Discussion Paper 2016

"DETERMINATION OF TARIFF FOR PROCUREMNENT OF POWER BY DISTRIBUTION LICENSEES AND OTHERS FROM WIND ENERGY PROJECTS FOR THE STATE OF GUJARAT"

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Executive Summary

The Gujarat Electricity Regulatory Commission (GERC) has initiated the tariff determination process for procurement of power by Distribution Licensees and others from wind power projects to be commissioned from the date of issue of order under the powers conferred to the Commission under Sections 61 (h), 62 (1) (a), and 86 (1) (e) of The Electricity Act, 2003, and National Electricity Policy, 2005, and Tariff Policy, 2016. The Commission had issued a generic tariff order for procurement of power by Distribution Licensees and others from wind power projects in Gujarat on 8 August 2012. The control period of the GERC Wind Tariff Order dated 8th August 2012 was up to 31st March 2016. The Commission also initiated suo-moto proceeding for extension of the existing control period beyond 31.03.2016 till the tariff for new control period is decided by the Commission. Hence the Commission presents this discussion paper to initiate the regulatory process for determination of wind power procurement tariff for the next control period starting from the date of issue of order after receiving comments from stakeholders on this discussion paper.

The State of Gujarat is blessed with excellent wind resources. National Institute of Wind Energy (NIWE) in association with Riso DTU National Laboratory for Sustainable Energy (NLSE), Denmark developed the Indian Wind Atlas which has been published in December 2015. As per this, the wind power potential of Gujarat is 84,431 MW at 100 m hub height. Further this Atlas shows that most of the areas in Gujarat are having wind power density between 200-350 W/m^2 at 100 m hub height and there are very less areas with wind power density lower than 200 W/m2. WinDForce along with CSTEP submitted a report on assessment of "India's wind power potential" to MNRE in July 2015. According to the study the CUF of Gujarat State ranges from 25% to 40% and wind speeds range from 6 to 9 m/s. The wind power density map developed by C-WET and the LBNL study during year 2012 reveals that most of the wind power potential area lies in between 200-375 W/m^2 wind power density zone. The current installed wind power capacity of the State is around 3933 MW as on March 2016. This indicates ample scope for future wind power development in the State.

While evolving the benchmark operating and financial parameters for determination of generic wind power tariff for the next control period starting from the date of issue of order, the following aspects were taken into consideration:

- In order to arrive at a benchmark capital cost for wind power projects to be commissioned in the next control period starting from the date of order, the wind power capital cost trends in the national and international markets during the last control period, and the commodity price increases during the last control period has been examined. Along with this the wind power capital cost data of the projects commissioned in Gujarat during the control period of the GERC Wind Tariff Order dated 8 August 2012 as well as the approach followed by the Central Electricity Regulatory Commission

(CERC) and SERCs. While fixing benchmark wind power capital cost under Regulatory approach has been studied in detail. The capital cost related data was also obtained from IREDA.

- It has been noted that during the last control period (2012-2016), about 67% of the total wind power projects (i.e. 638.5 MW out of 948 MW) commissioned in the State, have used MW-class WTGs. Over the period, with improvement in WTG technology, higher hub height, and larger rotor diameter, the Capacity Utilisation Factor (CUF) achieved by the commissioned wind power projects in the State has increased considerably.
- The actual CUF achieved by the wind power projects installed during FY 2012-13 and FY 2013-14 which have used MW-class WTGs in the State are noted. The CUF of the wind power plants commissioned during 2012-13 varies between 18.2% to 34.1% during 2013-14, 2014-15; while the CUF of wind power plants commissioned during 2013-14 have achieved CUF between 11.53% to 28.5% during 2014-15.
- In light of the above, and the fact that with advancement in WTG technology during the next control period, the CUF of future wind power projects will further increase. Therefore, it is decided to retain the normative CUF at 24.5% for the new control period.
- In case of financial parameters for tariff determination, the Commission observed that the current SBI base rate 9.3% is constant from October 2015. It is proposed to fix the interest rate of term loan equal to current SBI base rate plus 300 basis points. Further, based on the prevailing market practices, the tenure of term loan is proposed as 10 years. In case of the interest on working capital, since the requirement of working capital is generally for shorter time period, the interest on working capital is proposed at 200 basis points above the present SBI Base Rate during the control period.
- **Power evacuation System:** The Commission proposes to continue the practice as followed under GERC wind tariff order dated 8 August 2012, on 'Determination of Tariff for Procurement of Power by Distribution Licensees from Wind Energy Generators and other Commercial Issues'. The investors/developers will be allowed to construct the power evacuation line from wind farm switchyard to GETCO substation. The Commission has considered the cost of constructing the evacuation line up to 100 km length in the project cost.
- Based on the above, the Commission proposes the following normative operating and financial parameters and levellized tariff for wind power projects to be commissioned during the next control period starting from the date of issue of order.

Table: Benchmark parameters for Tariff Computation

Parameters	Existing Tariff	Proposal for new control period starting from the date of new order
Project Cost		
Capital Cost including Land, Plant & Machinery,, Erection and evacuation infrastructure Cost (Rs. Lakh/MW)	606	613
Normative O&M cost for first year (Rs. Lakh/MW)	8	10.63
Escalation in O & M (per annum from 2nd year)	5.72%	5.72%
Performance Parameters		
CUF	24.5%	24.5%
Project life in Years	25	25
Financial Parameters		
Debt-Equity ratio	70:30	70:30
Term of Loan in Years	10	10
Interest on term Loan	13%	12.3%
Interest on working capital	12%	11.30%
Depreciation	6% (for first 10 years) 2% (from 11 to 25years)	6% (for first 10 years) 2% (from 11 to 25 years)
Minimum Alternate Tax (MAT)	20.008%	21.34%
Corporate Income Tax	32.445%	34.61%
Return on Equity	14%	14%
Tariff	Levellised tariff of Rs. 4.15 per kWh	Levellised Tariff of Rs 4.19/kWh

Other Commercial issues

Transmission and Wheeling Charges:

1. **Third Party Sale**

a. Wheeling of Power for third party sale from wind power project shall be allowed on payment of normal open access charges as applicable to normal open access consumer.

b. 25% of the cross subsidy surcharge as applicable to normal open access consumer shall be applicable.

2. **Wheeling of power for Captive Use**

   a. In Case of wheeling of power to consumption site at 66 kV voltage level and above, normal open access charges and losses as applicable to normal open access consumer.

   b. Wheeling of Power to consumption site below 66 KV voltage level.

In case the injection of power is at 66 KV or above and drawal is at 11 KV, normal transmission charges and losses are applicable, however 50% of wheeling charges and 50% of distribution losses of the energy fed into the grid as applicable to normal open access consumers.

c. Wheeling of electricity generated by smaller investors having only one WEG.

Wheeling shall be allowed on payment of open access charges applicable to normal open access consumer and transmission and wheeling losses at @ 7% of the energy fed into the grid. The above losses shall be shared between the transmission and distribution licensees in the ratio 4:3

3. Wheeling of power to more than one locations

Wind power projects owners , who decide to wheel electricity for captive use / third party sale , to more than one location, shall pay 5 Paisa/KWh on energy fed in the grid to the distribution company concerned in addition to transmission charges and losses, as applicable.

Energy Metering

- Wind projects shall have to provide ABT compliant meters at the interface points and shall conform to the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006, as amended from time to time.
- Metering shall be done at interconnection point of the generator bus-bar with the transmission or distribution system concerned.

