exploitable wind potential in India. The NIWE has recently estimated total onshore wind potential as 302 GW⁸ at 100 meter hub height. Most of the recent studies in wind sector have focussed on the utility scale onshore market assessment, which is well established in India.

1.4 Need for Wind Vision 2032

The Government of India (GoI) has started many ambitious initiatives, including 24x7 Power for All, Make-in-India, Digital India and 100 Smart Cities, besides boosting overall infrastructure development. One of the initiatives is 175 GW of RE by 2022, including 100 GW of solar and 60 GW

⁸ NIWE, September 2015.

of wind capacity. Further, India aims to reduce emissions intensity of its GDP by 33%–35% by 2030 compared to 2005 levels, and generate 40% of the electricity through non-fossil fuel sources as part of its Nationally Determined Contributions (NDCs).

Presently, contributing the largest share (62%) of the country's total RE capacity, wind sector would continue to play a significant role in the NDC's target to achieve 40% of installed capacity from non-fossil fuel sources by 2030. Further, considering a massive untapped potential for wind in India and in order to achieve government targets of 60 GW by 2022, there is an urgent need for a renewed vision to re-ignite growth in the wind sector.

In view of this, **Shakti Sustainable Energy Foundation** initiated a process of – “**Evolving Consensus on Thematic Issues in Wind Sector through Stakeholder Engagement**”, and engaged **Idam Infrastructure Advisory Private Limited** for executing the process. This initiative is an effort to establish a broad-based platform for evolving consensus around solutions that can potentially mitigate the issues impeding the development of wind energy sector in India. This platform – called the Wind Discussion Forum – provided for open discussions and deliberations amongst various stakeholders to evolve development and policy approaches that are acceptable to all as well as practically implementable. These discussions were supported by independent research.

It was proposed to form an Advisory Group, comprising heads of various wind industry associations, regulatory, policy and technology experts to provide continuous guidance to the research team.

The purpose of “**Wind Vision 2032**” is to recommend alternate development strategies to policy makers, planners and implementing agencies to boost investments in the sector. The ‘Wind Vision 2032’ has been envisaged after analyzing key aspects such as grid integration, financing and incentives, power procurement, project development and policy and regulatory support.

1.5 Wind Vision Target of 200 GW by 2032

The primary goal of the initiative was to gain insights into wind power development process, develop future scenarios for wind energy and estimate a target for wind sector that is ambitious and visionary, yet achievable with coordinated efforts. Wind Vision has been conceived by bringing together stakeholders in the wind sector and collecting ideas to address the issues facing the sector.

1.5.1 Setting 200 GW Target

Creating a collective “Vision” is a significant task. The Vision has to be ambitious enough that it cannot be achieved easily but at the same time realistic enough, so that the pathway to achieve that vision can be identified and defined. Following was the approach adopted for estimating the wind target:

- a) Define target year.
- b) Identify annual electricity requirement based on 18th Electric Power Survey (EPS) of India.
- c) Develop renewable energy contribution trajectory based on National Action Plan on Climate Change (NAPCC) targets.
- d) Identify wind generation requirement.
- e) Calculate equivalent capacity based on generation requirement and set it as a target.



Table 1: Deriving Wind Vision Target of 200 GW by 2032

Particulars	12 th FYP (FY 2016-17)	13 th FYP (FY 2021-22)	14 th FYP (FY 2026-27)	15 th FYP (FY 2031-32)
Projected electricity requirement per annum (@ power station bus bars) based on 18 th EPS (billion units)	1,355	1,905	2,710	3,710
RE contribution based on NAPCC targets (%)	12%	17%	22%	27%
RE generation requirement (billion units)	163	324	596	1,002
Wind generation requirement in billion units (BUs) (assuming 40% of total RE requirement)	65	130	238	401
Cumulative wind installed capacity required in GW (assuming average capacity utilisation factor [CUF] of 23%)	32	64	118	199 (approx. 200 GW)

Source: Idam Infra Analysis

1.6 Benefits Envisaged From Proposed Target

The proposed Wind Vision 2032 is expected to accrue several benefits to energy sector in India, in particular, and Indian economy in general. Considering the life cycle of a wind project as 20 years, the total benefits of 200 GW have been quantified till 2032 and beyond. This is calculated at an interval of five years (in line with FYP) and cumulative benefit in each FYP are added to arrive at the total benefit at the end of the lifecycle of 200 GW wind generation capacity.

1.6.1 Emission Reduction

Considering the last five years' average emission factor (0.79 tCO₂/MWh) specified by the CEA, the GHG emission reduction potential over the useful life works out to 7,771 million metric ton of Carbon Dioxide equivalent (CO₂ e) by FY 2051-52.

1.6.2 Job Creation

Significant job opportunities will be available in the wind sector with 200 GW of installed capacity by 2032. In accordance with the Human Resource Development 2010 Report of MNRE, which envisage creation of around four direct and indirect jobs per MW in the wind sector. Considering the above, the total potential for job creation through Wind Vision 2032 is estimated to be around 7.5 - 8 lakh.

1.6.3 Import Bill Reduction

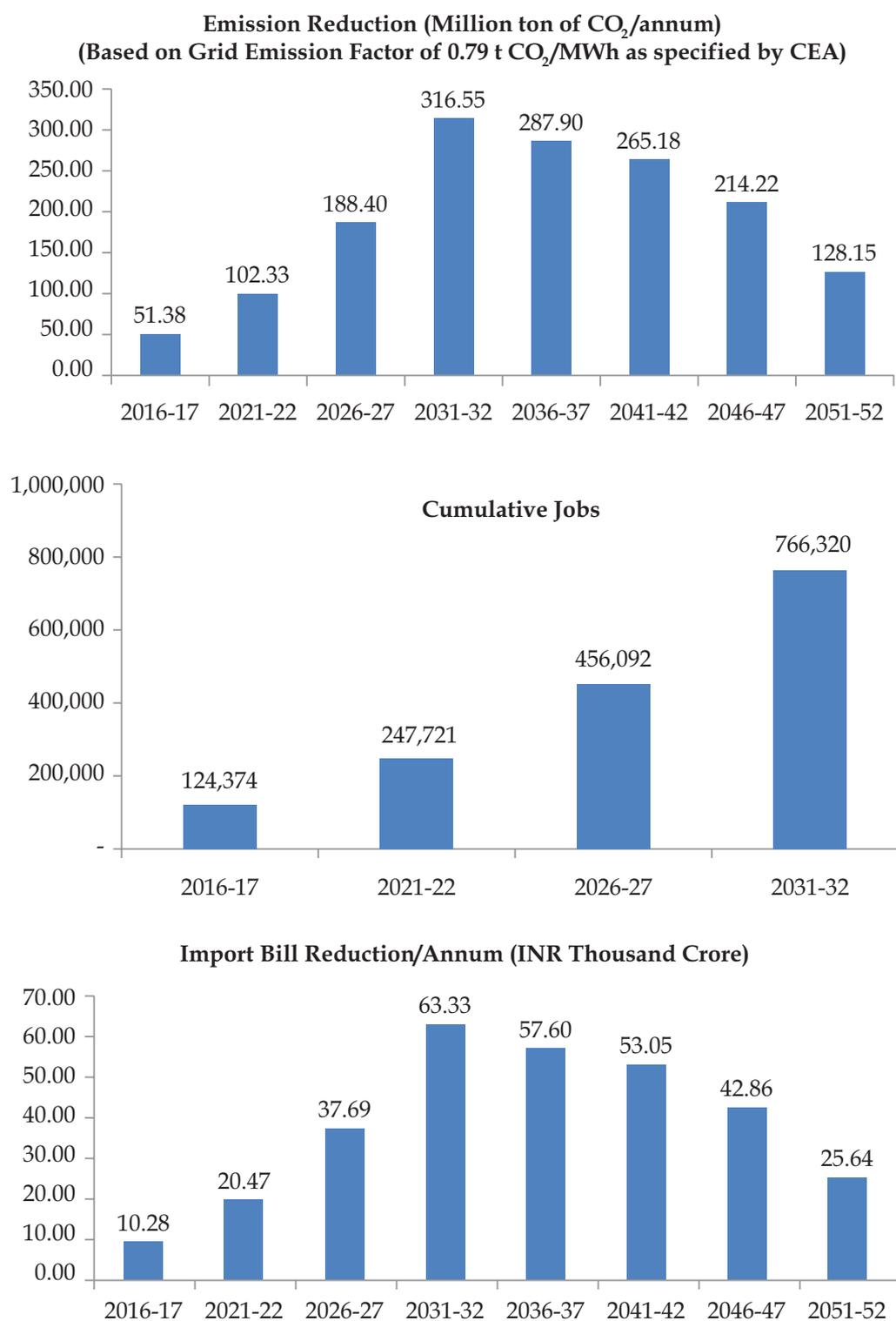
Considering the normative figures as shown in the following table, the fuel cost for power generation from imported coal, works as below.

Table 2: Assumptions for Computation of Coal Import Bill

Heat Rate	kcal/kWh	2,171.51
Cal Value of Imported Coal	kcal/kg	5,500.00
Coal Consumption	kg/kWh	0.39
Global Coal Price (20 Years Average)	USD/Ton	61.58
USD-INR Exchange Rate	INR/USD	65.00
Landed Price of Imported Coal	INR/kg	4.00
Fuel Price	INR/kWh	1.58

If the imported coal based power generation is replaced by wind power, the cumulative import reduction potential over the useful life of wind project is thus estimated at around INR 15.5 lakh crore. The summary of these benefits are shown in Figure 4.

Figure 4: Summary of Benefits From Wind Vision 2032



1.7 Segment Wise Targets

As the approach for the development of each segment of wind energy can be different, it is apt to segregate wind targets for onshore wind capacity addition and offshore wind capacity. Table 3 summarises the segment wise cumulative targets.



Table 3: Segment Wise Cumulative Targets (in GW)

Particulars	12 th FYP (FY 2016-17)	13 th FYP (FY 2021-22)	14 th FYP (FY 2026-27)	15 th FYP (FY 2031-32)
Wind Vision Target	32	64	118	200
Offshore Wind (10% of Wind Vision)		6	12	20
Small Wind				0.10
Repowering	1	4	9	20
Onshore Capacity	31	54	97	160

Source: Idam Infra Analysis

1.7.1 Offshore Wind

Offshore winds are stronger and more consistent. However, considering the huge capital cost, offshore wind energy development is still an unexplored territory in India. LBNL estimates total offshore developable potential in India of about 238 GW at 100 meter hub-height and with a minimum capacity factor of 21%. Around, 78% of the developable offshore potential is available at depths less than 30 meters. **Considering the huge capital cost of offshore wind power, a target of 10% of total Wind Vision 2032 (i.e., 20 GW) has been proposed to be contributed from the offshore wind segment in the overall Wind Vision of 200 GW.**

1.7.2 Small Wind

The largest market potential for small wind turbine lies in catering to energy requirements of 75 million households which still do not have access to electricity. India has made little progress in the small wind turbine space with current installed capacity of only 2.69 MW as on April 30, 2016. However, considering huge market potential without any access to electricity, small wind turbines including hybrid system can play an important role in improving energy access. An approximation of one million rural homes with the potential to install a small wind turbine with a 1-2 kW machine, leads to a total potential to renewable energy resources through small wind turbines to 1,000 MW or 1 GW. **Considering a conservative estimate of 10% of the potential, a target of 100 MW (0.1 GW) has been proposed for small wind turbines by FY 2031-32.**

1.7.3 Repowering

It is suggested that a comprehensive repowering policy should be developed to target repowering of old wind turbines, focussing on old low capacity turbines which have completed 15 years of operation. Based on the year on year capacity addition till now and projected for future, the repowering potential target has been derived with 15 years age criteria. It is estimated that, the incremental increase in wind installed capacity due to repowering will **contribute around 20 GW by FY 2031-32 to the overall 200 GW target.**

1.7.4 Onshore Large Wind Turbines

Onshore wind, which is the predominant contributor to the present wind capacity, has been identified to contribute the balance capacity addition target to meet the Wind Vision of 200 GW by 2032. It is estimated that the onshore wind capacity installation, excluding small wind turbine and repowering will **contribute around 160 GW by FY 2031-32 to the overall 200 GW target.**

2 Regulatory, Policy and Tax Incentive

Wind, being the largest contributor to the country's renewable energy sector, owes its growth to conducive policy measures and incentives by governments. With the recently announced aggressive RE targets of 175 GW by 2022 by GoI, appropriate policy, regulatory, financing and statutory frameworks would play a key role. In order to catalyse an exponential growth in annual capacity addition, planned and collaborative efforts would be required.

2.1 Legal and Regulatory Framework

Enactments prior to the EA 2003 had no specific provisions that will promote renewable or non-conventional sources of energy. The introduction of EA 2003 and subsequent notification of National Electricity Policy (NEP) and Tariff Policy (TP) radically changed legal and regulatory framework for the renewable energy sector.

2.1.1 Electricity Act, 2003

The EA 2003 provides for policy formulation by the GoI and mandates State Electricity Regulatory Commissions (SERCs) to take steps to promote RE sources of energy within their area of jurisdiction. Section 3 of EA 2003 mandates that formulation of NEP, NTP and Transmission Plan, thereof for the development of power systems shall be based on the optimal utilisation of all resources including RE. Section 61 of the EA 2003 provides the power of tariff determination to the Appropriate Commission, which inter-alia, shall be guided by promotion of RE sources. Section 86(1)(e) of EA 2003 requires SERCs to promote harnessing of RE sources by specifying minimum percentage for procurement from RE sources and also by providing suitable measures for connectivity to grid for such sources.

2.1.2 National Electricity Policy (NEP) and Tariff Policy (TP)

Clause 5.12 of the NEP stipulates several conditions with respect to promotion and harnessing of renewable energy sources. NEP emphasises the need for reduction of capital cost of RE projects and promotional measures be taken for the development and sustained growth of RE technologies. NEP also underlines the provisions of EA 2003, wherein SERCs have been bestowed upon the responsibilities of determination of RPOs and FITs.

Tariff Policy elaborates the role of Regulatory Commissions, the mechanism for promoting use of RE, time for implementation, etc. In the recently introduced key amendments in the Tariff Policy, GoI has substantially increased solar RPO to 8% in energy terms by March 2022 and also exempted inter-state transmission charges and losses for wind and solar.

2.1.3 National Action Plan on Climate Change (NAPCC)

Comprising of eight core "national missions" running through 2017, NAPCC aimed at bringing better planning, management and developmental strategies and cleaner technologies. The key RE related provisions of NAPCC was setting the national RE purchase standard target or RPO of 15% by 2020, with SERCs free to set higher targets. The 18th EPS, prepared by CEA, estimate the electricity demand in 2020 at 1,700 BUs which, if the NAPCC target is to be achieved, creates RE requirement of 255 BUs. For achieving this, more than 17,000 MW per annum [assuming a capacity utilisation factor (CUF) of 24%] of RE capacity would required to be added during FY 2015-16 to FY 2019-20. Wind being the dominant contributor to RE portfolio, is expected to contribute a significant share of the total RE capacity addition requirement.