Pricing of Reactive Power

- 10 paise/kVARh– For the drawal of reactive energy at 10% or less of the net energy exported.
- 25 paise/kVARh– For the drawal of reactive energy at more than 10% of the net active energy exported

Sharing of Clean Development Mechanism (CDM) Benefits

- Sharing of CDM benefits on gross basis, starting from 100% to developers in the first year after commissioning, and thereafter reducing by 10% every year till the sharing becomes equal (50:50) between the developers and the consumers, in the sixth year and equal benefits thereafter.

Banking of Surplus Wind Energy

As promotional measure, it is proposed to continue the banking facility for 1 billing cycle for the wind power captive projects wheeling electricity for own use. However, it is proposed to levy banking charges in kind. Banking charges shall be adjusted in kind at 2% of the energy banked.

Purchase of Surplus Power from Wind Power Projects opting for Captive use and Third Party Sale under Open Access.

- For captive wind energy projects, the surplus energy after one month's banking is considered for purchase by distribution licensee at 85% of the wind tariff.
- For third party wind energy sale, the surplus energy after 15 minutes time block is considered for purchase by distribution licensee at the rate of 85% of the tariff declared by the Commission.

Renewable Energy Certificates for Third party sale and Captive Use of Wind Energy

- Third party sale and captive use of wind energy will be eligible for availing Renewable Energy Certificates as per CERC REC Regulations and subsequent amendments

Security Deposit

- As per the Govt. of Gujarat Wind Power Policy 2013.
- In case of delay in project commissioning beyond the allowed period due to unforeseen reasons GETCO may issue extensions on case-to-case basis.

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Abbreviations

%	Percentage
ABT	Availability-Based Tariff
AC	Alternating Current
AEO	Annual Energy Output
APPC	Average Pooled Purchase Cost
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CER	Certified Emission Reductions
CERC	Central Electricity Regulatory Commission
CUF	Capacity Utilization Factor
C–WET	Center for Wind Energy Technology
DC	Direct Current
FY	Financial Year
GBI	Generation Based Incentives
GEDA	Gujarat Energy Development Agency
GERC	Gujarat Electricity Regulatory Commission
GETCO	Gujarat Energy Transmission Corporation Ltd.
GoG	Government of Gujarat
GoI	Government of India
IEGC	Indian Electricity Grid Code
IEX	Indian Energy Exchange
IREDA	Indian Renewable Energy Development Agency
IRR	Internal rate of returns
Kg	Kilo gram
kg/m^3	kilogram per cubic meter
Km	Kilo meter
kW	Kilo Watt
kWh	Kilo Watt hours
M	Meter
m/s	meter per second
MA	Machine Availability
MAT	Minimum Alternate Tax
MNRE	Ministry of New and Renewable Energy
MW	Mega Watt
MWh	Mega Watt hour
NAPCC	National Action Plan for Climate Change
ND	Normal Depreciation
NEP	National Electricity Policy

NTP	National Tariff Policy
O&M	Operation and Maintenance
PDD	Project Design Document
PLF	Plant Load Factor
PPA	Power Purchase Agreement
PPA	Power Purchase Agreement
PXIL	Power Exchange India Limited
RBI	Reserve Bank of India
RE	Renewable Energy
REC	Renewable Energy Certificate
RPO	Renewable Purchase Obligation
RPS	Renewable Purchase Standards
Rs	Rupees
SBI	State Bank of India
SERC	State Electricity Regulatory Commission
V	Volt
W/m^2	Watt per square meter
WEG	Wind Energy Generator
WPD	Wind Power Density
WTG	Wind Turbine Generators

1. Introduction

1.1 Background

In exercise of the powers conferred under Sections 3 (1), 61 (h), 62 (1) (a), and 86 (1) (e) of The Electricity Act, 2003 and the National Electricity Policy, 2005 and Tariff Policy, 2016 and all other powers enabling it in this behalf, the Gujarat Electricity Regulatory Commission (GERC) presents this Discussion Paper for determination of tariff for procurement of power by Distribution Licensees and others from wind power projects to be commissioned in the control period starting from the date of order . The wind power tariff proposed under this discussion paper is based on the broad principles contained under the (i) GERC (Multi Year Tariff) Regulations 2016, (ii) GERC (Procurement of Energy from Renewable Sources) Regulations 2010 and (iii) CERC (Terms and conditions for Tariff determination from Renewable Energy Sources) Regulations 2012 and amendments made thereto.

The Commission earlier had issued a generic tariff order for procurement of power by Distribution Licensees and others from wind power projects in Gujarat on 08 August 2012. The control period of GERC wind power tariff order 2012 expired on 31 March 2016. The Commission also initiated suo-motu proceedings for extension of the existing control period beyond 31.03.2016 till the order for tariff determination for new control period is issued by the Commission. The Commission has decided to initiate the tariff determination process for procurement of power by Distribution Licensees and others from wind power projects to be commissioned during the new control period to be specified in the wind tariff order.

1.2 The Electricity Act, 2003

The following provision of the Act provides enabling legal framework for promotion of the Renewable Sources of energy by the State Electricity Regulatory Commissions (SERCs):

1.2.1 Section 86 (1) (e) of the Electricity Act 2003 mandates promotion of cogeneration and generation of electricity from renewable sources of energy:

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

1.2.2 **Section 61 (h)** of the Act provides that, while specifying the terms and conditions of determination of tariff, the Commission shall be guided by the objective of promotion of cogeneration and generation of electricity from renewable sources of energy.

1.2.3 **Section 62 (1) (a)** of the Act provides for determination of tariff for supply of electricity by a generating company to a distribution licensee.

"Supply of electricity by a generating company to a distribution licensee: Provided that the Appropriate Commission may, in case of shortage of supply of electricity, fix the minimum and maximum ceiling of tariff for sale or purchase of electricity in pursuance of an agreement, entered into between a generating company and a licensee or between licensees, for a period not exceeding one year to ensure reasonable prices of electricity."

While determining the generation tariff for RE sources under Section 62 (1) (a), the SERCs are supposed to be guided by the promotional aspect of RE as stipulated in tariff regulations framed under Section 61 (h) of the Act.

1.2.4 **Section 3 (1)** of the Electricity Act 2003 requires the Central Government to formulate, inter alia, the National Electricity Policy in consultation with the Central Electricity Authority (CEA) and State Governments. The provision is quoted below:

"The Central Government shall, from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy."

1.3 National Electricity Policy (NEP)

Clause **5.12** of the National Electricity Policy stipulates several conditions for promotion and harnessing of renewable energy sources. The salient features of the said provisions of NEP are reproduced below.

5.12.1*: Non-conventional sources of energy being the most environment-friendly, there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.*

5.12.2*: The Electricity Act, 2003, provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with the grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively, the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.*

1.4 Tariff Policy (TP), 2016

In compliance with the Section (3) of the Act, the Central Government has notified the revised Tariff Policy on 28 January 2016. The Tariff Policy elaborates the role of Regulatory Commissions, the mechanism for promoting renewable energy, the time-frame for implementation, etc. Clause 6.4 of the Tariff Policy addresses various aspects associated with promoting and harnessing renewable sources of energy generation including Co-generation from renewable energy sources. The provisions stated under Clause 6.4 of TP are given below.

"(1) Pursuant to provisions of Section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage of the total consumption of electricity in the area of a distribution licensee for purchase of energy from renewable energy sources, taking into account availability of such resources and its impact on retail tariffs. Cost of purchase of renewable energy shall be taken into account while determining tariff by SERCs. Long term growth trajectory of Renewable Purchase Obligations (RPOs) will be prescribed by the Ministry of Power in consultation with MNRE.

Provided that cogeneration from sources other than renewable sources shall not be excluded from the applicability of RPOs.

(i) Within the percentage so made applicable, to start with, the SERCs shall also reserve a minimum percentage for purchase of solar energy from the date of notification of this policy which shall be such that it reaches 8% of total consumption of energy, excluding Hydro Power, by March 2022 or as notified by the Central Government from time to time.

(ii) Distribution Licensee(s) shall compulsorily procure 100% power produced from all the Waste-to-Energy plants in the State, in the ratio of their procurement of power from all sources including their own, at the tariff determined by the Appropriate Commission under Section 62 of the Act.

(iii) It is desirable that purchase of energy from renewable sources of energy takes place more or less in the same proportion in different States. To achieve this objective in the current scenario of large availability of such resources only in certain parts of the country, an appropriate mechanism such as Renewable Energy Certificate (REC) would need to be promoted. Through such a mechanism, the renewable energy based generation companies can sell the electricity to local distribution licensee at the rates for conventional power and can recover the balance cost by selling certificates to other distribution companies and obligated entities enabling the latter to meet their renewable power purchase obligations. The REC mechanism should also have a solar specific REC.

(iv) Appropriate Commission may also provide for a suitable regulatory framework for encouraging such other emerging renewable energy technologies by prescribing separate technology based REC multiplier (i.e. granting higher or lower number of RECs to such emerging technologies for the same level of generation). Similarly, considering the change in prices of renewable energy technologies with passage of time, the Appropriate Commission may prescribe vintage based REC multiplier (i.e. granting higher or lower number of RECs for the same level of generation based on year of commissioning of plant).

(2) States shall endeavour to procure power from renewable energy sources through competitive bidding to keep the tariff low, except from the waste to energy plants. Procurement of power by Distribution Licensee from renewable energy sources from projects above the notified capacity, shall be done through competitive bidding process, from the date to be notified by the Central Government.

However, till such notification, any such procurement of power from renewable energy sources projects, may be done under Section 62 of the Electricity Act, 2003. While determining the tariff from such sources, the Appropriate Commission shall take into account the solar radiation and wind intensity which may differ from area to area to ensure that the benefits are passed on to the consumers.

(3) The Central Commission should lay down guidelines for pricing intermittent power, especially from renewable energy sources, where such procurement is not through competitive bidding. The tariff stipulated by CERC shall act as a ceiling for that category.

(4) In order to incentivize the Distribution Companies to procure power from renewable sources of energy, the Central Government may notify, from time to time, an appropriate bid-based tariff framework for renewable energy, allowing the tariff to be increased progressively in a back-loaded or any other manner in the public interest during the period of PPA, over the life cycle of such a generating plant.

Correspondingly, the procurer of such bid-based renewable energy shall comply with the obligations for payment of tariff so determined.

(5) In order to promote renewable energy sources, any generating company proposing to establish a coal/lignite based thermal generating station after a specified date shall be required to establish such renewable energy generating capacity or procure and supply renewable energy equivalent to such capacity, as may be prescribed by the Central Government from time to time after due consultation with stakeholders. The renewable energy produced by each generator may be bundled with its thermal generation for the purpose of sale. In case an obligated entity procures this renewable power, then the SERCs will consider the obligated entity to have met the Renewable Purchase Obligation (RPO) to the extent of power bought from such renewable energy generating stations.

Provided further that in case any existing coal and lignite based thermal power generating station, with the concurrence of power procurers under the existing Power Purchase Agreements, chooses to set up additional renewable energy generating capacity, the power from such plant shall be allowed to be bundled and tariff of such renewable energy shall be allowed to be pass through by the Appropriate Commission. The Obligated Entities who finally buy such power shall account towards their renewable purchase obligations.

Provided also that scheduling and despatch of such conventional and renewable generating plants shall be done separately.

(6) In order to further encourage renewable sources of energy, no inter-State transmission charges and losses may be levied till such period as may be notified by the Central Government on transmission of the electricity generated from solar and wind sources of energy through the inter-State transmission system for sale.

(7) Appropriate Commission may provide regulatory framework to facilitate generation and sale of electricity from renewable energy sources particularly from roof-top solar system by any entity including local authority, Panchayat Institution, user institution, cooperative society, Non-Governmental Organization, franchisee or by Renewable Energy Service Company. The Appropriate Government may also provide complementary policy support for this purpose."

1.5 Government of Gujarat Wind Power Policy 2013

Government of Gujarat has notified the 'Wind power policy 2013' on 25th July 2013 for development of wind power projects in the State. Some important provisions of this Policy are listed below:

- This policy came into force with effect from 25th July 2013 and remained in operation up to 31st March 2016.
- Electricity generated from WEGs is exempted from payment of Electricity Duty except in the case of third party sale.
- In order to ensure timely completion of project and timely utilization of the infrastructure created by GETCO, the project developers are required to furnish the Bank Guarantee of Rs.5 lakhs/MW to GETCO based on allotment of transmission capacity. In case the developer fails to commission the Windfarm substation and the transmission line within the specified time frame, GETCO is empowered to encash the Bank Guarantee.
- Concessional transmission and wheeling losses in case the energy is wheeled at below 66 KV voltage level/in case of single WTG owner.
- The evacuation facility from the wind farm substation to GETCO substation within the range of 100 km shall be erected by developer at their own cost and beyond this limit, GETCO shall erect the evacuation facility.
- The voltage level of evacuation of wind power in the grid shall be at 66 kV and above.
- The electricity generated from the WEGs, shall be metered on a monthly basis jointly by GEDA/GETCO at the sending substation of 66 kV or above located at wind farm site.

1.6 Renewable Purchase Obligation in Gujarat

The Gujarat Electricity Regulatory Commission (Procurement of Energy from Renewable Sources) Regulations, 2010, (Notification No. 3 of 2010) dated 17 April, 2010 has specified the minimum renewable power purchase by the obligated entities for the financial year (FY) 2010-11 to 2012-13 as shown in Table No. 1.1 below.

Table No. 1.1 Renewable purchase obligation in Gujarat for FY 2010-11 to 2012-13

Year	Total RPO	Non Solar RPO		Solar RPO
		Wind	Biomass bagasse and other	Solar
2010-11	5%	4.5%	0.25%	0.25%
2011-12	6%	5%	0.5%	0.5%
2012-13	7%	5.5%	0.5%	1%

(Note: RPO specified for FY 2012-13 shall be continued beyond 2012-13 till any revision)

As per this regulation, the obligated entities have the obligation to purchase electricity (in kWh) from specified RE sources. The said purchase shall be at a defined minimum percentage of the total consumption of its consumers including T&D losses during a year.

This renewable purchase obligation applies to:

- distribution licensees; and
- any other captive and open-access users consuming electricity (i) generated from conventional captive generating plant having capacity of 5 MW and above for their own use and/or (ii) procured from conventional generation through open access and third party sale.