2.1.4 Nationally Determined Contribution (NDC)

At COP 21 in Paris, Parties to the UNFCCC reached a historic agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. On October 2, 2015, India declared its NDC for the period 2021 to 2030. Inter-alia, the NDC declared by India has intended to reduce the emissions intensity of its GDP by 33% to 35% by 2030 from 2005 level and also achieve about 40% cumulative electric power installed capacity from RE sources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF). It also includes creation of an additional carbon sink of 2.5 to 3 billion tons of CO₂ equivalent through an additional forest and tree cover by 2030. The Paris Agreement was opened for signature at the United Nations Headquarters in New York on April 22, 2016 and will remain open until April 21, 2017.

2.1.5 Draft RE Act and Proposed Amendments in Electricity Act 2003

With a purpose to promote and increase the proportion of energy generation through RE sources, MNRE, GoI, has come up with a Draft RE Act.

In order to accelerate the development of RE sources, a number of measures have been included in the Electricity Act Amendment Bill, consisting of the provision for a separate National RE Policy, Renewable Generation Obligation (RGO) on coal and lignite based thermal power plants, specific exemptions to renewable energy sources from open access surcharge, separate penal provisions for non-compliance of RPO.

2.2 Regulatory Incentives

Regulatory incentives are provided by the Central or State Electricity Regulatory Commissions under the powers enshrined under EA 2003 and/or Regulatory Framework and Tariff Policy. Regulatory incentives have been instrumental in the development of wind energy in India. These incentives are key to the viability of the project, as they are available for long term and in many cases associated with the project for the entire life cycle.

2.2.1 Feed in Tariff (FIT)/Preferential Tariff

FIT are the most prevalent incentive structure adopted world-wide for accelerating RE deployment. It accounts for a larger share of RE deployment as compared to any other incentive of policy measures. FIT or Preferential Tariff system is an incentive to the RE generator, offering guaranteed fixed price applicable for a given period of time, determined by a regulator, which is usually higher than the cost of power from conventional sources. This mechanism helps to overcome the higher upfront capital costs of many RE technologies.

2.2.1.1 State-Wise Wind FIT

Though the initial FIT orders were issued under the Electricity Regulatory Commissions Act, 1998, for e.g., in Maharashtra, the country-wide implementation of FIT mechanism gathered momentum only after the enactment of the EA, 2003. Section 61 (h) prescribes the philosophy to be followed by SERCs while determining tariffs and Section 86(1) (e) prescribes promotion of RE as one of the functions of SERCs. Further, the Tariff Policy has introduced specific provision for determination of FIT for RE sources by the Appropriate Commission.

2.2.1.2 Uniform FIT Mechanism Across States

There have been growing concerns among wind stakeholders regarding huge variation between wind FIT approved by SERCs across the states and wind FIT determined by Central Electricity Regulatory Commission (CERC). Since CUF is the only factor which significantly varies across the sites, other financial parameters including capital cost, return on equity and cost of loan and so on should remain same irrespective of the state. Hence, there is an urgent need for consistency in the tariff determination process across all the SERCs.

a) Indexation Mechanism for Capital Cost

CERC under its RE Tariff Regulation specifies norms for tariff determination while considering the risks associated with wind projects. CERC also provides a provision for annual revision in capital cost based on the indexation mechanism to account for price escalation. However, all SERCs are not following the CERC tariff regulation. Some states have preferential tariffs for wind that are only marginally higher than the normal power costs.

b) Principle for Computation of Levelized Tariff

CERC specify that tariff has to be levelized over the useful life of the project by taking into consideration discount rate equal to post tax weighted average cost of capital. However, some SERCs, for e.g., Tamil Nadu Electricity Regulatory Commission (TNERC), while approving FIT for wind projects do not take into account impact of time value of money and therefore computed tariff on average basis rather than levelizing it over useful life.

It is recommended that specific guidelines should be issued for the determination of FIT across states, especially for indexation of capital costs and determination of levelized tariff.

2.2.1.3 Zone-Wise Tariff for Wind Power

The varying wind regimes prevalent in the state leading to diversity in CUF need to be factored in while specifying the norm for CUF. However, the CUF norm set by the SERCs doesn't take into account the site specific parameters as single CUF norms has been specified for projects to be installed at different sites in the state. It not only leads to under development of projects on low wind regions but also adversely impacts returns for the project developer. Wind potential assessment studies should be carried out in every two-three years and wind zones should be identified based on the scientific method by every state. The SERCs should determine FIT for different zones and classify the projects in each zone based on the actual generation from the wind project.

2.2.2 Renewable Purchase Obligation (RPO) Mechanism

Section 86 (1) (e) of the EA 2003, empowers the SERCs to determine RPO, is probably the most important Section in the Act from RE perspective, read as follows:

"Promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of total consumption of electricity in the area of distribution licensee."

Various states have issued RPO orders or regulations specifying percentage for mandatory RE procurement obligation for RE. Moreover, most SERCs define separate RPO targets for obligated entities for purchase from solar and non-solar RE sources. Therefore, purchase of power from wind power constitutes toward fulfilling the non-solar RPO targets of the obligated entities.



In January 2016, the Union Government has amended the National Tariff Policy for Electricity, which focuses on RE and sourcing of power through competitive bidding (CB). According to one of the amendments, to promote renewable energy, it is proposed to increase solar RPO to 8% of the total energy consumption by 2022. For the purpose of computing solar RPO, power sourced from hydro power plants shall not be considered.

2.2.2.1 Analysis of Non-Solar RPO

As per the 18th EPS, total energy requirement in FY 2015-16 is around 12.50 lakh MUs across the country. Considering the respective state-wise non-solar RPO targets, the total non-solar energy requirement works out to be 0.81 lakh MUs, which at 20% average CUF translates to approx. 46 GW installed capacity requirement from non-solar sources. With the existing total grid-connected RE installed capacity in the country as on April 30, 2016, at 43 GW, there is already a wide gap even at the existing RPO levels, which are much lower than NAPCC targets. Based on the 18th EPS trend, the total energy requirement would reach around 16.60 lakh MUs in FY 2019-20. Assuming 20% average CUF and 10% RE target in line with NAPCC targets, the total RE capacity requirement for meeting RPO will be approx. 95 GW.

2.2.2.2 RPO Compliance

In the past, the unequivocal legal provisions regarding RPO led to deficiency of an equally stringent compliance monitoring on the part of SERCs. In many states, RPO targets were waived, reduced, carried forward by the SERCs. However, the scenario started changing slowly but surely with the recent stern orders from various SERCs. Further, the Hon'ble Supreme Court in its Judgment dated May 13, 2015 has upheld the RPO regulations of the Rajasthan Electricity Regulatory Commission, whereby it is held that the Commission is right in treating open access (OA) and captive consumers as obligated entities under the RPO framework and thus the RPO targets shall apply to them. Considering these developments, there is a revived hope in the industry about RPO mechanism getting implemented of in its true spirit.

2.2.2.3 Challenges and Recommendations on RPO Compliance

The main challenges and recommendations in RPO compliance are summarised as under:

Table 4: RPO Compliance – Challenges and Recommendations

Challenges	Recommendations
RPO Compliance Monitoring and Enforcement	
<ul style="list-style-type: none"> No uniform RPO monitoring and enforcement (M&E) mechanism in place. Ambiguity around operationalizing penalty for non-compliance of RPOs for Captive Power Plant (CPP)/Open Access (OA) consumers. Monitoring/Reporting framework for compliance of RPO regulations is inadequate. Carry forward of RPO is not helping and making Obligated Entities non-serious for RPO compliance. 	<ul style="list-style-type: none"> Forum of Regulators (FOR) in consultation with MNRE should formulate guidelines for RPO M&E. Amendments to EA 2003 to address the following: <ul style="list-style-type: none"> Stringent penal provisions to ensure compliance of RPO. RECs to be recognised as statutory instrument rather than regulatory instrument. Enable RPO applicability on open access and captive user.
RPO Enforcement on CPP/OA	
No framework for collection and verification of RPO compliance data from CPP/OA consumers.	FOR should formulate model framework for RPO compliance reporting from CPP and OA consumers.



Recently, India through its NDC, has committed for the reduction in carbon emissions intensity by 33% to 35% by 2030 from 2005 level. Large scale RE deployment will be key to achieve this target, as also indicated by GoI vide its RE target of 175 GW by 2022. These targets are further been segregated into technologies and states duly taking into account the RE potential. However, there is a lack of mechanisms to translate these national level targets to state level targets, binding on SERCs, which are guided by provisions of Section 86(1)(e) of EA, 2003 only. There is an urgent need of amending the NEP in consultation with state governments to make the targets identified under NAPCC or 175 GW by 2022 as targets under EA 2003. FoR may be further empowered to develop and implement a methodology to further devolve this target to the respective SERCs.

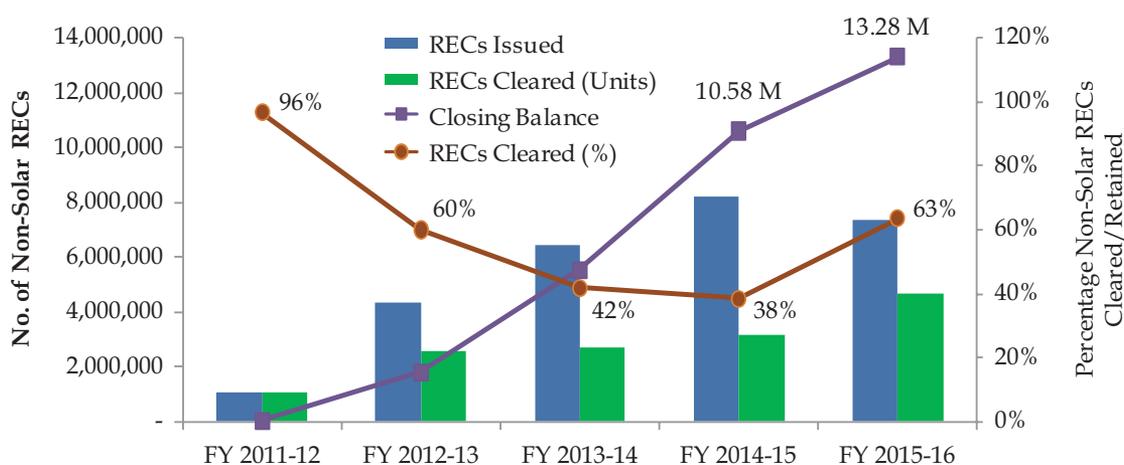
2.2.3 Renewable Energy Certificate (REC) Mechanism

RE sources are not evenly spread across different parts of the country. In some of the states with high RE potential, there are avenues for harnessing the RE sources beyond the RPO level fixed by the SERCs. However, the relative higher cost of generation from RE sources, as compared to the prevailing average power purchase cost, discourages the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the SERCs. States with low RE potential continue to keep their RPO target at lower level. To address this mismatch between the availability of RE sources and the requirement of the obligated entities to meet their RPO, REC mechanism was introduced by CERC in January, 2010.

2.2.3.1 Non-Solar REC Market

Out of the total installed RE capacity of 43,086 MW till April 30, 2016, only 4,856 MW has been registered under REC mechanism. Lack of strict RPO compliance mechanism has been resulting in a continuous decreasing trend in both the number of projects as well as the capacity registration for REC mechanism in the non-solar projects. The impact of lack of RPO compliance is also clearly reflected in the poor off-take of RECs in the exchange market. Since the last three years, non-solar RECs are being consistently traded at the floor price only. Even then, the annual clearance through power exchanges or retention continuously decreased till FY 2014-15, only to slightly increase to 64% in FY 2015-16. Presently, 13.54 million non-solar REC, amounting to INR 2,031.97 crore (at floor price) remained unsold as on May 31, 2016. There is a need for multi-pronged strategy to resurrect the REC mechanism from the present situation. While RPO compliance needs to be strengthened, on the other end, CERC has also been taking corrective steps from the learning of REC market, including reduction in floor and forbearance price, introduction of vintage multiplier, etc.

Figure 5: Non-Solar REC Market



Source: Idam Analysis



Further, amendments are proposed for making open access projects availing concessional wheeling, banking or cross-subsidy benefits and CPP generators for self consumption portion, ineligible for RECs.

2.2.3.2 Issues and Recommendations

Besides the above amendments, few more REC related and corresponding recommendations are summarised as under

Table 5: REC Mechanism – Recommendations

Issue	Current Status	Recommendations
Bankability of REC Mechanism	<ol style="list-style-type: none"> Trading of RECs is restricted to CERC approved Power Exchanges. Lack of bilateral trade also hinders the ability of Discoms to enter into long term purchase transactions. 	<ol style="list-style-type: none"> Generators should be allowed to securitize RECs in favour of lenders, which is necessary to raise money for new projects. Bilateral transactions of RECs should be encouraged.
Long Term Visibility of Floor and Forbearance Price	<ol style="list-style-type: none"> CERC has addressed concern of regulatory certainty by specifying floor and forbearance price for five years (2012-17) only. 	<ol style="list-style-type: none"> Visibility to cover at least debt service period is desirable. CERC may specify continuation of floor and forbearance for 10 to 20 years in principle, but values to be fixed periodically, say every five years.
Multiple Trading of RE Certificates	<p>As soon as the transaction takes place at the power exchange, RECs are redeemed:</p> <ol style="list-style-type: none"> No role for intermediaries or market makers. Banks/Lenders cannot acquire and then sell RECs. 	<ol style="list-style-type: none"> Multiple trading should be permitted. Trading frequency should be enhanced from monthly to fortnightly/weekly. Mandatory registration of traders with the REC Registry.
Average Pooled Purchase Cost (APPC) Determination - Uniformity at State Level	<ol style="list-style-type: none"> Different approach for determination of APPC and different time of notification in different states. 	<ol style="list-style-type: none"> Consistent approach for determination of APPC and timely notification of APPC by SERCs is desired. Standard Contracting Arrangement for power procurement by Discoms under REC mechanism. Conducive framework for captive/open access models participating in REC.
RPO Trajectory and Compliance	<ol style="list-style-type: none"> Very few states have RPO trajectory beyond 2016-17. Yearly RPO compliance monitoring and reporting. Despite applicability of RPO targets for captive/open access users, its compliance status is not known in many states. 	<ol style="list-style-type: none"> Improved frequency (monthly/quarterly) for RPO compliance monitoring and reporting is necessary prior to ensuring enforcement for non-compliance. Long term RPO trajectory should be announced across states. GoI's initiative of 175 GW by 2022 to be backed by a comprehensive state-wise revision of indicative RPO trajectory.

Contd...