The Regulations recognise the certificates issued within the scope of Central Electricity Regulatory Commission's (CERC) Notification No. L-1/12/2010-CERC dated 14 January 2010 as the valid instruments for discharge of the mandatory obligations set out in these Regulations for the obligated entities to purchase electricity from renewable energy sources termed as Renewable Energy Certificates (REC).

Subsequently, the Commission has amended the Principal GERC (Procurement of Energy from Renewable Sources) Regulations, 2010 on 4 March 2014 as GERC (Procurement of Energy from Renewable Sources) (First Amendment) Regulations, 2014 (Notification No. 2 of 2014) and specified the RPO targets for FY 2013-14 to FY 2016-17. The RPO targets specified under the Regulations are given in the Table No. 1.2 below.

Table No. 1.2 Renewable purchase obligation in Gujarat for FY 2013-14 to 2016-17

Year	Total RPO	Non Solar RPO		Solar RPO
		Wind	Biomass bagasse and other	Solar
2013-14	7%	5.5%	0.5%	1.00%
2014-15	8%	6.25%	0.5%	1.25%
2015-16	9%	7.00%	0.5%	1.50%
2016-17	10%	7.75%	0.5%	1.75%

Applicability of RPO on Captive power users: Fossil fuel based CPPs in Gujarat have approached the Hon'ble High Court of Gujarat and filed a petition on the issue of applicability of RPO on the CPPs and Open Access consumers in Gujarat. Hon'ble High Court of Gujarat in its judgement (Special Civil Application No. 171 of 2011) dated 13 March 2015 ruled in favour of the GERC and upheld the applicability of RPO on open access consumers, CPPs as well as co-generation plants with fossil fuel, as proposed by the Commission under its RPO Regulations. Subsequently, the Commission vide notification No. 2 of 2015 dated 1 July 2015 notified that Renewable Purchase Obligation as per GERC (Procurement of Energy from Renewable Sources) Regulations, 2010 (Notification No.3 of 2010) and amendments shall become applicable to Captive and Open Access User(s)/Consumer(s) from the date of notification i.e. 1 July 2015, subject to final orders by the Hon'ble High Court.

1.7 Wind Energy Tariffs in Other States

Central Electricity Regulatory Commission (CERC) under its RE Tariff Regulations 2012 and RE Tariff Order 2015 has adopted wind zone based tariff for wind power projects. Similar methodology has been adopted by Maharashtra Electricity Regulatory Commission. In case of Rajasthan, the RERC has divided the wind potential areas of the State in two different zones and separate tariff for wind power projects coming under these two regions are awarded. However, most of other SERCs like TNERC, KERC, GERC & KSERC have adopted single normative tariff for wind energy projects commissioned in the respective States. CERC, MERC and RERC have adopted capital cost indexation mechanism for revision of capital cost and tariff during subsequent years of control period, whereas most of other SERCs have retained the capital cost and tariff constant during control period. The comparison of Wind Tariff specified by different SERCs for wind energy projects is tabulated below:

Table No 1.3 Comparison of Wind Energy Feed-in Tariff in Different States

CERC (31.03.15)	MERC (11.11.2015)	KERC (10.10.2013 Amended on 24.02.2015)	RERC (29.05.15)	TNERC (25.07.14)	GERC (Existing Order)	MPERC (17.03.16)	KSERC (11.11.15)
Z1-Rs 6.58 PU (0.71) Z2-Rs 5.98 PU (0.64) Z3-Rs 5.27 PU (0.57) Z4-Rs 4.39 PU (0.47) Z5-Rs 4.11 PU (0.44)	Z1-Rs 5.70 PU (0.62) Z2-Rs 5.01 PU (0.55) Z3-Rs 4.18 PU (0.46) Z4-Rs 3.92 PU (0.43)	Rs. 4.50 PU	Rs 5.74 for Jaisalmer, Jodhpur and Barmer districts) Rs 5.14 for other districts	Rs 3.51 PU	Rs 4.15 PU	Rs 4.78 PU	Z1-6.34 PU Z2- 5.76 PU Z3- 5.07 PU

Note: Figures in parentheses represent monetary benefit of accelerated depreciation.

1.8 GERC Tariff Order 2012 for WEG

Gujarat Electricity Regulatory Commission (GERC), in its Order No. 2 of 2012 dated 08 August, 2012 determined the tariff for procurement of power by the Distribution Licensees and others from wind energy projects in the State of Gujarat. After due public consultation and regulatory process, GERC had offered single part levellized tariff of Rs. 4.23 per kWh for procurement of wind power by the distribution licensees in the State. This tariff order was made applicable for the wind energy projects commissioned on or after 11th August 2012. The control period of this tariff order expired on 31 March 2016. Along with the rate for sale of electricity to Distribution Licensees the Commission in this order has addressed the other commercial issues associated with wind power transactions for third party sale and captive use. Further, in review of the Commission's Order No.2 of 2012, in Petition No.1243/2012 and Petition No.1249/2012, Commission re-determined the tariff as Rs. 4.15/kWh, which was made applicable for the projects commissioned during the control period from 11.8.2012 to 31.3.2016.

1.9 Wind Power Project developments in Gujarat during Control Period of Previous Tariff Order

From 01st April 2012 till 31st December 2015, Gujarat had added around 948 MW capacity of wind power projects. The annual capacity addition during the control period of previous tariff order is shown in the **Table No.** 1.4.

Table No. 1.4 Annual wind energy capacity addition since 01st April 2012

Duration	Installed Capacity in MW
01.04.2012 to 31.03.2013	208.3
01.04.2013 to 31.03.2014	279.8
01.04.2014 to 31.03.2015	190.725
01.04.2015 to 31.12.2015	269.4
Total	**948.225**

Source: GEDA

Most of the above wind energy project installations are in the wind potential districts like Kutch, Jamnagar, Rajkot, and Porbandar.

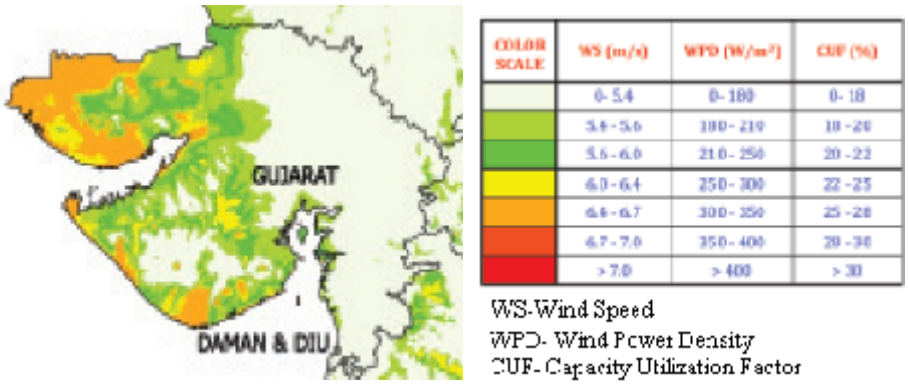
2. Wind Resource Assessment and Wind Power Technology

2.1 Wind Resource Potential Assessment for Gujarat

Wind power density which is a function of wind velocity and air density is better indicator of wind resource availability at a particular location. National Institute of Wind Energy (NIWE) formerly known as C-WET, under MNRE in association with Riso DTU National Laboratory for Sustainable Energy (NLSE), Denmark, developed the Indian Wind Atlas which has been published in April 2010. In the wind atlas meso scale models have been used to develop the wind resource map of India for 50m and 80m level. The results of these meso scale models have been correlated with the actual measured data from various wind monitoring stations to arrive at certain accuracy of the meso scale wind mapping. NIWE has chosen advanced modeling techniques and revisited this study under the guidance and directives of MNRE/Govt. Of India, with realistic and practical assumptions and estimated the wind power potential in India at 100m height as 302 GW. The Indian Wind Atlas was published on 7th December 2015. This assessment has been made at 500m resolution. The study was performed with actual land availability estimation using NRSC 56m resolution land use land cover (LULC) data (AWiFS) 1:250K scale and with consideration of 6MW/sq.km. The suitable land has been ranked as Wasteland-Rank 1, Cultivable/Agriculture land-Rank2 and Forest land-Rank 3with weightage as 80%, 30% and 5% respectively. While developing the Atlas, zones with Capacity Utilization Factor of 20% and more are considered for wind potential estimation. NIWE has installed around 81 wind monitoring stations for wind resource assessment of Gujarat as on 31.01.2016. As per these assessments, the installable wind power potential of Gujarat State was pegged at 84,431 MW.

Figure 2.1 below shows the pattern of wind power density over State of Gujarat at 100m hub height above ground as given in Indian Wind Atlas.

Figure 2.1 Wind Power Density Map at 100 m level (Wind Power Density Watts/Sq. Mtr)



(Source: NIWE)

It can be noticed that by increasing the hub height of wind turbine the wind power density increases and in turn the power generation capacity increases. Recent advancement in WTG technology coupled with introduction of MW class WTG with higher hub heights are capable of extracting more power at higher hub height. In a recent study, NIWE has re-assessed the wind power potential of India at 100 m hub height and concluded that wind power potential of India has increased from 102.788 GW (at 80 m level) to 302 GW (at 100 m level) . In case of Gujarat State the earlier NIWE assessed wind power potential has increased from 35.071 GW (at 80 m level) to 84.431 GW (at 100m level).

From above map (Figure 2.1) it can be seen that most of the area of Gujarat fall under 200 to 350 W/m^2 wind power density zone at 100 m above ground level and there are very less areas with wind power density lower than 200 W/m^2. The revised NIWE assessed State wind potential of 84,431 MW (at 100 m hub height) and present installed capacity of 3645.4 MW as on 31st March 2015 indicates huge potential for further wind power project development in the State.

2.2 Report on India's Wind Power Potential

WinDForce along with CSTEP submitted a report on assessment of "India's wind power potential" to MNRE in July 2015. The study was based on LULC data obtained from National Remote Sensing Center (NRSC). The wind power was calculated based on CUF for 5Dx7D and 3Dx5D and for 100m and 120 m hub heights.

The LULC mapping used was of 1:250000 scale with areas divided into 7 categories viz. Vector, Agriculture, Forest, Grass/Grazing, Barren/Uncultivable/Wastelands, Water bodies and Snow and Glacier. The areas are ranked according to suitability of land type as Wasteland-Rank 1, Agriculture land-Rank 2 and Forest land-Rank 3. The MW potential was taken as 5.7 MW/sq.km for 5Dx7D turbine spacing and 13.3MW/sq.km for 3Dx5D turbine spacing. A cut off of 20% CUF has been considered with a Weibull shape parameter of the order of 2. An average representative 2 MW WTG was assumed for the assessment. WinDForce and CSTEP conducted the assessment of wind power potential of States of India using different methods and arrived at the results for the State of Gujarat as shown in Table 2.1.

Table 2.1 Wind potential for State of Gujarat

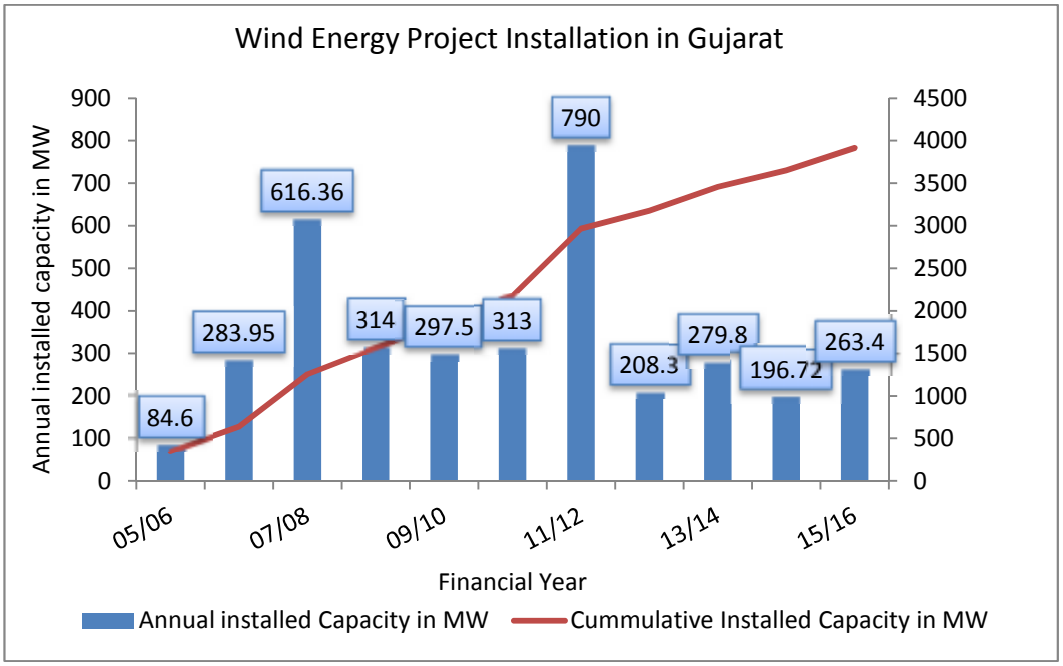
	5Dx7D (100m) GW	**3Dx5D(100m) GW**	**5Dx7D (120m) GW**	**3Dx5D(120m) GW**
WinDForce	275	642	285	666
CSTEP	223	519	252	590

According to the study the CUF of Gujarat State ranges from 25 to 40% and wind speeds range from 6 to 9 m/s.