Issue	Current Status	Recommendations
Action by State Nodal Agencies (SNAs) for RPO Compliance	Few state agencies have taken certain steps for RPO enforcement in the state.	<ol style="list-style-type: none"> 1. Heavy penalty enforcement on non-compliance of RPO by OE. 2. RPO compliance awareness by SNAs-Formats, list of OE on their website, periodic notices to OE and so on.
Other Measures		<ol style="list-style-type: none"> 1. Voluntary markets for RECs from non-OE to be promoted with appropriate incentives and policy measures. 2. Voluntary purchase of RECs to be recognised as CSR activity.

2.2.4 Open Access (OA) Transactions in RE

Open Access arrangements are not per se covered under “Incentives”, rather, these are special dispensation provided by the Regulators. There is no direct measurable financial impact on the Discoms, though indirectly the burden is “socialised,” i.e., shifted on the broader consumer base of the Discoms only. In order to promote OA transactions from RE sources, which often have lower plant load factors than those of conventional power plants; various SERCs have issued favourable OA regulations and tariff orders.

2.2.4.1 Transmission and Wheeling Losses and Charges

The financial viability of an OA transaction depends upon the landed cost of power at the delivery point of the OA consumer, as compared to the energy (variable) charges being payable to the incumbent distribution licensee. It is pertinent to note that in majority of the states, the long term transmission charges are not in INR per unit terms. This result in an unfavourable transmission charge component in case of RE open access, as the PLF/CUF of wind and other RE technologies, is lower as compared to PLF of conventional generation technologies. Therefore, it is argued that long term transmission charges for RE open access should be levied on INR per unit basis, which is being followed in some states like Maharashtra. Further, OA transactions also attract cross-subsidy surcharge (CSS), which is exempt in case of captive transactions, even in case of conventional sources. For third-party open access sale, CSS remains applicable, which in most of the cases, are very high. Further, proposed amendment in EA, 2003 provides for universal exemption from CSS for RE open access.

2.2.4.2 Current Open Access Regime

In majority of the states, model for third-party sale of power from wind projects through intra-state open access framework is not conducive to competitive procurement due to high open access charges applicable to the open access/ third-party wheeling transactions. Similarly, open access is not granted or delayed by the utilities in some states. Wind projects have lower CUF, which translates into higher per unit wheeling charges under the open access model. The issues in inter-state, third-party OA model or group captive model are summarised below:

- a) Delays in granting OA permissions.
- b) Low MW size of transactions makes accounting difficult.
- c) Management of Unscheduled Interchange (UI) charges – Provision of scheduling.
- d) High cost of transmission and wheeling in case of RE transactions.
- e) No uniformity on provisions for group captive/third-party sale; CSS, scheduling requirements, banking and treatment of excess power/unbanked power.
- f) No uniform approach for demand-charge waiver/set off for captive capacities.



2.2.4.3 Recommendations

- a) Need for national level consensus building on open access regime for RE/wind related Transactions – Captive and third-party sale.
- b) Promotion of inter-state RE/wind power sale through introduction of national/regional level RE/wind open access framework.

2.2.5 Provisions for Banking

Reasonable banking provisions are imperative due to variable nature of wind sources. Unavailability of banking or unrealistic provisions may completely negate the entire open access prospect from the wind resource point of view, even with the best possible tariffs and open access losses and charges. Unfavourable banking provisions often prove to be “**Non-Tariff Barriers/Hurdles**” for open access transactions, especially for RE sources. It is completely reasonable for the SERCs to consider the state specific characteristics including RE potential, type of OA transactions, i.e., captive or third-party, REC or non-REC, seasonal demand curve, overall power situation, prevailing consumer mix, tariff regime, etc., while drafting banking and energy accounting related provisions. However, following are the indicative features, which are imperative for the feasibility of RE related open access transaction.

Table 6: Recommended Provisions for Banking of RE Power

Particulars	Recommended Banking Provisions
Permission for Banking	<p>Permission for banking should be for all type of RE open access transaction – whether captive or third-party; whether with REC or without REC.</p> <p>There may be some reasonable variation, for the sake of providing a level playing field in-between the type of RE open access transaction. For e.g., a captive OA or a RE source which should have lesser favourable provisions as compared to third-party or RE source without REC.</p>
Banking Period	<p>Banking period should be either on monthly or annual basis.</p> <p>Seasonal restriction should be avoided.</p>
Time Block Duration of Energy Credit	<p>Energy credit should not be other than Time of Day (ToD) block applicable for Tariff. There shouldn't be any peak hour or seasonal restriction on withdrawal. Condition of 15 minute time block is literally “No Banking.”</p>
Conditions of Settlement of Surplus Energy	<p>Surplus energy should not be lapsed and should be deemed to be purchased by the distribution licensee.</p> <p>The applicable rate should be reasonable, i.e., in case entire energy is accounted for – not less than APPC.</p> <p>In case some percentage of energy is considered to be lapsed, than applicable rate should not be lower than FIT. Further, the said percentage should be within reasonable limits, i.e., 10%-20% of the surplus energy.</p>
Banking Charges	<p>Banking charges should either be completely exempt or very minimal in terms of percentage or INR per unit.</p> <p>Banking charges should be certain and clear upfront and shouldn't be dependent upon variable factors like, APPC, time of usage, consumer category, etc.</p>

2.3 Fiscal and Tax Incentives

Incentives in category are provided by the central or state governments vide policy measures or their respective annual budgets (finance bills). These incentives are instrumental in making the investment decision by the project developers as in most of the cases the benefits of these incentives are available to the investor in the early stages of the project operation only, thereby hugely influencing the return on the project.

2.3.1 Generation Based Incentives (GBI)

GBI is a direct subsidy paid over and above the tariff, for each unit of generation being fed into the grid. GBI was first introduced in December 2009, by GoI, with Indian Renewable Energy Development Agency (IREDA) as the nodal agency, with the objective of broadening investor base by facilitating entry of independent power producers (IPPs) and attracting Foreign Direct Investment (FDI) in the wind power sector. GBI also incentivised higher efficiencies, by encouraging actual energy generation rather than capacity addition only, resulting in optimum utilisation of wind resource. The original GBI scheme was valid only till the end of 11th five year plan. Thus, it was discontinued for a while. GBI was reintroduced in FY 2013-14, with retrospective effect from April 2012, targeting a much larger capacity installation.

2.3.2 Accelerated Depreciation (AD)

AD is a fiscal mechanism that speeds up the depreciation in value of wind projects in the financial year after commissioning of a project and thus reduces tax liability by a significant amount. Introduced in the early 1990s, the GoI allowed the producers of RE based power to claim AD up to 80% in the first year on a written down value (WDV) basis under Section 32, Rule 5, of the Income Tax Act, 1961. AD was one of the most significant drivers of additions to RE capacity. However, AD was discontinued in March 2012, lowering the effective depreciation rate from 80% to 15%, resulting in significant drop in the installed capacity of wind, from 3.2 GW in FY 2011-12 to 1.7 GW in FY 2012-13. AD was reintroduced on September 16, 2014 by notification w.e.f. April 01, 2014, restoring the higher depreciation rate of 80%.

2.3.3 Issues and Recommendations

Evidently, AD and GBI are mutually exclusive incentives targeting different set of investors. In order to achieve the 60 GW target by 2022, full-fledged contribution from all sections of potential developers and investors is required. Therefore, it is imperative to continue both AD and GBI for the time being, at least till FY 2021-22.

MNRE has been facing difficulty in timely disbursement of GBI through IREDA, prompting IREDA to devise a loan scheme for stakeholders, against discounting the GBI payable till, funds is made available by the GoI. Ministry of Finance should ensure timely disbursements to IREDA. Further in case of delays, provision of interest should also be implemented.

Presently, the GBI is payable @INR 0.50/kWh with a limit of INR 10 Million/MW over 10 years. As majority of the new wind projects are only coming up in low wind density zones, as high wind density zones have already been exploited, it may be difficult for several generators to avail the entire limit available under the scheme. In view of this, it is suggested to have a provision of higher per unit subsidy (INR 0.80/kWh) for initial four years and INR 0.50/kWh for remaining period without changing the overall limit of INR 10 Million/MW.



2.3.4 Direct Tax

2.3.4.1 Direct Tax Code (DTC)

The present Income Tax Act, 1961, has been amended several times through successive Finance Act, leading to a large and complicated structure. The Finance Minister, during his Budget Speech for FY 2014-15 stated that since most of the provisions of the DTC have already been included in the Income Tax Act, there is no great merit in going ahead with DTC. Further, the GoI has also announced the gradual reduction in the corporate tax rates from 30% currently to 25% over the next four years, effective from FY 2016-17, with simultaneous withdrawal of various tax exemptions. Therefore, it is not clear, whether the income tax holidays currently enjoyed by various RE projects will be continued. If withdrawn, the return on investments, mainly on the capital intensive RE sources is bound to be affected adversely.

2.3.4.2 Recommendation on Tax Holiday—Section 80-IA

Under Section 80-IA of the Income Tax Act, wind project developers are exempted from income tax on all earnings generated from the project for a period of 10 consecutive assessment years during the first 15 years of the project life. The book profit from such undertaking, however, attracts minimum alternate tax @ 18.50% (excluding surcharge and cess) of book profit. The benefit under Section 80-IA is available to all eligible developers, irrespective of the availing AD or GBI. It is recommended to ensure continuance of the existing tax holidays to RE/wind projects.

2.3.5 Indirect Tax

2.3.5.1 Proposed Goods and Services Tax (GST)

The much awaited GST is likely to be implemented sometime in FY 2016-17. GST will be India's far-reaching tax reform aimed at removing the barriers to movement of goods and services across the country by creating a single, unified tax system. This ambitious reform in indirect taxation is meant to abolish all other existing tax structures such as octroi, the central sales tax, state level sales tax, excise duty, service tax, and VAT. Both the central government and the state governments will impose the GST on all goods and services produced domestically or imported. GST is expected to subsume several central and state taxes, with some exceptions.

2.3.5.2 Issues in GST

- a) **Cascading Tax Structure:** Since electricity is not liable to indirect taxes either under the central government or under the state government, indirect taxes levied on the input side drive up the cost of the project. Even after the introduction of GST, the cascaded tax structure is expected to prevail unless electricity duty is considered within the GST.
- b) **Duty Exemptions:** Most investors in RE sector currently avail benefits of duty exemptions on various parts of wind-powered generating sets, solar PV modules, mounting structures, invertors and so on. The proposed GST does not say whether such benefits are likely to be continued. Failing to provide exemption from duty will ultimately result in increasing the capital expenditure and may affect the growth of the renewable industry.
- c) **Negative List of Services:** The negative list of services in place of a positive list of services is expected to impose a greater burden, in the form of service tax, on the power developer.

2.3.5.3 Recommendations

- a) Take appropriate measures to avoid the cascading effect of indirect taxation under the GST regime. Electricity duty should be considered within the GST and a suitable mechanism should be formulated to share the electricity duty portion between the centre and the states.
- b) Extend the exemption from custom and excise duties enjoyed by most RE generators at present to the GST to avoid a steep increase in capital expenditure and in turn, the cost of energy.
- c) Place the services rendered to/by/for the development of RE in India in the negative list.

2.3.5.4 Clean Energy Cess on Coal

India is among the few countries in the world to have introduced a carbon tax in the form of coal cess. This cess on coal which feeds the National Clean Environment Fund (NCEF) increased from INR 100 per tonne in FY 2014-15 to INR 200 per tonne in FY 2015-16. Recently, this cess on coal was increased to INR 400 per tonne in the Union budget for FY 2016-17. The scope of the NCEF has now been expanded to include funding clean environment initiatives.

2.3.5.5 Recommendations

Similar mechanism of carbon finance should be encouraged. The funds collected under such taxation regime may be utilised by MNRE to facilitate subsidies and incentives to the developers.



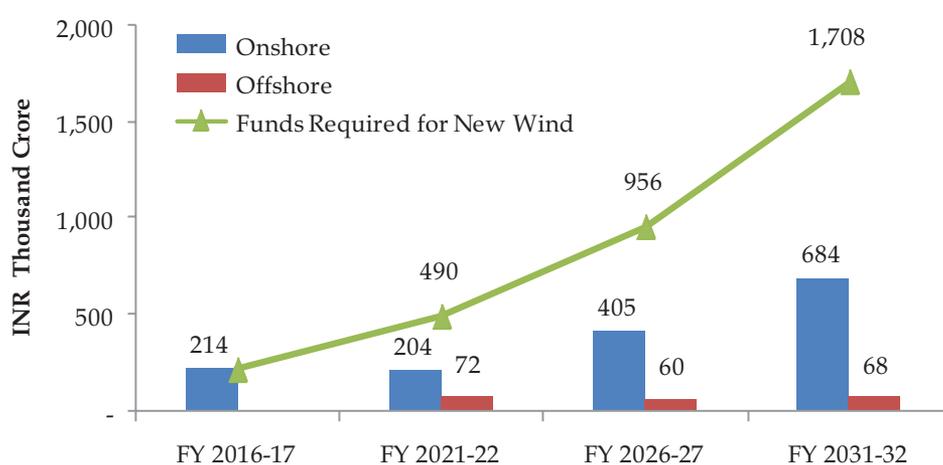
3 Financing Wind Sector

Financing a capital intensive sector such as renewable energy has always been challenging, especially in a developing country like India, where capital is already scarce. With a view to attract sufficient capital for wind project developers in India, appropriate interventions for arranging alternate source of capital is need of the hour. This is required with optimised terms of financing and exploring avenues for promoting monetisation or re-circulation of capital.

3.1 Financing Wind Vision

To achieve the ambitious Wind Vision of 200 GW by FY 2031-32, fund requirement is estimated at INR 1,708 thousand crore as shown in Figure 6.

Figure 6: Funds Required for New Wind



Source: Idam Analysis

The financing requirement is worked out considering the following assumptions:

- Onshore wind capital cost of INR 6.50 crore/MW (with 1.5% annual escalation).
- Offshore wind capital cost assumed to be INR 12 crore/MW, INR 11 crore/MW and INR 10 crore/MW, for FY 2021-22, FY 2026-27 and FY 2031-32 respectively.
- Investment required to achieve the target of INR 1,708 thousand crore by FY 2031-32, translates to INR 107 thousand crore per annum from FY 2016-17.
- Investment of INR 36 thousand crore in the year 2011 is considered as the best case in India which gives an average gap of INR 61 thousand crore per annum, which is well beyond the present capacity of Indian financial market.

Since, funding from public and concessional sources is scarce, an engaged private sector will be needed to make significant investments. Thus, the target can be achieved through public funding supported by the private participation and international support.

3.2 Debt Financing

Wind sector, being a part of power sector, is an important constituent in the overall infrastructure segment of the country's economy. Therefore, all the financing related issues being faced by the infrastructure segment, holds good for the wind financing as well.

3.2.1 Source of Debt Financing

3.2.1.1 Commercial Banks

Infrastructure financing for private sector projects in India has been led by commercial banks. Commercial banks can be classified in two ways – one as rupee loan and foreign currency loan, and the other is public and private banks. These banks are different from each other in terms of their appetite for giving longer tenure rupee loans to wind projects.