2.3 Wind Power Project Development in Gujarat

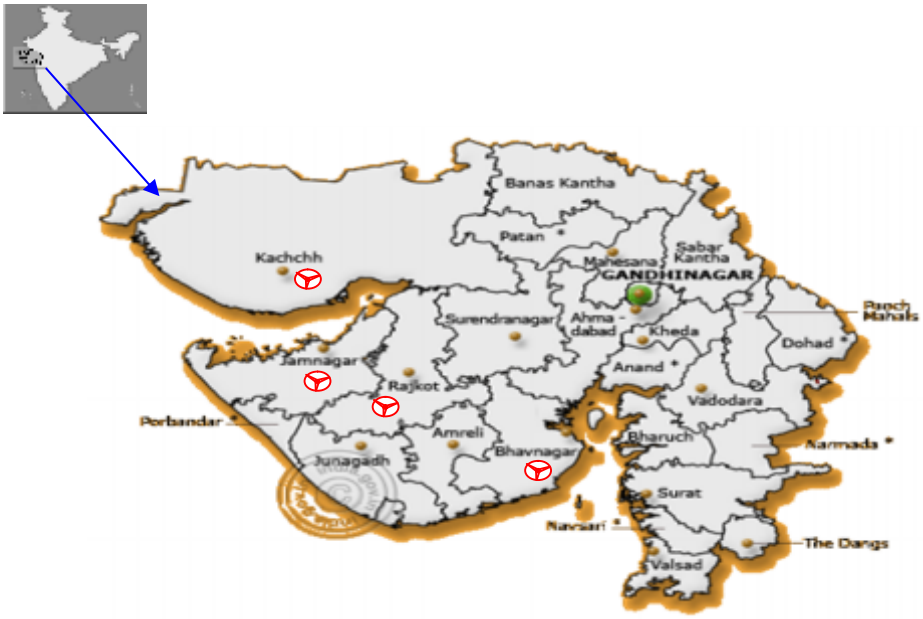
Wind Energy Projects Installation in Gujarat has reached to 3933 MW by 31st March 2016. Out of this, cumulative installation during April 2012 to December 2015 is 948.225 MW, accounting to around 25% of cumulative installed capacity of 3933 MW as on date. The credit for peaking of wind capacity installation in the State goes equally to the conducive Policy and Regulatory framework created by the State Government and State Regulator as well as the fiscal incentives offered by Government of India. The annual installed capacity and cumulative installed capacity of wind energy projects in Gujarat is as shown in **Figure No**.2.2 and the locations of wind power projects in Gujarat is shown in **Figure** 2.3

Figure 2.2 Wind Energy Project Installations in Gujarat



(Source: MNRE, GEDA)

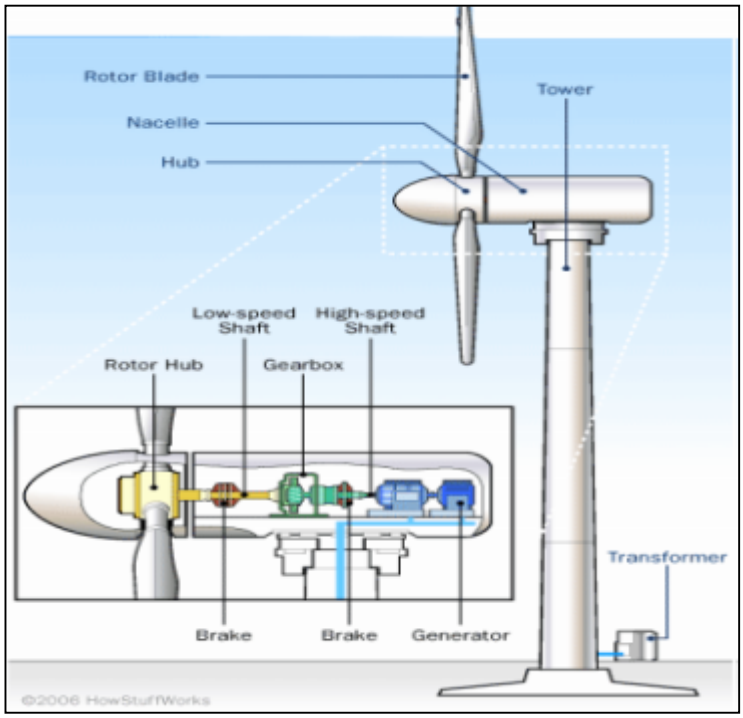
Figure 2.3 Wind power potential regions in Gujarat



2.4 Wind Power Technology

The wind power generation is simple conversion of kinetic energy of wind into the electrical energy. However the mechanism to capture the energy, transmit and convert in electrical energy involves several stages, components and controls. The important components/controls of horizontal axis wind turbine are Rotor blades, Tower, Generator, Gear Box, Main Shaft, Nacelle and Aerodynamic power regulation and brakes

Figure 2.4 Components of Wind Turbine

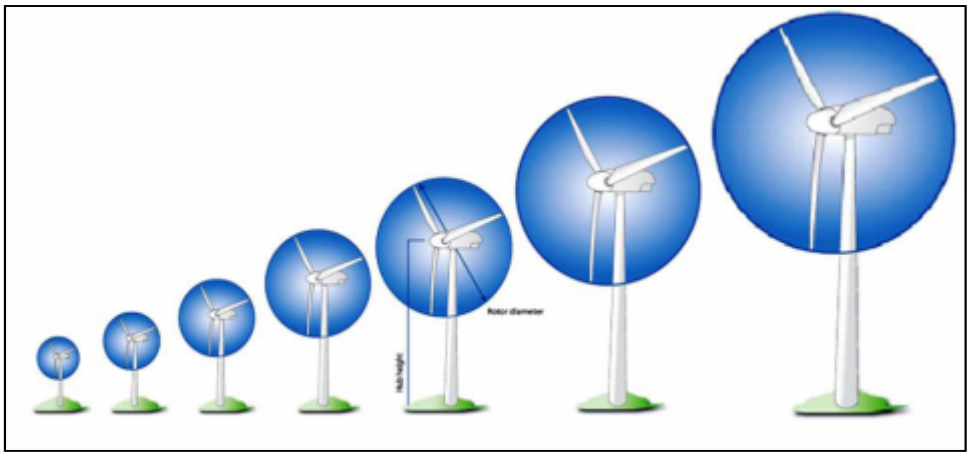


Based on the axis of rotation of the rotor, wind turbines are classified into horizontal axis wind turbines (HAWT) and vertical axis wind turbines (VAWT). Because of their higher energy conversion efficiency compared to VAWT, the HAWT has been preferred by the wind turbine manufacturers, specially in the large size wind turbine sector. All the grid connected wind power projects in India are with HAWT. **Figure** 2.4 above shows various components of the wind power system.

Though there has been no major change in the overall architecture of the modern wind turbines there have been many technological improvements in the design of the wind turbines worldwide resulting in improved performances, optimal land use and better grid integration. The areas in which development work is being targeted are large size wind turbines with higher rated generating capacity, development of powerful and larger blades, improved power electronics and taller towers. Lot of improvements have been taking place in the size and performance of wind turbines with the market demand and the manufacturer's initiatives. An exponentially increasing growth with time in turbine size has taken place since the start of the millennium. In the last 20 years the turbine sizes have been increased by a factor of 100 (i.e. from machines of just 25 kW twenty years ago to 2500 kW and above). Today, modern wind turbine technology is available for a greater range of sites, such as for low and high wind speeds, desert

and arctic climates. In these years interest is in the larger size turbine development for offshore project sites. The land-based market is being focussed for volumetric production of the wind turbines in the range of 1.5 MW to 3.0 MW rated capacity. Figure 2.5 shows the development in the rated capacity of wind turbines being installed in India.

Figure 2.5 Evolution of WTG capacity and size in India



2.5 NIWE Approved List of WTGs

In order to streamline the development and facilitate healthy and orderly growth of the wind power sector in the country, Ministry of New and Renewable Energy had issued guidelines for installation of duly tested and certified quality equipment to optimise energy generation from wind power projects. The list of wind turbine manufacturers and models approved by NIWE are being published under Revised List of Models and Manufactures (RLMM) of Wind Turbines. As per this list following wind turbine models are allowed for large scale installation in India.