3.2.1.2 Infrastructure Finance Companies (IFCs)

IFCs also play a key role in financing renewable energy projects in India. IREDA, Rural Electrification Corporation Limited, IDFC Limited and Power Finance Corporation are some of the IFCs having large credit exposure to the power projects. Many private IFCs like L&T Infrastructure Finance and Tata Capital are more receptive to finance RE projects. These financial institutions raise funds from multilateral agencies like World Bank, Asian Development Bank (ADB) (with sovereign guarantee); issue infrastructure tax-free bonds and explore other sources of low cost financing such as external commercial borrowings (ECBs), etc.

3.2.1.3 Institutional Investors

Multilateral development banks (MDBs)/Bilateral Agencies (BAs) includes World Bank, Asian Development Bank, Japan International Cooperation Agency (JICA), KfW Development Bank, Inter-American Development Bank and the recently announced New Development Bank BRICS. The MDBs and BAs provide financial assistance to developing countries in order to promote economic and social development. They primarily fund large infrastructure and other development projects.

3.2.1.4 Corporate Bonds

Bond market in India is one of the largest in Asia and includes issuances by the government (central and state governments), public sector undertakings, other government bodies, financial institutions, banks and corporates. Despite there being a large number of players, bond issuances are dominated by central and state governments through the issue of government securities. In direct contrast, the corporate bond market is not well developed. Further, corporate bond market is dominated by issues from financial institutions only. Many development finance institutions used to issue infrastructure bonds for retail investors which were made attractive by offering options of tax-free interest or tax saving bonds.

3.2.2 External Borrowings/External Debt

Gross external debt is defined as “the outstanding amount of those actual current, and not contingent, liabilities that require payment(s) of principal and/or interest by the debtor at some point(s) in the future and that are owed to non-residents by residents of an economy.”

3.2.2.1 Multilateral and Bilateral Debt

Multilateral creditors are primarily multilateral institutions such as the International Development Association (IDA), International Bank for Reconstruction and Development (IBRD), ADB, etc. Bilateral creditors are sovereign countries with whom sovereign and non-sovereign entities enter into one-to-one loan arrangements. Some of India’s bilateral creditors include Japan, Germany, United States, France, Netherlands and Russian Federation.



3.2.2.2 Trade Credits/Export Credits

Trade credits/export credits refer to loans and credits extended for imports directly by overseas supplier, bank and financial institution to sovereign and non-sovereign entities. Depending on the source of finance, such credit can be either suppliers' credit or buyers' credit.

- **Suppliers' credit:** Extended by overseas supplier of goods in the form of deferred payments.
- **Buyers' credit:** Provided by a bank or financial institution and is generally governed by consensus terms and carries insurance from export credit agency of the concerned country.

3.2.2.3 External Commercial Borrowings

Commercial borrowing includes loans from commercial banks, other commercial financial institutions, money raised through issue of securitized instruments like bonds (including India Development Bonds [IDBs] and Resurgent India Bonds [RIBs]), Floating Rate Notes (FRN) and so on. It also includes borrowings through Buyers' credit and Suppliers' credit mechanism of the concerned countries - International Finance Corporation, Washington [IFC (W)], Nordic Investment Bank and private sector borrowings from ADB.

3.2.3 Modes of Availing Debt Finance

3.2.3.1 Project Finance

The project finance structure revolves around the creation of the project company that holds all the project's assets, including its contractual rights and obligations. It insulates the sponsor and the holding company from liability to either the project company's contractual counterparties or to the holding company's lenders. Project financing has been used extensively by private power producers for wind projects. In some cases, project finance is the only alternative for RE producers, as they often do not have the assets, track record, or credibility to obtain corporate financing on favourable terms. From the developer's perspective, project financing provides several benefits. First, project finance is generally non-recourse (sometimes limited recourse) to the parent company and, therefore, does not have a substantial impact on their balance sheet or creditworthiness. Second, greater debt capacity associated with project finance can result in reduced financing costs because debt funds are less costly than equity. However, some negative aspects of project finance include high transaction costs associated with arranging the various contracts, high legal fees, higher debt and equity costs, restrictive loan covenants, etc.

3.2.3.2 Corporate Finance

Investor Owned Utilities (IOUs) depend primarily on corporate finance structures, which rely on the attractiveness of a firm's balance sheet and prospective cash flows. Therefore, when IOUs borrow money from public markets, the support for their credit comes from the income stream of their entire asset base (generation, transmission, and distribution) and not from any individual project. Debt and equity investors in IOUs typically require lower returns than investors in individual power projects. This is due to the asset diversity of corporate finance, increased liquidity and information flow associated with public markets, franchise monopoly provided to IOUs, and implicit social contract with regulatory agencies to maintain the existence of firms barring catastrophic events. The benefits associated with IOU corporate finance include, lower interest rate debt, longer debt amortization, lower cost equity and, no project specific debt service coverage requirements.

3.2.3.3 Takeout Financing

Commercial bank funding of infrastructure projects run the risk of asset liability mismatch, which can be addressed by use of “takeout” finance. In this, the bank funding an infrastructure project gets into an arrangement with a financial institution, where the institution commits to buying the bank loan after a certain period.

3.2.4 Other Sources of Funds

3.2.4.1 National Clean Environment Fund (NCEF)

The GoI has set up NCEF to serve as a separate corpus for funding green energy projects with the broader objective of cutting down India’s carbon footprint. Up to FY 2014-15, the GoI has collected INR 16,389 crore as cess on coal through NCEF and the budget estimates expect to further collect an amount of INR 13,118 crore in FY 2015-16.

3.2.4.2 Infrastructure Debt Funds – Non-Banking Finance Company (IDF-NBFC)

IDF-NBFC is designed to facilitate the flow of low cost, long term funds from domestic and global debt investors, to capital intensive infrastructure projects. IDF-NBFCs will provide long term funds to operational infrastructure projects, enabling them to refinance their existing bank loans. An innovative credit enhancement mechanism allows IDF-NBFCs to bridge the gap between the low risk appetite of long term debt investors and the high risk associated with infrastructure projects. To incentivize overseas investments in these funds, government has lowered withholding tax on interest payments by IDF from 20% to 5% and exempted income of IDFs from tax.

3.2.4.3 Green Bonds⁹

Green bonds are fixed-income securities that raise capital exclusively for projects or activities with specific climate or environmental sustainability aim such as renewable energy, waste management and energy efficiency. Capital market financing needs, combined with rising demand from sustainable, responsible and impact investors and the issuance of benchmark-sized deals that are effectively priced, both investment grade and, to a lesser extent, speculative grade, should lift Green Bond issuance over the next few years. As per Moody’s report, the global Green Bond market is expected to exceed USD 40 billion. India is looking to raise these low cost, long-term funds to finance its plan to quadruple its RE production and to make it economically viable. India’s Yes Bank Limited (Baa3 stable) sold the first Green Bond in the country in March 2015, aiming to use proceeds from the 10-year INR 10 billion notes to fund RE projects. Further, Export-Import Bank of India (Baa3 positive) has issued a 5-year USD 500 million bond to finance low-carbon transport, solar and wind projects.

3.2.5 Barriers in Indian Debt Market Financing

Lenders aim to minimise their risk by providing funds to a project guaranteed either by the government or fundamentally strong corporate. Most wind projects fructify into profit making entities 10 to 15 years after the initial investment and hence, require longer tenor financing to ensure financial viability of the project. However, long-term debt is not easily available in India for several reasons, such as under-developed bond market, asset-liability mismatch, limited takeout financing, high financing cost, limited non-recourse financing, non-performing assets (NPAs), poor financial health of Discoms and so on.

⁹ <http://ifcextapps.ifc.org/ifcext/Pressroom/IFCPressRoom.nsf/0/3EEBDBE938EBEF0F85257E96006C578E> Moody’s Report on Environmental Risks and Developments - Green Bonds Start to Bloom



3.2.6 Risks Management Practices

To attract investment or debt financing, project developers should exhibit stable performance driven by healthy risk-management practices. Some of the key risk-management practices being adopted by project developers in India are mentioned as under:

- a) Focus on states with low counterparty risks.
- b) Geographical diversification at special purpose vehicle (SPV) level and at group level.
- c) Longer tenures and innovative debt structuring to partially offset wind variability risks.
- d) Strategies to offset pre-construction risks.
- e) Mitigating design and construction risks by IPPs – by diversified their procurement across various wind turbine equipment manufacturers.

3.2.7 Risks Management Instruments

3.2.7.1 Partial Guarantee

Partial guarantee helps in raising the credit quality of debt issued by project SPVs to levels where bond market investors become comfortable. IIFCL, a government-owned enterprise, set up to provide long-term finance for infrastructure projects, offers partial guarantee to enhance the ratings of bonds issued by infrastructure companies.

3.2.7.2 Loan Guarantee by Parent Companies

As large wind projects are developed under SPV model, lenders always look for the guarantee from the parent company of the SPV. Guarantee from the parent company hedge risk of lenders depending upon the type of guarantee provided by the parent company. In most cases, SPV is financed by the lenders based on the balance sheet and credit rating of the parent company.

3.2.7.3 Government Share in Project

In India, some of the state governments adopt PPP model for the development of infrastructure project. Government, being one of the stakeholders in the project, enhance lender's confidence to provide loans to such projects. Government may replicate the same model in the development of large scale wind projects.

3.2.7.4 Government Guarantee to Agencies

Government guarantees are given by host governments to assure project lenders that they will take certain actions or refrain from taking certain actions affecting the project. Typically, multilateral agencies provide debt at lower rates to the emerging economies, on provision of sovereign guarantee from government of the concerned country. The government in turn charges sovereign guarantee fee from the borrower, such as GoI charges guarantee fee from the borrower. However, GoI gives guarantee only to the government companies or public sector undertakings (PSUs) and not to the private companies. For example, IREDA avail loans from multilateral agencies with sovereign guarantee and use the proceeds for renewable project development.

3.2.7.5 Securitization

Securitization is the process of pooling and packaging financial assets, relatively illiquid, into liquid marketable securities. Securitization allows an entity to assign (i.e., sell) its interest in a pool of financial assets (and the underlying security) to other entities. Loans extended to wind power developers

can also be bundled together and sold in the form of securities in capital markets. However, as per Reserve Bank of India's regulations, lending institutions can undertake securitization only for risk transfer and not for profit booking.

3.2.7.6 Quantification of Risk for Each Stage of Project

While conducting project appraisal, banks/FIs may identify risk for different stages of project development. Banks/FIs may quantify each risk in terms of interest rate premium and suggest interest rate for each stage. This shall reduce the cost of funds along with risk reduction for the projects.

Further, some of the banks/FIs provide interest rate rebate for successful commissioning of the project i.e., IREDA provide rebate of 0.5% in interest rate after commissioning.

3.2.7.7 Letter of Comfort by Banks/FIs

In India, some of the banks/FIs provide letter of comfort on behalf of the investor to the foreign lenders. Under letter of comfort, banks/FIs bear the payment risk of the foreign lenders. Further, same can be implemented for financing the wind projects for foreign financing.

3.2.8 Recommendations

3.2.8.1 Establish Apex Body to Promote Refinancing

There is a need to develop an apex body to govern a well-developed refinancing market. Institutional framework needs to be established to enable easy availability of refinancing options for wind projects where risks are contained.

3.2.8.2 Developing a Longer Term Bond Market

Government should encourage financial intermediaries to offer new product structures (e.g., credit enhancement, bond insurance) that enable sub-investment grade corporate to access financing. Further, suitable measures should be taken to increase the appetite of long-term investors. Allowing pension funds, insurance companies and sovereign funds to invest in wind projects through encouraging securitization market; will permit access to long term investments via subscription of long term tranches to such organizations. Wind project developers should be permitted issuance of Green/Tax-Free Bonds, Inflation Linked Bonds and Capital Gain Tax Bonds for gathering low cost long-term debt.

3.2.8.3 Reduction in Sovereign Guarantee Fee

The government may reduce guarantee fee for financing wind energy projects to increase the exposure of NBFCs in financing wind energy projects.

3.2.8.4 Modify Asset Classification Norms

RBI needs to modify its asset classification norms to bring more consistency and similarity in NPA definition for bank and NBFC. Due to the inconsistency, banks do not prefer to provide loans to the projects and fear to have accounts receivables of more than 90 days.

3.2.8.5 Relaxation in Investment Guidelines

The investment guidelines for insurance companies need to be modified to allow investment in instruments with a rating of less than AA. The investment guidelines for insurance companies need



to be modified to allow investment in instruments with a rating of less than AA. This modification should allow them to invest in wind energy projects, guaranteed by the government. The cost of such funding will be lower since these will not carry any currency risk.

3.2.8.6 Increase Involvement of FIs

Specialized infrastructure financing institutions need to participate at the design stage of a wind project. The backing of such institutions at an early stage will not only make it easier for project developers to obtain finance from other sources, but also provide them the opportunity to use the expertise of such institutions in project finance structuring.

3.2.8.7 Encouraging Mezzanine and Takeout Financing

Removing interest rate caps on ECBs can encourage foreign investors to use instruments like mezzanine and takeout financing for wind project investment. In addition, tools for mitigating the risks involved for international lenders should be developed. High stamp duties levied at ad valorem rates are barriers to securitization as well as takeout financing. Given that stamp duties are state subjects, the central government can play a persuasive and demonstrative role.

3.2.8.8 Capacity Building

Capacity building of the lenders in the wind sector will enable to understand the risks associated with wind projects better and can lower the risk perception. MNRE should empanel a set of agencies who will appraise new wind projects to provide additional comfort for lenders not having full-fledged in house capability to assess wind projects.

3.2.8.9 National Clean Energy Fund

Government should create a dedicated fund for renewable energy proceeds catering to the needs of the sector. A minimum percentage of the proceeds to the NCEF must be credited to this fund set up for RE deployment.

3.2.8.10 Crowd Funding

Crowd funding makes use of the easy accessibility of vast networks of people through internet to attract investors. Crowd funding may be implemented in India also for financing wind projects with appropriate regulatory framework to avoid any fraudulent activities.

3.2.8.11 Micro Finance

Under micro finance, NGOs and micro finance institutes provide loans to the projects for the development of poor population at lower interest rate. Micro finance can be utilised for financing the small scale wind projects located in the rural areas. Government may designate an agency to appraise various small scale wind projects, which will be financed by NGOs.

3.2.8.12 Benefits of Low Cost Credit Lines

Low cost foreign credit lines along with the cost of hedging and other administrative cost comes approximately equal to domestic funds and thus, there is no major difference in the financing cost between domestic lending and external commercial borrowings as popularly believed. Hence, project developers require fixed cost loan which can be secured through external borrowings. The advantage of such credit line is that, fixed cost and long term loan provides certainty to the project vulnerable to cost variation.



3.2.8.13 Flexible Loans

Another innovative financing mechanism is generation linked repayment loans, wherein, project developer can repay loan based on the generation of projects. Therefore, lenders also share operational risk related to the project.

3.2.8.14 Promote Foreign Currency Long Term Deposits

RBI may promote foreign currency long term deposits in banks from NRIs and foreigners. This will provide low cost deposit to the banks and enough liquidity to meet their asset liability mismatch. Long term deposits will enable banks to extend finance to the wind projects thereby increasing exposure to the renewable sector.

3.3 Sources of Equity Financing

Equity financing is considered as the most risky investment, as equity investors always stand at the end of the stakeholder queue. Therefore, equity investors focus on commercial/large scale wind projects which provide economies of scale. At present, in wind sector, private equity funds have dominated the equity investment scene. In India, the hurdle rates for direct equity investments is in range of 16%-20% and are dependent on several factors such as the size of the project, the background of sponsor, the technology risk, the stage of maturity and geographical and policy risks.

3.3.1 Venture Capital/Private Equity

Private equity capital is an equity capital that is not quoted on a public exchange. Private equity investors or funds make investments directly into private companies or conduct buyouts of public companies that result in delisting of public equity. Capital for private equity is raised from retail and institutional investors and can be used to fund start-ups (venture capital), make acquisitions (growth equity, buyout), or to strengthen a balance sheet (special situations). Investments are generally made through a fund partnership having the following features:

- Private equity funds are closed-end investment structures.
- Funds terms and conditions are defined in a limited partnership agreement.
- Term of a fund ranges between 10 to 12 years.
- Investment disciplines include leveraged buyouts (LBO), venture capital, distressed, growth, mezzanine finance and angel investor.

3.3.2 Developer's Equity/Internal Accruals

Sponsors equity comes from reserves and surplus of sponsors existing businesses. Large companies have high risk taking and execution abilities to undertake capital-intensive projects. To ensure successful achievement of the target, it is imperative to select technically equipped and financially sound companies with committed management. It is also imperative to channelize PSUs' attention in promoting wind in the same way they have come forward for developing the solar photovoltaic (PV) sector.

3.3.3 Capital Market

Capital market is the market where established players raise equity for the investment in the project/businesses. However, tapping capital market is feasible only for those companies which have achieved significant scale and have profitable operations.



In India, private equity investment is more popular for financing wind projects. To minimise their risks, private equity investors make their investment at parent company through fund partnership. They do not make any direct investments in the projects to insulate themselves from the associated risks and look for opportunities with minimal risk and maximum returns.

3.3.4 Barriers in Availing Finance From Indian Equity Market

3.3.4.1 Returns on Equity Vis-a-Vis Interest Rate

In a rational world, expected return on equity should be higher than the cost of debt. As electricity sector is a regulated market and cost of equity is fixed for the wind energy generation, increase in cost of debt in the country is decreasing the spread between cost of equity and debt. Thus, equity investors are taking on more risk by assuming debt. However, due to high cost of debt, does little to enhance their returns.

3.3.4.2 False Expectation

Project developers earn lower returns in the initial years of operation (i.e., post commissioning of the project) due to high proportion of debt servicing. Equity investors make investment in the project with the perception of refinancing the project at better terms once it gets commissioned. However, reduction in cash flows in the initial years makes it difficult for investors to negotiate better terms for the project and reduce its cost of funds.

3.3.4.3 Availability of Equity

Availability of equity from both domestic and foreign sources is comparatively better than the availability of debt. However, lack of availability of debt to refinance a project may actually force equity to be locked in a project for too long and hence restrict the availability of equity for recycling and starting new projects. In particular, developers who have financed projects on their own balance sheets during construction - when debt is usually more expensive and difficult to get, due to related risks and uncertainty are finding it difficult to raise reasonably priced debt even after the project is built and operating.

3.3.5 Recommendations

3.3.5.1 Rational Risk Pricing for Equity Investor

Strategy of accepting lower returns in the short term to capture the market is not sustainable over time because the high risk investment environment in India will require correspondingly higher expected returns. In the long run, the flow of information in the market about the risk profile of projects will help in obtaining more rational risk pricing.

3.3.5.2 Equity as a Combination of Debt and Equity

Some developers typically use multiple levels of leverage to increase their effective Internal Rate of Return (IRR). Many private equity funds raise equity as a combination of equity and debt, which reduces the cost of equity and inflates returns from the initial investments. This also provides enough liquidity to developers to invest in the subsequent projects and further enables equity investors to invest in multiple projects and maintain their effective IRR even in the regulated market.

3.3.5.3 Community Based Financing

In rural areas, community based financing may provide a better way of tapping small scale wind projects, wherein people self-finance and utilise power generated from the wind projects. Further, government may also provide grant to small wind projects in the rural areas.

3.3.5.4 Specialized Project Developer

The large developers conduct wind assessment, procure land, take clearances and develop project and further sell that project to various investors who are reluctant to invest due to high risk of development. The developer bearing the entire risk till commissioning of the project may charge risk premium from the investors willing to invest in the project.

3.3.5.5 Build Investment Ecosystem for Wind

Build an effective investment ecosystem for the wind sector instead of dealing with individual issues i.e., grid, financing, incentive, manufacturing in bits and pieces. The entire system should be driven by some national authority which may guide the development of wind sector. The national action plan and policy can be made available for conducive progress, which may set the target for wind and drive the entire ecosystem.

3.3.6 Other Financing Instruments

3.3.6.1 Partial Risk Guarantee and Loan Support

Partial risk guarantees protect foreign lenders from specific risk such as political risk and exchange rate risk. Partial risk guarantee attracts foreign funds by mitigating political risks such as breach of contract by the state, expropriation and currency inconvertibility, thereby reducing the cost of financing. A partial risk guarantee typically covers the entire debt amount as well as interest payments. Partial risk guarantee and loan support can mitigate political and exchange rate risks facilitating access to foreign capital and can reduce the cost of wind energy.

3.3.6.2 Subordinate Funding/Mezzanine Debt

Mezzanine debt capital refers to a layer of financing between a company's senior debt and equity. Structurally, it is subordinate in priority of payment to senior debt, but senior in rank to equity. Mezzanine finance is less risky than equity as it provides fixed interest along with principal repayment and minimum guaranteed returns to investors. The Indian RE market has seen few mezzanine finance transactions because of interest rate caps on ECBs. This prevents the pricing of mezzanine financing commensurately with the risks associated with them.

3.3.6.3 Securitization of Cash Flows of RE Projects Pooled From Multiple Projects

Securitization not only enhance the credit quality of the instrument but also help RE projects get additional debt based on the strength of operational cash flows to fund other business investments or other under-construction projects. In these transactions, the project SPV issues bonds by securitizing the project cash flows and the proceeds from bonds are used to refinance existing bank debt. Securitization process can also be used to aggregate cash flows from a portfolio of high quality operating projects from single or multiple developers.



3.3.7 New Investment Structures

YieldCo and Renewable Energy Investment Trust (REIT), which have been successful in USA, are the two proposed innovative financial models. These financial models have the potential to lower the cost of capital for projects and in turn make investment returns more attractive. Lower interest rates and longer-tenure funding are imperative for India's RE sector to compete with the traditional energy sources. While banks have been supportive, their ability to provide longer-tenure debt and lower interest rates is limited. A deeper and more diversified financial sector can certainly help increase public and private participation in the development of wind projects.

3.3.7.1 YieldCo

YieldCos are companies that own clean energy subsidiaries and use the reliable cash flows from these subsidiaries to pay dividends to investors. YieldCos are publically listed and tradable companies set up by pre-established RE developers. The developers place a portfolio of energy generating assets under the governance of YieldCo. In turn, the YieldCo raises capital and manages the energy generating assets which provide stable, long-term cash flow back to the shareholders. Following are the key benefits of YieldCos:

- a) Provide liquid means of investing in renewable energy.
- b) Financing is an attractive option to fund projects without raising debt levels.
- c) Offers low cost of equity funding for renewable energy projects.
- d) Do not carry development risk as assets dropped down are stabilized.
- e) The long-term, low risk and contracted asset profile of the YieldCo can support lower cost of capital for the YieldCo and for the parent company.
- f) YieldCos having pool multiple assets can diversify geographical and single-asset risk.

3.3.8 REITs

REITs are similar to the Real Estate Investment Trusts. REITs are companies that own or finance and often manage income-producing real estates. Modelled after mutual funds, REITs provide investors regular income streams, diversification and long-term capital appreciation. REITs are publicly traded as liquid stocks on major exchanges. Following are the key benefits of REITs:

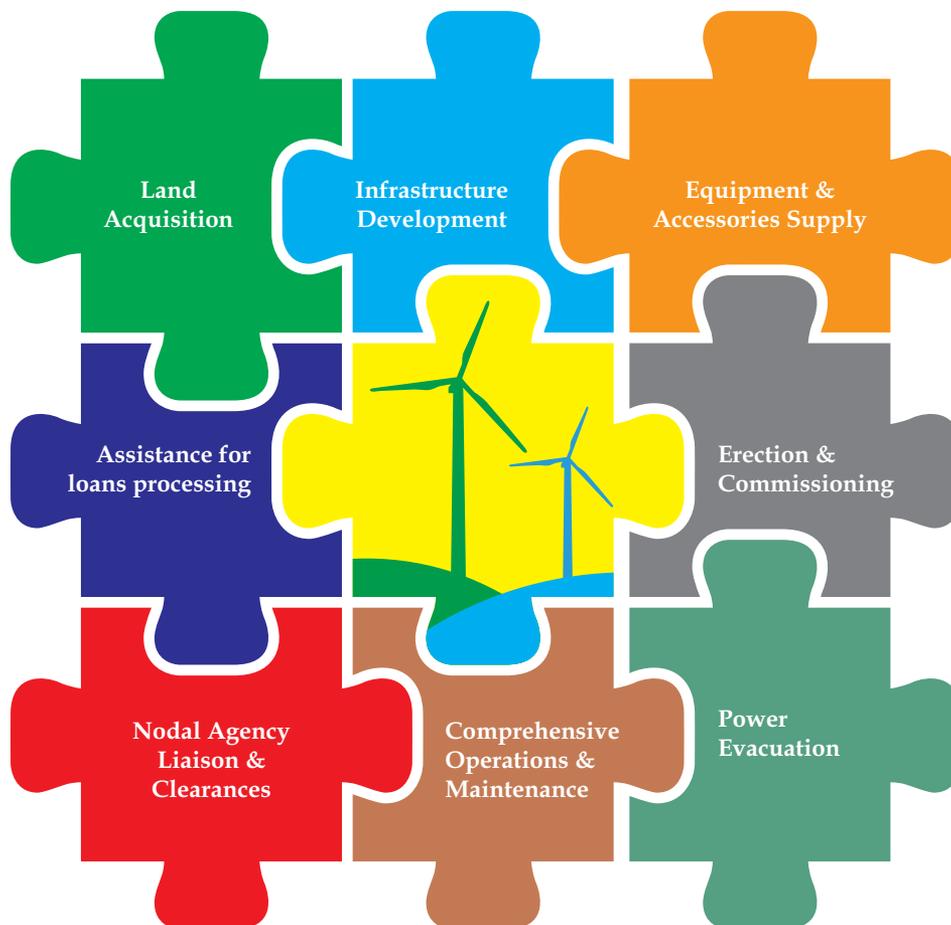
- a) Investors are able to diversify within the market by holding an interest in multiple assets.
- b) Pass profits directly to its investors and are thus not taxed at a corporate level, but taxed only at the shareholder level.
- c) Risk is pooled among many investors instead of a sole asset owner.
- d) REITs pay high cash dividends and also offer high liquidity.
- e) Investors share ownership in large assets, which otherwise would be difficult to afford.
- f) Foreign individuals, otherwise restricted from owning asset, can have an interest in such property via REIT.
- g) Depreciation expenses can minimise shareholder taxes on dividends.

4 Wind Power Project Development

The wind power project development commenced in mid 1980s and the sector witnessed setting up of small-scale demonstration projects of 100-200 kW, primarily initiated by the government. Thereafter, the phase of private sector participation evolved from mid 1990s till 2003, wherein, growth was mainly driven by market development initiatives taken up by the Ministry of Non-Conventional Energy Sources (MNES) (now MNRE) during this period. This phase also witnessed favourable policy framework coupled with low manpower cost, raw material availability and vast market potential which resulted into significant growth of wind manufacturing industry. The wind turbine manufacturing was started in India by companies such as Vestas, NEG and Enercon by setting up manufacturing facility in collaboration with local manufacturers. This phase also witnessed the birth of the largest domestic wind turbine manufacturing company, Suzlon Energy Limited, followed by many others.

Figure 7 represents the involvement of wind turbine manufacturers in the different stages of the wind project development cycle.

Figure 7: Different Stages of the Wind Project Development Cycle

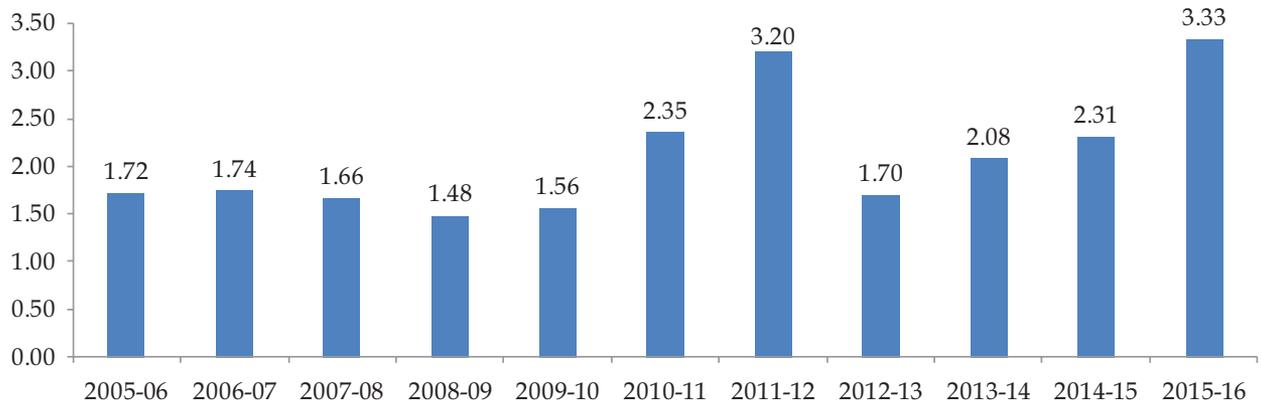


Source: Indian Wind Turbine Manufacturer Association (IWTMA)

The annual wind capacity addition reached its peak at 3.3 GW in FY 2015-16. In 2012-13, due to policy uncertainty and withdrawal of AD and GBI, the growth trend and the annual capacity addition fell to almost half than current scenario at 1.7 GW. Since then, annual capacity addition has continued to remain subdued in the last two years i.e., FY 2013-14 and FY 2014-15 at 2.1 GW and 2.3 GW respectively.