Table No.2.2 List of Wind Turbine Models Approved by NIWE as per RLMM

	Name of WTG Manufacturer	Rating of WTG (in kW)	Model No	Rotor Dia. (in Mtr)	Hub Height (in Mtr)
1.	Gamesa Renewable Pvt. Ltd.	850	G52	52	44/55/65
2.	Gamesa Renewable Pvt. Ltd.	850	G58 (IIA)	58	44/55/65
3.	Gamesa Renewable Pvt. Ltd.	850	G58(IIIB)	58	44/55/65/74
4.	Gamesa Renewable Pvt. Ltd	2000	G97	97	78/90
5.	Gamesa Renewable Pvt. Ltd	2000	G97 GF-2.0	97	78/90
6.	Gamesa Renewable Pvt. Ltd	2000	G971	97	78/90
7.	Gamesa Renewable Pvt. Ltd	2000	G97	97	104/108
8.	Gamesa Renewable Pvt. Ltd	2000	G114-2.0 IEC IIIA	114	80/93/125

	Name of WTG Manufacturer	Rating of WTG (in kW)	Model No	Rotor Dia. (in Mtr)	Hub Height (in Mtr)
9.	Gamesa Renewable Pvt. Ltd	2000	G114-2.0 IEC-S	114	106/110
10.	M/s Garuda Vaayu Shakthi Limited	700	Garuda 700.54 EU54.1250. 1-B	54	73
11.	M/s GE India Industrial Private Limited	1600	GE1.6-82.5	82.5	80
12.	M/s GE India Industrial Private Limited	1600	GE1.6-87	87	80
13.	M/s GE India Industrial Private Limited	1700	GE1.7-103	103	79.7
14.	M/s Global Wind Power Limited	1500	Mingyang 1.5	77.36	75
15.	M/s Global Wind Power Limited	1500	Mingyang 1.5-89	89	80
16.	M/s Inox Wind Limited	2000	WT2000DF	93.3	80
17.	M/s Inox Wind Limited	2000	DF/2000/1 00	100	80/92
18.	M/s Kenersys India Private Limited	2000	K82	82	80/98
19.	M/s Kenersys India Private Limited	2500	K100	100	85/100
20.	M/s Kenersys India Private Limited	2400	K110	109	85/95
21.	M/s Kenersys India Private Limited	2625	K110 P+	109	85
22.	M/s. Leitwind Shriram Manufacturing Limited	1500	Leitwind LTW77-1.5	76.6	61/65/80
23.	M/s. Leitwind Shriram Manufacturing Limited	1500	Leitwind LTW80-1.5	80.3	80
24.	M/s Leitwind Shriram Manufacturing Limited	1800	Leitwind LTW80-1.8	80.3	80
25.	M/s Leitwind Shriram Manufacturing Limited	1500	Leitwind LTW86-1.5	86.4	80
26.	M/s Leitwind Shriram Manufacturing Limited	3000	Leitwind LTW101-3.0	100.9	93.5
27.	M/s NuPower Technologies Private Limitd	2050	W2E-93/205	93.2	85/98.2
28.	M/s NuPower Technologies Private Limited	2050	W2E-100/2.05	100.13	98.2/117/141
29.	M/s Para Enterprises Private Limited(Formerly M/s Pioneer Wincon Private Limited)	250	Pioneer 250/29	29.6	50
30.	M/s Para Enterprises Private Limited(Formerly M/s Pioneer Wincon Private Limited)	750	Pioneer Wincon 750/49	49	61.1
31.	M/s Power Wind Limited	900	PowerWind	56	71

	Name of WTG Manufacturer	Rating of WTG (in kW)	Model No	Rotor Dia. (in Mtr)	Hub Height (in Mtr)
			56		
32.	M/s PASL Wind Solutions Private Limited	1500	PWS 1800i(de-rated configuration)	83.64	80
33.	M/s Regen Powertech Private Limited	1500	Vensys 82	82.34	70/75/85/100
34.	M/s Regen Powertech Private Limited	1500	Vensys 87	86.6	85/100
35.	M/s Regen Powertech Private Limited	1500	Vensys 89	88.34	85
36.	M/s RRB Energy Limited	500	V39-500	47	50
37.	M/s RRB Energy Limited	600	Pawan Shakthi-600	47	50/65
38.	M/s RRB Energy Limited	1800	Pawan Shakthi- PS 1800	82.4	80/100
39.	M/s Shriram EPC Limited	250	SEPC 250T	28.5	541.5
40.	M/s Shriram EPC Limited	250	SEPC 250T	28.5	51.5
41.	M/s Siva Wind turbine India Private Limited	250	SIVA 250/50	30	50
42.	M/s Southern Wind Farms Limited	225	GWL 225	29.8	45
43.	M/s Suzlon Energy	1500	S82V3	82	78
44.	M/s Suzlon Energy	2100	S88 V3A	88	80
45.	M/s Suzlon Energy	2100	S95 DFIG	95	80/90/100
46.	M/s Suzlon Energy	2100	S97 DFIG	97	80/90/100/120
47.	M/s Suzlon Energy	2100	S97 HT	97	120
48.	M/s Suzlon Energy	2100	S111 DFIG	111.8	90
49.	M/s Vestas Wind Technology India Private Limited	1800	V100-1.8 MW 50 hZ VCS Mk 7	100	80/95/120
50.	M/s Vestas Wind Technology India Private Limited	1800	V100-1.8 MW 50 hZ VCS Mk 7.1	100	95
51.	M/s Vestas Wind Technology India Private Limited	2000	V100-2.0 MW 50 hZ VCS Mk 7.1	100	80/95
52.	M/s Vestas Wind Technology India Private Limited	2000	V100-2.0 MW 50 hZ VCS Mk 7	100	80/95/120
53.	M/s Vestas Wind Technology India Private Limited	2000	V110-2.0 MW 50 hZ VCS Mk 10	110	80/95/110/120 /125

	Name of WTG Manufacturer	Rating of WTG (in kW)	Model No	Rotor Dia. (in Mtr)	Hub Height (in Mtr)
54.	M/s Vestas Wind Technology India Private Limited	2000	V110-2.0 MW 50 hZ VCS Mk 10 IEC S	110	110
55.	M/s WindWorld (India) Limited	800	WW-53	52.9	75
56.	M/s WinWinD Power Energy Private Limited	1000	WinWinD 1 MW	60	70

(Ref: NIWE RL2100MM list dated 28.09.2015 and 03.02.2016)

2.6 Wind Energy Projects Installation Trend in Gujarat

To analyse the wind energy projects technology trend in Gujarat, the wind projects installations post GERC tariff order 08.08.2012 were considered. Total 952 MW capacity wind power projects were installed in Gujarat during the last control period (08th August 2012 to 31st March 2016). Most of these wind energy project installations were concentrated in the districts like Kutch, Jamnagar, Rajkot, and Porbandar.

A systematic analysis of Wind power installation during the control period of previous GERC tariff order shows a clear shift towards the MW class WTG.

Currently the market trend is towards higher hub height and higher turbine capacity machine because of simple reasons that for a given capacity lower number of higher capacity WEGs are required which ultimately cut down the land & O&M cost and extract more energy from the wind due to higher hub height.