Figure 8: Annual Wind Capacity Addition, GW



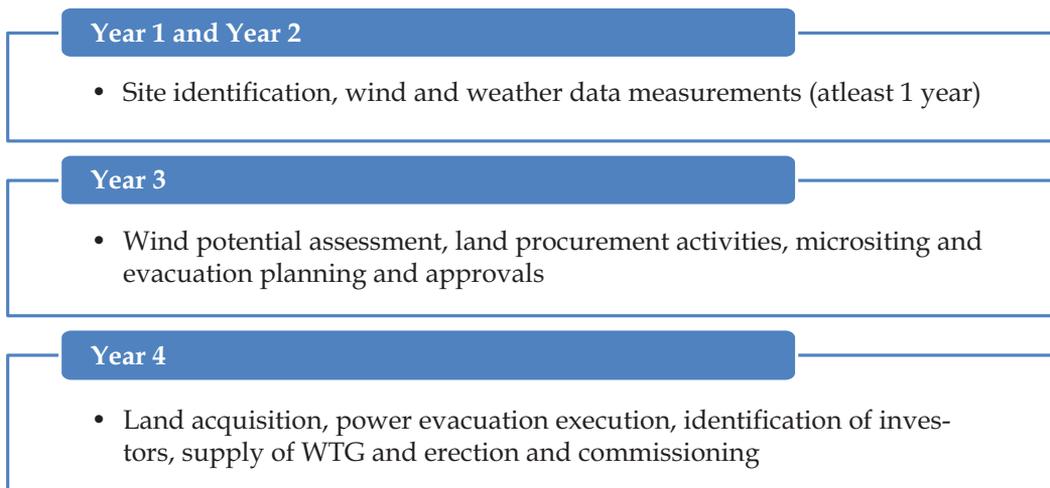
Source: MNRE

As on April 2016, the total wind installed capacity in the country stands at 26.86 GW, while total potential estimated by NIWE at 100 m hub height is about 302 GW. Clearly, there is a huge amount of untapped wind potential yet to be harnessed. In order to achieve the Wind Vision Target of 200 GW by 2032, an average annual capacity addition of about 10–12 GW is required, for which, alternate business models need to be explored.

4.1 Current Wind Project Development

Wind power project development for commercial scale wind farms is a multifaceted, lengthy process often requiring collaborative efforts among several entities and stakeholders. Figure 9 illustrates the various activities undertaken on year on year basis in wind project development.

Figure 9: Year on Year Activities Undertaken in Wind Power Project Development



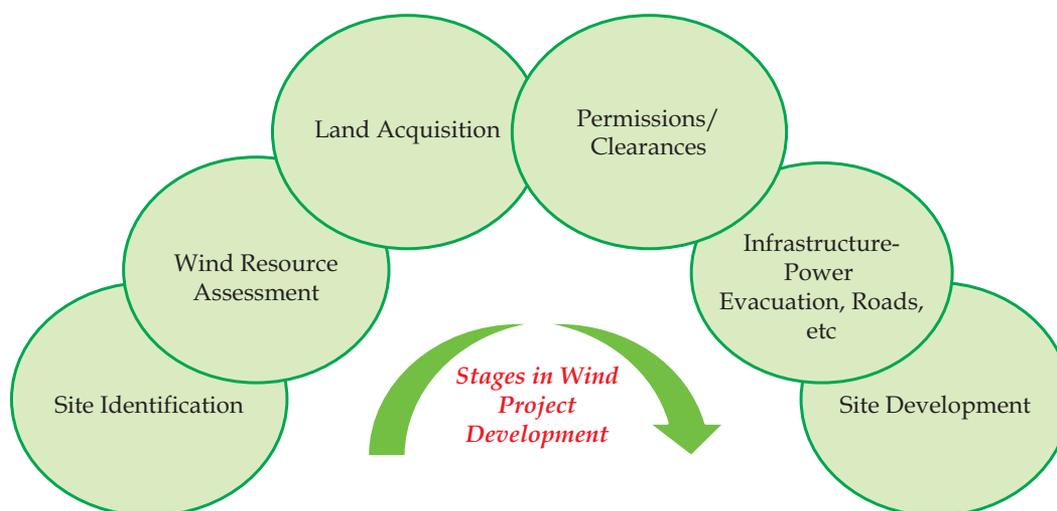
Source: Idam Infra Analysis

At present, all activities are being undertaken by wind turbine manufacturers in India. Besides, there are distinct practices and rules as applicable depending upon the state specific policy regime. The rule for allotment of wind farm project development is also very significant across states. The role of state nodal agencies, state transmission utilities and need for coordinating with them is crucial. Even the IPPs do rely upon the project development services rendered by turbine manufacturers. It is important to understand and address challenges in every stage of project development from



scalability point of view. Figure 10 illustrates the six stages of the existing wind project development model which takes approximately four to five years from development to commissioning.

Figure 10: Stages Involved in Wind Project Development



Source: Idam Infra Analysis

4.2 Issues and Possible Solutions in Various Stages of Wind Project Development

4.2.1 Site Identification and Allotment

The selection of an ideal site for developing a wind project depends on various factors like type of land, elevation of site, access to grid and proximity to the road network. The dynamics of wind behavior at the site helps in determining the size and type of turbine. Below are the few issues and possible solutions related to site identification and allotment:

- a) **Development of Land Bank:** Inventory of surplus and unused land available with public sector undertakings, state govt., urban local bodies/gram panchayat lands and suitable private waste lands, unproductive single crop agricultural lands should be made available in public domain on cost basis.
- b) **Blocking of Sites by Developers:** Most of the good sites with maximum potential are blocked in by the developers by way of approvals/data/land and so on. The time bound development of the site should be encouraged. If the site is not developed in a stipulated period of time, bank guarantee should be forfeited as in case of solar projects.
- c) **Number of Sites/MW Installed:** Only about 25% to 30% projects are commissioned as compared to the allocated wind capacity. In case of Karnataka, allocated wind capacity as of July 2015 was about 13 GW; whereas the commissioned capacity was only 2 GW. Karnataka Renewable Energy Development Limited (KREDL) being the facilitating agency for implementation of RE sources took some strict steps in cancelling about 2 GW projects which were not developed in the stipulated time. Time bound development of the project should be enforced and delays must be penalized.
- d) **Preference Issue - Wind Versus Solar Projects:** In case of common site identified for developing RE project (wind/solar), the issue of preference may arise. If both technologies are feasible, that particular site can be optimally utilised for both the technologies.



4.2.2 Wind Resource Assessment (WRA)

WRA is one of the most important factors for wind project development. With a high quality of WRA, efficiency of wind farm can be increased which can subsequently reduce per unit cost of wind generation. For an accurate WRA, at least one year wind data is required to identify turbine suitability and thereafter micro-siting. It is important to note that the assessment of wind potential is a high-level assessment and does not identify investment grade locations for siting actual wind farms nor did the energy generation for existing wind farms. Key issues and possible solutions related to WRA are as follows:

- a) **Lack of Reliable Long Term Wind Data:** Long term wind data is essential for the assessment of any wind project. In addition, development of a meso-scale wind atlas based on satellite data, weather model reanalysis and existing meteorology models is also essential. Continuously updating wind resource maps and database (every two years) for the country would facilitate in planning new capacity addition. It will give the developer a confidence level in terms of wind data for his project and long term wind power output forecast model.
- b) **Identification of Wind Rich Sites:** SNAs in consultation with the private entities may facilitate WRA at few pre-identified sites on cost sharing mechanism. Sharing of wind resource data and idle sites (with SNA) for putting a wind project should be encouraged.
- c) **Government Does Little or No Predevelopment Work for Potential Wind Sites:** Govt. may facilitate some predevelopment work on the promising sites with good wind resource, grid access and good accessibility necessary for developing a wind project. This will help the developers in choosing their project locations.
- d) **Enhancement of WRA Standards:** WRA being one of the essential stages in wind project development process; enhancement and improvement in the WRA technical standard, measurement procedures and numerical computation should be adopted across all states.

4.2.3 Land Procurement

Land ownership has become one of the most critical factors especially in a democratic federal structure like India with different states having different policies for land purchase/allotment. Based on ownership structures, land may be categorised under - private land, revenue land, and forest land. The issues and possible solutions related to land procurement are discussed below:

- a) **Land Conversion Issues:** SNA in each state needs to be identified as a single point coordinator to facilitate all land clearance and leasing/acquisition of land related processes. This will reduce the overall time in conversion and acquisition issues.
- b) **Resistance to Project by Local Population:** Due to lack of information or participation, there may be resistance by the local population to the proposed project. The potential solution to address such issues could be to provide appropriate compensation for the land or employment opportunities to the displaced population. One of the solutions may be to provide share in the revenue from the wind project. Central government may propose guidelines to states and share best practices through which this issue can be avoided.

4.2.4 Permissions/Clearances

Wind projects require various permissions and clearances from different agencies. Permitting entities at the central, state and local levels may have jurisdiction over a wind project. While developing a project, it is important to determine the legal aspects of building a wind farm on a certain site and pay



attention to whether there are restrictions on factors such as height, noise levels or minimum distances to buildings. The two important issues and possible solution related to clearances/permissions are listed below:

- a) **Time Consuming Process:** Due to the multiple agencies involved (at central and state level) in granting clearances and permissions required for developing a wind project, it becomes a time consuming process. Single window clearances or maximum clearances under one roof such as SNAs being a coordinator for all revenue land related clearances will make this time consuming process much simpler for the developer. Significant automation is also required for faster clearances.
- b) **Delay in Getting NOCs:** Facilitation in offering pre-developed sites can also be adopted to develop programmatic approach in order to achieve 200 GW by 2032.

4.2.5 Infrastructure-Roads and Power Evacuation

The infrastructure for wind power project development includes power evacuation arrangement and transport infrastructure. Wind power evacuation comprises of five crucial aspects, namely, wind farm planning and internal evacuation, building pooling substation, defining interconnection point, construction of transmission line and interface with grid substation. In most states, the entire evacuation infrastructure has to be developed by the developer at his own cost. Prior to the setting up of wind farms, site development activities are undertaken which are purely dependent on terrain conditions and soil strata. The key issues and possible solution related to infrastructure (power evacuation and transportation) as follows:

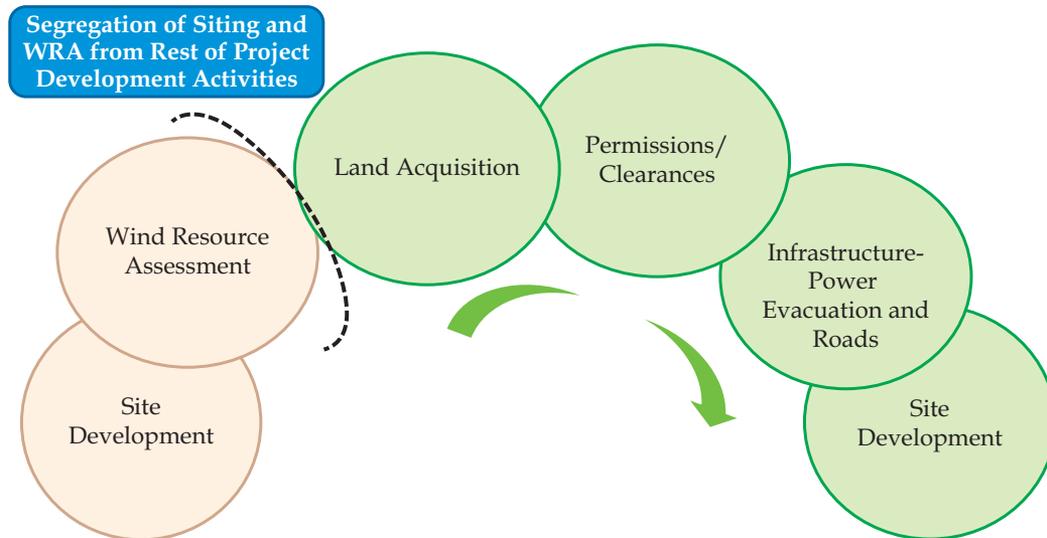
- a) **Inadequate Grid Capacity to Transmit Power:** Lack of adequate transmission infrastructure is identified as the biggest bottleneck for wind energy development in India. STU should make wind capacity addition as an integral part of their future plan.
- b) **Lack of Infrastructure:** Developers have to construct their own transmission/distribution lines from point of generation to the consumption point at their own cost. Transmission utility should plan substations close to the proposed wind farms.
- c) **Constraint in Transportation:** There are constraints in transporting and installing large size wind turbines to wind farms located in the difficult terrains (hilly areas). In addition to this, developers have to carry out repairs/strengthening/reinforcement works of structurally weak roads on way to project site. SNA (State Nodal Agency) in coordination with Public Works Department (PWD) should arrange to strengthen connecting roads for any wind farm above 100 MW could be a potential solution to address such issues.

4.3 Proposed Wind Project Development Model

In India, the present wind project development model is driven by turbine manufacturers who offer a turnkey solution i.e., identification and procurement of land, grid connectivity, supply and erection of turbine, facilitation of PPA, maintenance and so on. The role of an investor is limited only to that of a capital provider. The IPPs opine that they do not have level playing field as compared to the turbine manufacturers. In order to expand the project development options, alternate/additional project development model need to be explored. The proposed business phase described in this section will segregate activities like project siting and WRA from rest of the project development activities. This will act as a level playing field for all including turbine manufacturers, IPPs, SNAs, government entities, independent entities and so on.



Figure 11: Proposed Wind Project Development Cycle



Source: Idam Infra Analysis

State governments can invite bids from private players for WRA activity. A designated SNA can facilitate such process. A step by step description of the proposed project development model is given below:

- Step 1:** SNA to invite public/private sector for WRA study for potential wind rich sites.
- Step 2:** Selection of Wind Project Preparatory Agency (WPPA) based on predetermined criteria.
- Step 3:** Agency can be the project developers, turbine manufacturers or any other independent entity.
- Step 4:** Permission for carrying out WRA by SNAs on first come first serve basis. The total capacity should be capped at 100 MW/entity.
- Step 5:** Agency to access wind site and prepare a Detailed Project Report (DPR) in a time frame of 1 to 1.5 years.
- Step 6:** SNA to ensure that no other site to be allotted to any other agency for WRA study within 5 kms of radius of the assigned site.
- Step 7:** SNA to be responsible for assessing the quality of DPR prepared.
- Step 8:** SNA to define a "PROJECT" covering parameters like permissions and clearances, interconnections, grid integration and so on.
- Step 9:** Development rights need not rest with the contractors.
- Step 10:** In case agency chooses to act as the project developer, they may proceed to develop the project. In case they do not, they may transfer the project development rights of that site to the developers. Agency can earn revenue through sale of the recorded data or any derived product to the developer.
- Step 11:** Developers to develop the project in a period of two/ years. Failure to which the project allotment stands automatically cancelled.
- Step 12:** SNAs to allot wind site to any other developer on a predefined criteria.

The state governments should identify GW scale wind farms/parks; obtain all clearances including land, evacuation clearances, resource assessment and so on, similar to existing Ultra Mega Power Project (UMPP) development for thermal projects or solar parks. Such ultra mega wind projects can then be developed by PSUs such as NTPC Ltd, Bharat Heavy Electricals Limited, Engineers India Limited, and Power Grid Corporation of India Limited.

4.4 Key Benefits of the Proposed Model

The key benefits of the proposed model are as follows:

- a) Segregating WRA from rest of the phases of wind project development allows creating level playing field for all manufacturers, IPPs, PSUs and WPPA and they all will be at par.
- b) Multiple project development initiatives in parallel will increase project pipeline and share business risks and reduce timelines.
- c) Time bound project development of the project.
- d) SNA to be responsible for quality of DPR prepared by WPPA including potential assessment of the site.
- e) WRA already done, thereby, making identification of wind rich sites much easier.



5 Procurement of Wind Power

Wind and solar are the predominant technologies contributing to the RE portfolio of the country and will continue to remain the key drivers of RE in future. The solar sector is witnessing a steep reduction in tariffs, mainly attributable to competitive bidding. This has initiated a debate among stakeholders about the possibility of introducing competitive bidding in wind power procurement also.

5.1 Wind Procurement: Buyer's Perspective

Wind energy buyers are classified in two broad categories:

- i. **Distribution Companies (DISCOMs):** Either purchasing power from wind developers at FIT or APPC; or buying Renewable Energy Certificates (RECs).
- ii. **Open Access (OA) Consumers:** Buying power through OA from wind developers; or putting up captive generation plants or buying RECs.

Procurement of any commodity is a function of demand and cost economics. In case of wind industry in India, both these factors largely remain dependent on government initiatives, till recently. As power from conventional sources was available at low cost as compared to wind energy, demand was primarily created through RPO to promote wind energy and cost economics majorly depended on government determined tariff for the same. However, the scenario is now changing slowly. The average price of coal-fired electricity has now exceeded INR 5 per unit¹⁰ (as per Case 1 bidding trends w.e.f 2012 for long term power procurement by various distribution licensees in India). Whereas, the levelized cost of wind energy is in the range from INR 4.16 per unit¹¹ to INR 4.78 per unit¹², thus, bringing wind power at parity with conventional power without considering the storage cost.

5.2 Challenges in Wind Procurement

Though wind is the most pervasive among all the renewable energy technologies contributing 62% of the total renewable sector in India, power procurement through wind is still facing many challenges. Few of the major challenges for wind power procurement are: Unevenly distributed wind resource, lack of accurate resource assessment, variable nature of wind energy generation, costly wheeling of wind power, poor transmission planning for RE, increasing trend in FITs, lack of clarity on existing procurement mechanisms, and non-clarity on tariff discovery/determination mechanism.

5.3 Lessons for India from International Experience

From the recent successful international experiences of South Africa and Brazil, moving from FIT based wind power procurement towards competitive bidding based procurement; following learning may be derived for India:

- a) Auction design, stringent qualification requirements and robust bidding documents play a vital role in the success of competitive bidding process. Penalties should be levied for non-performance and for not sticking to the schedule. Secured payment mechanism should be adopted to attract serious investors and secure developer's interests.

¹⁰ MERC Order in Case No. 65 of 2015 dated November 06, 2015.

¹¹ TNERC Comprehensive Tariff Order on Wind Energy, March 2016.

¹² MPERC Wind Tariff Order, March 2016 (Control Period Up to March 2019).

- b) It should be ensured that the rate of decline in tariffs is matched by the rate of decline in capital and development costs. Extraordinary low bids suffer sustainability issues threatening project viability in long term and delays in achieving installation targets. The absence of stringent compliance rules leads to the risk of underbidding. To reduce this risk, other criteria should be added to the project evaluation stage including technical experience and the local economic benefits.
- c) In order to maintain investor's confidence in the program and compensate projects for their loss of revenue, it is critical that power evacuation arrangements are in sync with the project development process and buyer obligations under the PPA are upheld.
- d) Technology-specific auctions have supported the development of wind energy and have led to the market development and price competitiveness.
- e) Site specific biddings, government auctioning projects in pre-determined locations would be beneficial for the sector. It frees the investors from the liability of securing land, obtaining environmental permits, carrying out resource assessments and securing access to the grid.
- f) The criteria of requirement for local content should be introduced carefully with a view to help local manufactures to expand and also encourage global players to establish manufacturing facilities.
- g) Policy should be designed to support all the interested participants such as small investors and manufacturers. It should not favour big players only.

5.4 Options for Wind Procurement in India

Wind power procurement based on FIT approach has worked very well in Indian context. Besides, REC mechanism has also worked well during the initial period but for lack of adequate RPO enforcement, RE power off-take under this route is suffering. Through solar power projects reverse bidding through discount on tariff has enabled another option for the allotment of project development rights and power procurement. While the debate on competitive procurement as against FIT based procurement will continue; the selection of appropriate model for RE procurement needs to be compliant with the policy and statutory framework of EA, National Electricity Policy and Tariff Policy.

Both the FIT approach and reverse bidding have met with success in different sectors and at different stages of market development. The draft National Wind Energy Mission has suggested yet another model of centralized RE procurement at national level as against existing practice of state level procurement as guided by the state specific requirement and prevalent policy and regulatory regime at the state level. Transparency in procurement, ease of RE power procurement, standard contracting arrangement, certainty of regulatory principles and approach are the key to success of any RE procurement model.

5.5 APPC Plus REC as Proxy for Competition

One of the modes for wind power procurement is purchasing power from the renewable generator at APPC, as determined by the SERCs of the states on annual basis. Such power sold is considered as a component equivalent to procurement of power from conventional sources of power. The REC accredited on account of such RE power are available for sale in the form of REC at power exchanges. Therefore, this APPC-REC mechanism already has an in-built competitive mechanism. The power sale to Discoms at APPC provides certainty of off-take to the RE generator and trading of REC at power exchange are envisaged to carry the competitive feature. The prices of REC are market discovered within the band of floor and forbearance prices as determined by CERC from time to time.



However, this method of procurement faces several challenges due to non-compliance RPO by Discoms. Further, the Discoms are not so keen to procure RE power at APPC due to its variable nature, which, in any case, is neither supporting RPO compliance nor bringing down the overall weighted average power procurement cost. However, with the recent actions by SERCs, the strengthening of RPO compliance is expected to regain its competitive feature in the near future in true sense. With stringent RPO compliance on part of SERCs, the APPC plus REC mechanism will act as one of the mode of competitive procurement. Assuming strengthened RPO compliance mechanism, robust M&V framework in place, and a nationally accepted long-term RPO trajectory reflecting the national level targets, the APPC plus REC mechanism can still emerge as one of the alternatives, if not the only one, for RE procurement through competitive mechanism.

5.6 Procurement Competitive Bidding Framework

Competitive Bidding (CB) mechanism is required to be designed in such a way that it takes into account technology specific key considerations associated with wind energy, including different risk parameters such as variability of resource, grid connectivity and availability, capacity utilisation factors, set of clearances required and so on.

Data asymmetry, land acquisition (especially for Case 1 bidding) and financing are important concerns that need to be addressed before moving toward bidding. Site assessment, especially for wind power takes time, and hence, the bidding process should not get limited to developers who have a head start with respect to obtaining land and doing the necessary assessment. Clause 6.4 (2) of the Tariff Policy has envisaged competitive bidding in the renewable sector within the same type of technologies. Further, comparison between wind and solar power may not be appropriate in India due to high number of developers and technology providers in the solar sector.

Accordingly, a detailed competitive bidding framework may be developed consisting the following features:

- a) Constitution of the empowered committee consisting of experts from CEA, CTU, Niti Ayog and MNRE in order to identify the projects to be developed, facilitate evaluation of bids and also facilitate development of projects under the bidding scheme.
- b) Renewable Energy Corporation of India (RECI) or some other central agency to be the bid process coordinator as well as procurement agency, with appropriate payment security mechanism in place to provide the requisite payment security comfort to the project developers.
- c) Project preparatory activities to be in place well before the commencement of the bidding process, including site identification, land acquisition, environmental/forest clearance, WRA data, necessary transmission evacuation clearances.
- d) Prior to the bidding process, the requisite PPAs, transmission connectivity agreements and other project related agreements – escrow, hypothecation and so on should be entered between the SPV and the concerned entities.
- e) The bidding parameters may be among - tariff based, reverse bidding with FIT as ceiling tariff, viability gap funding, minimum incentives, maximum CUF and so on.

It is recommended that the proposed competitive bidding framework should be first taken up for the proposed government backed GW scale Wind Parks. In order to avoid monopoly in a bidding round, a restriction on maximum allocation up to 20%-25% per bidder shall be in place.

Further, while rolling out competitive bidding framework in the wind sector, sufficient precautionary measures are required so that the existing market structures are not affected. For instance, inadequately designed penalties or prequalification requirements may reduce the number of potential developer participants and push small and medium-sized players out of the market. Therefore, before the full-fledged rollout of the competitive bidding mechanism in the wind sector, more experience is needed to improve design, to make outcomes more predictable and to evaluate under which conditions they are a suitable instrument to meet ambitious RE targets.

To achieve the desired results from the competitive bidding mechanism, following points should be considered:

- a) While considering the volume of capacity under a competitive bidding round, the market's ability to supply should be taken into consideration.
- b) There should be sufficient time between the two rounds of competitive bidding.
- c) The bidding mechanism should ensure stringent qualification criteria and strong penalties for not commissioning on time to exclude non-serious bidders.

Further, following steps should be taken simultaneously to improve the deployment effectiveness:

- a) Improve transmission infrastructure to address completion risk.
- b) Payment guarantees to reduce off-taker risk.
- c) Start with location-specific bidding in which the govt. procures land and other regulatory permits and plans for transmission infrastructure in advance.
- d) Include a limit on capacity per bidder. This will increase competition and will fairly allocate capacity to multiple developers.
- e) Penalties for not commissioning to address the possibility of underbidding and thereafter non-commissioning the project
- f) Include design elements such as - guarantees to cover off-taker risk and certified pre-bid ground resource assessment.

Competitive Bidding, if designed and implemented well, can be an effective way to procure the required renewable power at the least cost. CB will incentivize higher energy generation (higher CUFs) eventually leading to lower tariff impacts and higher capacity addition targets. This is gravely important for India, given the financial health of our public utilities which puts added onus on policy makers and regulators to facilitate cost reduction.

5.7 Capacity Procurement

The procuring agency can enter into a long term Energy Purchase Agreement (EPA)/Power Purchase Agreement (PPA) with renewable energy project developer in two ways i.e., capacity based (MW) and energy based (MU) contract. Considering variable nature of wind under a capacity based contract, projects with similar capacity may offer different quantum of energy, considering different capacity utilisation factors and project developers have no obligation toward the quantum of net energy being supplied. Further, the tariff for wind being single part tariff comprising of only the energy charges, it is suitable to enter into energy based contracting.

Further, for Discom to comply with its RPO target, it is prudent that project developer contracts with Discom in terms of contracted energy rather than on contracted capacity. The RE developer shall have the right to sell energy in excess of the contracted energy to any third-party subject to first right of refusal to the Discom.



5.8 Possible Threats and Disadvantages of Competitive Bidding

5.8.1 Dominance by Major Players

Developers having land banks and other clearances will have unintended advantage over other players in the market. Further, developer already having strategic location i.e., nearer to substation shall have location advantage also. Many developers have provided with the exploration permissions for assessing wind potential of various identified sites. Such developers may quote aggressively in the bid process, as they have the biggest advantage of control over the site with wind potential. This will leave the other developers, not having existing control over the site and potential developers at great disadvantage. This will result in oligopolistic wind market leading to possibilities of cartelised bidding, defeating the purpose of competitive bidding in the sector. Therefore, it is imperative to commence the competitive bidding procurement framework with government promoted Wind Parks, which will address this anomaly to a larger extent and provide level playing field to all developers.

5.8.2 Winner's Curse

Primary challenge in competitive bidding is unrealistic prices quoted by many developers. Consequently, developers are not able to develop the projects despite winning or even if developed are not profitable for the company—hence “Winner's Curse”. Winner's Curse has been observed on several occasions in Indian power sector. In case of conventional power, most of the developers are approaching electricity regulatory commissions with a request to provide compensatory tariff in addition to the winning tariff. It is becoming impossible for the developers to operate their plant on tariff as quoted four to five years back. Change in fuel price has affected significantly resulting in electricity generation business as loss making for them.

5.8.3 Defaulting Bidders

Bidders defaulted during the bid process should be barred to participate in the next bid process. Previously, it was experienced that many bidders misquoted their technical experience in order to win the bid. Such bidders should be disallowed to participate in subsequent bids in order to promote participation from serious players only. Further, bidders quoting unrealistic prices for winning the bid should be penalized heavily to maintain the competitive environment.

5.8.4 Recommendations

In the immediate future, the APPC-REC procurement model should be promoted having inherent features of competitive procurement. There is an urgent need to iron out the problems faced by this procurement model, which includes implementation of several reform measures to be taken by centre and state:

- a) Enforce RPO by the obligated entities
- b) REC should be allowed to be sold in open market
- c) Introduction of REC market-maker
- d) Provide unrestricted open access
- e) Increase inter-state sale of wind power
- f) Capacity building of implementing agencies

The competitive bidding procurement framework should be initiated along with the government promoted GW scale Wind Parks to enable level playing field to all potential developers with existing land banks. In order to ensure existence of competitive market, it is not only essential to have sufficient number of potential bidders, but also a level playing field among those bidders. An inadequate design of competitive bidding framework may result in low effectiveness in renewable energy deployment and may impact the targets defined.

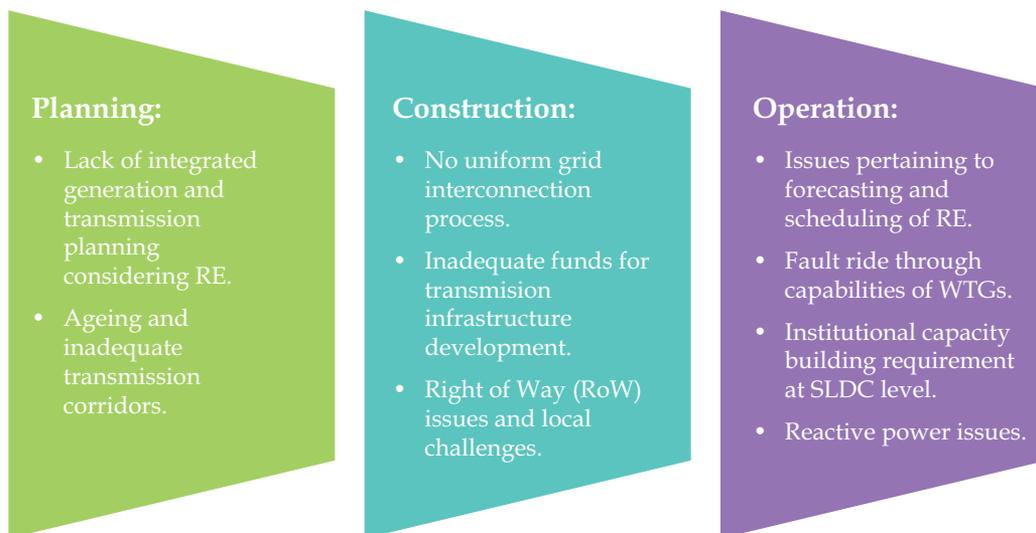


6 Grid Integration of Wind Energy

It is necessary to develop an appropriate framework for grid planning and operations to ensure grid safety which might get affected due to supply-side and demand-side factors. Currently, power sector planning, for both generation and transmission, takes only into consideration conventional sources of electricity, which are firm in nature. Accordingly, regulatory, policy, commercial and institutional frameworks is being designed for an inflexible power system at present. Such archaic provisions create operational challenges for the renewable sector since renewable power is a variable resource. As a result, grid planners and operators find it difficult to integrate RE into the power system and hence point towards the need for significant balancing resources like storage, gas based power project etc., which are usually expensive to procure. With the future trajectory of the renewable power generation being quite ambitious, it is now time to implement frameworks that support a higher share of RE in the grid in a cost effective manner.

The challenges in integrating wind power projects in to the grid can be categorised into 1) planning, 2) construction and 3) operational stages for setting up any wind power project. It is important to understand the challenges along with the associated risks so that appropriate policy, regulatory or utility intervention measures can be identified. Figure 13 illustrates the various challenges pertaining to grid integration.

Figure 12: Outline of Key Challenges for Grid Integration of Wind



Source: Idam Infra Analysis

6.1 Challenges in the Planning Stage

The present process followed in planning transmission capacity is mostly aligned with the conventional generation planned and load growth anticipated. However, what is required is an approach wherein, transmission capacity is planned keeping in view the balancing mechanism of future demand and supply scenario that takes into consideration variation in local, regional demand, conventional generating sources and variable RE/wind energy sources. At present, such an integrated approach is not being followed and transmission plans rarely takes into account the evacuation requirements for renewable energy generators.

Besides, most of the wind farms in the country are located in southern and western states of India where wind resources are abundantly available. Therefore, most of the future wind capacity addition is envisaged to take place in these regions. However, it is observed that the transmission corridor interconnecting these states and regions are inadequate for the transfer of surplus power outside the state/region.

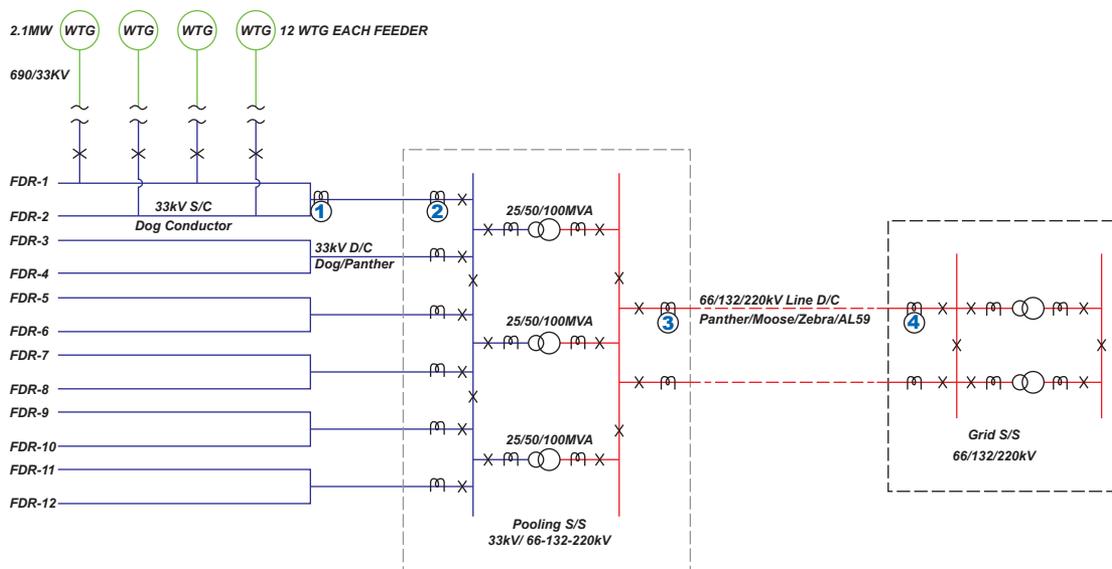


Considering the wind capacity additions to the tune of 200 GW planned for by 2032, there will be a requirement of significant transmission capacity to be available both at the state level for last mile connectivity as well as at the inter-state and inter-regional level for seamless off-take of wind power. It is, therefore, advised to develop an integrated planning approach to facilitate off-take of wind power that is based on optimisation of network that in turn will reduce cost of grid integration of wind. The reduced cost of grid integration will have multifaceted benefits, thereby paving way for smooth grid integration of wind.

6.2 Challenges in the Construction Stage

One of the major barriers encountered by wind generators and developers is the non-uniform approach and diverse set of practices followed by utilities across states while allowing interconnection of wind power projects to the grid. Numerous differences exist in terms of the interconnection point, applicable charges for interconnection, permissions and clearances and the contractual framework for an interconnection agreement. In addition, practices vary depending upon the type of renewable energy project (e.g., wind or solar) and this often results in significant delays in project implementation. There is an urgent need to devise a standard methodology and related protocols that institute uniformity across states in interconnection processes.

Figure 13: Wind Farm Layout and Difference in Practices



Billing Meters Position	⇒	3&4	3	4	2&3	1	2&4	0&1
State	⇒	AP	GJ	KN	MH	MP	RJ	TN

Level of Metering	Description
0	Individual WTG level
1 and 2	33 kV feeder level
3	EHV side of pooling S/S
4	Grid substation

Source: Suzlon Energy

The availability of funds for the construction of evacuation infrastructure also poses an issue. The development of transmission evacuation for 200 GW of wind power projects will require funding support of around US\$ 30 billion (conservative estimates at the current price levels). However, poor financial health of the STUs may hold back investment in up gradation and augmentation of the transmission networks by STUs. Consequently, the wind power development is likely to be adversely affected if the above issues are not addressed completely. Looking forward to a horizon of 2032, huge amount of investment will have to be put in and a significant contribution has to come from private sector. Unlike other businesses in the value chain of the power sector, transmission sector has seen less number of private players who are capable of setting up high capacity transmission systems, which adds to the challenge.

Transmission project development in many states face challenges with the right of way issues wherein it is tedious to construct transmission lines in farmland and forest areas. This, in turn, hinders the evacuation of power from the already commissioned/near commissioning wind projects. Generally, the gestation period for setting up evacuation infrastructure is two to three years. However, owing to the right of way, land acquisition related issues; the commissioning time of such infrastructure gets prolonged causing adverse delays to evacuate power from wind power projects. The issues pertaining to right of way should be adequately tackled through ways and means such as construction of multi-circuit towers, re-conductoring of old conductors with high current carrying capacity conductors, etc.

6.3 Challenges in the Operation Stage

The velocity of wind fluctuates daily as well as seasonally. Presently the major chunk of wind generators is embedded at the state level network undertaking intra- state transactions. Majority of wind rich states 1) do not have an imbalance settlement framework in place; 2) are constrained with the balancing resources (viz. pumped hydro storage, storage mechanism, wind-solar hybrid); 3) lack of mechanism for sharing balancing resources with other control areas or expanding the control areas to mitigate variability in generation from wind sources. Therefore, meeting the requisite demand and undertaking load-generation balancing with variable resources pose certain difficulties. The variations observed in the past were of the order of approximately 1,500 MW in a single day in Tamil Nadu. Similarly, in Rajasthan, the variations were of the order of 800 MW in a single day. Managing this variability in the grid is a daunting task today. However, there exist various strategies globally including wind forecasting techniques and weather prediction tools, etc., which could be developed in Indian context, to effectively manage power system with higher penetration of variable resources.

Increased accuracy of predictability of injection of generation from wind power projects to the grid shall enable grid operators to plan for despatch of such generation. Thus, more accurate predictions of wind generation from wind farms shall facilitate to improve acceptability of wind generation in the grid. However, implementation of forecasting and scheduling (F&S) mechanism and the related deviation settlement mechanisms at the state level and regional level requires concerted efforts from regulatory authorities, grid operators (State and Regional Load Despatch Centres - SLDCs and RLDCs) and wind developers. Further, no F&S regime will be adequate without addressing associated issues of load-generation balancing rules, despatch mechanism, deviation settlement mechanism, mechanism for payments to generators and institutional framework to operationalize the same.

Many wind rich states have state specific grid codes but differ in eligibility criteria for generators. In fact, in most of the states, payments for intra-state transmission of power are linked to actual generation whereas payments for all inter-state transactions are linked to scheduled generation. This calls for operationalization of state imbalance pool to facilitate state. However, except in few states, state imbalance pool and intra-state ABT mechanism has still not been operationalized. Many states have inadequate IT/ communication infrastructure to track real time generation at pooling stations and visibility of wind



farms (embedded or otherwise) is still a challenge. This calls for developing standardised practices and protocols that can be adopted across states as well as setting up of a robust institutional framework at the state level for buoying up the grid integration of wind generators.

Hence, with a view to mitigate the various grid integration challenges, different potential intervention measures have been identified which is presented in the following table.

Table 7: Key Challenges and Intervention Measures for Grid Integration

Development Stage	Key Challenges for Grid Integration	Potential Intervention Measures
Planning Stage	<ul style="list-style-type: none"> • Inadequate transmission planning for renewable sources. • Inadequate representation of RE, especially wind during transmission planning. • Lack of flexibility in plans to further augment RE/wind. 	<ul style="list-style-type: none"> • Adopt integrated approach for planning of transmission-generation and load demand at national and state level with due focus on RE/wind grid integration. • Amendments to State Planning Codes by SERCs and insistence for adoption of special planning criteria for RE as per CEA manual by STUs. • Active involvement and participation of wind generators/wind associations in the grid coordination committees. • Annual review and revisions of the transmission plans to facilitate growth of RE.
Construction Stage	<ul style="list-style-type: none"> • Non-uniform grid inter-connection processes. • Lack of adequate RE transmission development model. • Addressing right of way and other local issues. 	<ul style="list-style-type: none"> • Development of standard interconnection process manual under aegis of Forum of Regulators (FoR). • Exploring PPP model or Independent Private Transmission Company (IPTC) model for the development of RE transmission schemes. • According highest priority status to RE transmission projects and continuous monitoring of progress of such projects.
Operations Stage	<ul style="list-style-type: none"> • Lack of implementation framework for Forecasting and Scheduling • Managing resource variability and intermittency. • Grid instability. • Reactive power management issues. 	<ul style="list-style-type: none"> • Establishing visibility and communication links between wind farm pooling stations and SLDCs. • Establishing REMCs/coordinating agencies. • Developing and operationalizing ancillary services market mechanism and inter-state and inter-regional coordination frameworks. • Undertaking reactive compensation requirements at Pooling S/S and grid and developing pilot schemes including storage - active/reactive. • Developing reactive energy pricing framework and pricing signals to address reactive energy management issues.

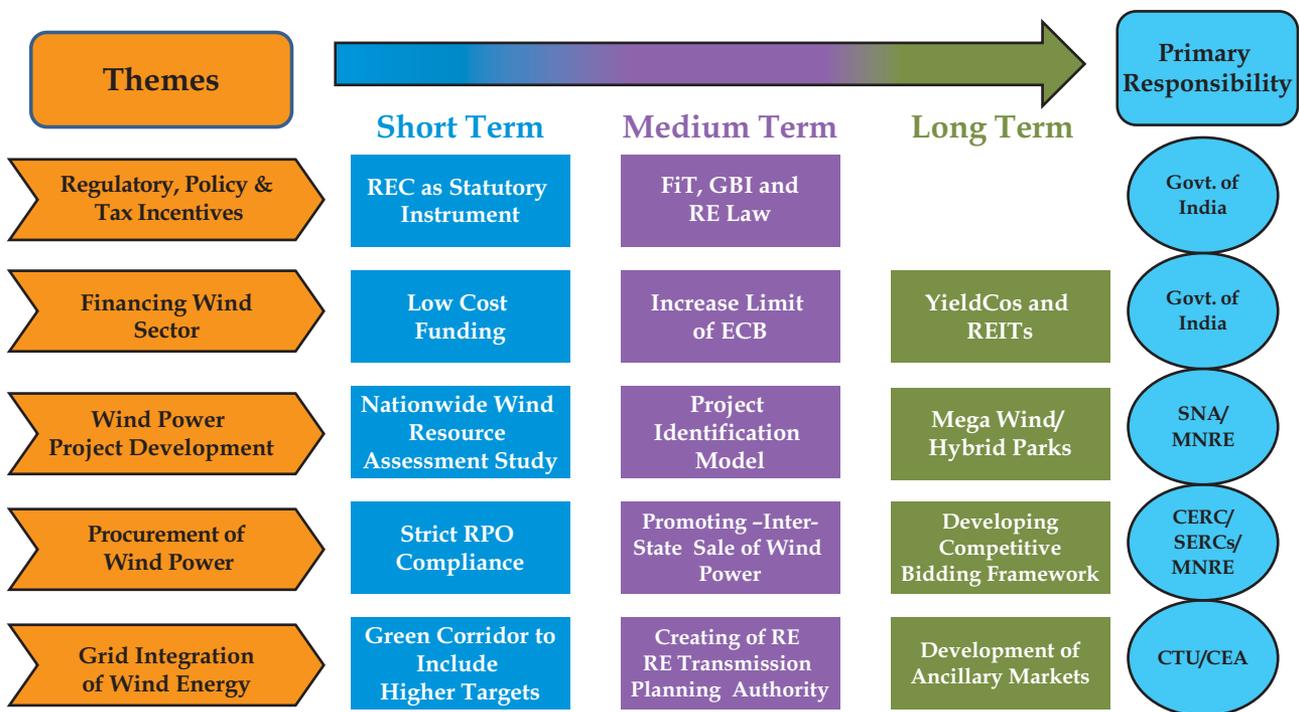
7 Conclusion

India is endowed with abundant wind energy potential. In spite of this huge potential and the ongoing process of wind development for over 20 years, the total grid-connected wind energy capacity has only reached to 26,867 MW as on April 30, 2016.

The experience as far as legislative and policy interventions are concerned has been mixed; although some success has been achieved due to a number of schemes and incentives, the larger issues impacting the sector continue to remain unaddressed. It is high time that the government also review policy and regulatory framework for RE as a means for meeting its commitment to the people of India in terms of employment generation, energy access and energy security.

Energy policy, more than subsidy management, requires unanimous political commitment to implement a national wind energy strategy. Having too many policies confuses stakeholders. Thus, the need of the hour is to boost the investors' confidence, by bringing in policy and regulatory certainty in the wind energy sector.

Figure 14: Actions to Scale Up the Market to 200 GW by 2032





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