The State of Gujarat is not exception to this as can be seen from the following table:

Table No. 2.3 MW Class and Sub MW Class WTG Installations in Gujarat

Duration	Total Installed Capacity in MW	Total installations (in MW) with sub MW class WTG	Total installations (in MW) with MW class machine
01.04.2012to 31.03.2013	208.3	97.55	110.75(53.3%)
01.04.2013 to 31.03.2014	279.8	134.05	145.75(51.1%)
01.04.2014 to 31.03.2015	190.725	47.775	142.95(76.0%)
01.04.2015 to 31.12.2015	269.40	29.40	240.0(88.9%)
Total	948.225	308.775	639.45(67.6%)

(Source: GEDA)

From above **Table No**. 2.3 it can be seen that during each year from the control period of previous tariff order more than 65% of the machine chosen by investor were MW class machines. Out of 948.225 MW of wind projects installed in Gujarat 639.45 MW of wind projects have used MW class wind turbines and 308.775 MW of wind projects have used wind turbines of ratings below 1 MW. Also, these MW class wind turbines were placed at 80 mtr above ground level. The wind turbine models installed after 08th August 2012 are tabulated in Table No 2.4.

Table No.2.4 Wind turbine models installed in Gujarat

WTG Make	Rating (kW)	Hub Height in mtr	Generator	Regulation
Suzlon	2100	80 /90/100	Asynchronous Flexi Slip	Pitch Regulated
	1500	78	Asynchronous Flexi Slip	Pitch Regulated
	1250	56/65/74	Asynchronous	Pitch Regulated
Enercon	800	50/56/57/65/75/76	Synchronous	Pitch Regulated
Vestas	2000	80/95/105	Asynchronous, Optislip	Pitch Regulated
	1800	80/95	Synchronous	Pitch Regulated
Gamesa	800	44/55/65	DFIG	Pitch Regulated
	850	44/55/65	DFIG	Pitch Regulated
	2000	93/120/140/site specific	DFIG	Pitch Regulated
SWL	225	45	Asynchronous	Stall regulation
Pioneer Wincon	750	61.1	Asynchronous	Stall regulation
SEPC	250	41.2	Asynchronous	Pitch Regulated
Inox	2000	80	DFIG	Pitch Regulated
PASL	900	71/74	Asynchronous	Pitch Regulated
	1250	68/83.64	Asynchronous	Pitch Regulated
	1800	83.64/100	Asynchronous	Pitch Regulated
WWIL	800	74	Direct Drive	Pitch Regulated
LSML	1500	65	Direct Drive	Pitch Regulated

3. Computation of Tariff for Wind Energy Projects

3.1 Approach & Methodology :

3.1.1 The Commission notes that the revised Tariff Policy notified by the Central Government on 28 January 2016 in pursuance of Section 3 of the Act has stipulated that the Appropriate Commission may determine preferential tariff for procurement of power by distribution licensees from non-conventional sources of energy till issue of notification on procurement of power from renewable energy sources through competitive bidding by Central Government. The relevant extract of para 6.4 of the Tariff Policy is given below.

".....(2) States shall endeavor to procure power from renewable energy sources through competitive bidding to keep the tariff low, except from the waste to energy plants. Procurement of power by Distribution Licensee from renewable energy sources from projects above the notified capacity, shall be done through competitive bidding process, from the date to be notified by the Central Government.

However, till such notification, any such procurement of power from renewable energy sources projects, may be done under Section 62 of the Electricity Act, 2003. While determining the tariff from such sources, the Appropriate Commission shall take into account the solar radiation and wind intensity which may differ from area to area to ensure that the benefits are passed on to the consumers.

(3) The Central Commission should lay down guidelines for pricing intermittent power, especially from renewable energy sources, where such procurement is not through competitive bidding. The tariff stipulated by CERC shall act as a ceiling for that category."

3.1.2 Above provisions under the Tariff Policy has been noted. The fact is that tariff of the solar based generation has substantially come down as a result of adoption of competitive bidding process for procurement of solar based generation in the country.

It is decided to determine the tariff under 'cost –plus' methodology as adopted in previous tariff orders during 2009 and 2012. However, the distribution licensees may carry out the competitive bidding for procurement of electricity from wind power projects in the State. In case such tariff has been determined through a transparent process of competitive bidding under Section 63 of the Act, they may approach to the Commission for adoption of Tariff discovered through bidding. In such case, the distribution licensees are free to procure electricity from wind power projects at a tariff discovered

under competitive bidding with the tariff determined by the Commission in its order acting as ceiling tariff .

3.2 General Principles

Under this section the general principles for wind power tariff determination such as control period, tariff period, tariff structure, tariff design; plant life etc has been discussed

3.2.1 Control Period: Since the control period of previous wind tariff order 1 of 2012 dated 08 August 2012 expired on 31th March 2016 and the Commission has initiated proceedings for extension of control period, it is decided that the new control period of the tariff order under discussion will be from the date of order to 31.03.2019.

3.2.2 Tariff period: The tariff period for the tariff determined by the Commission for procurement of electricity from wind power projects by the distribution licensees in the State will be 25 years.

3.2.3 Tariff structure & design: It is preferred to award a 'single part levellized tariff' for procurement of electricity from wind power projects commissioned during the next control period by the distribution licensees in the State.

3.2.4 Useful life of plant: In its earlier order dated 08.08.2012 the project life considered was 25 years for wind energy projects. Further, the CERC in its order dated 31.03.2015 has also considered the wind energy project life of 25 years. In view of above, 25 years as useful life of the wind power generating station including the evacuation line seems reasonable for tariff determination purpose.

3.2.5 Eligibility criteria: The wind power projects using new wind turbine generator and commissioned after the wind tariff order up the control period of this tariff order will be eligible to sell power to distribution licensee of Gujarat at tariff determined in the order.

3.2.6 Scheduling of wind power: CERC has finalised the framework on forecasting, scheduling, and deviation settlement of RE generation based on wind and solar generators which qualify as regional entities as per the IEGC. After instituting an inter-State framework, the Forum of Regulators (FoR) has framed model regulations on forecasting, scheduling, and deviation settlement of RE generation for the State level. The said framework, when implemented in the State level will be applicable for the wind generators also.

3.2.7 Applicability of Merit order despatch principle: The wind power plants irrespective of plant capacity shall be treated as 'MUST RUN' power plants and shall not be subjected to 'merit order despatch' principles.

3.2.8 Metering point, grid connectivity and evacuation arrangement: The metering point will be at the pooling substation at 66KV and above located at wind farm site, whereas the interface point for the grid connectivity will be the nearest GETCO substation.

3.3 Evolution of Capital Cost and Other Performance Parameters

3.3.1 Benchmark Capital Cost for Wind power Project in Gujarat

Capital cost is the most critical component while determining the tariff in a regulated environment. The capital cost of wind power project comprises of the cost of (i) tower and its base, (ii) turbine generators, (iii) blades, (iv) controllers, (v) power and control cabinets, (vi) distribution structure, (vii) transformer and associated equipments, (viii) land and its development cost, (ix) processing fee of Gujarat Energy Development Agency, (x) erection and commissioning charges, (xi) financing charges and IDC and (xi) creation of evacuation system up to the interconnection point .

In order to arrive at benchmark capital cost for the next control period starting from the order for the new control period, the wind power capital cost trends in national and international market during the last control period have been examined. Along with this the wind power capital cost data of the projects commissioned in Gujarat during the control period of previous wind tariff order as well as the approach followed by CERC and other SERCs while fixing the benchmark capital cost have been analysed. The trend in Wholesale Price Index (WPI) of major commodities (steel and electro-mechanical equipments) constituting wind power capital cost as per data published by the Office of Economic Advisor, Ministry of Commerce and Industry, GoI has also been analysed.

Components of Capital Cost and its Trend:

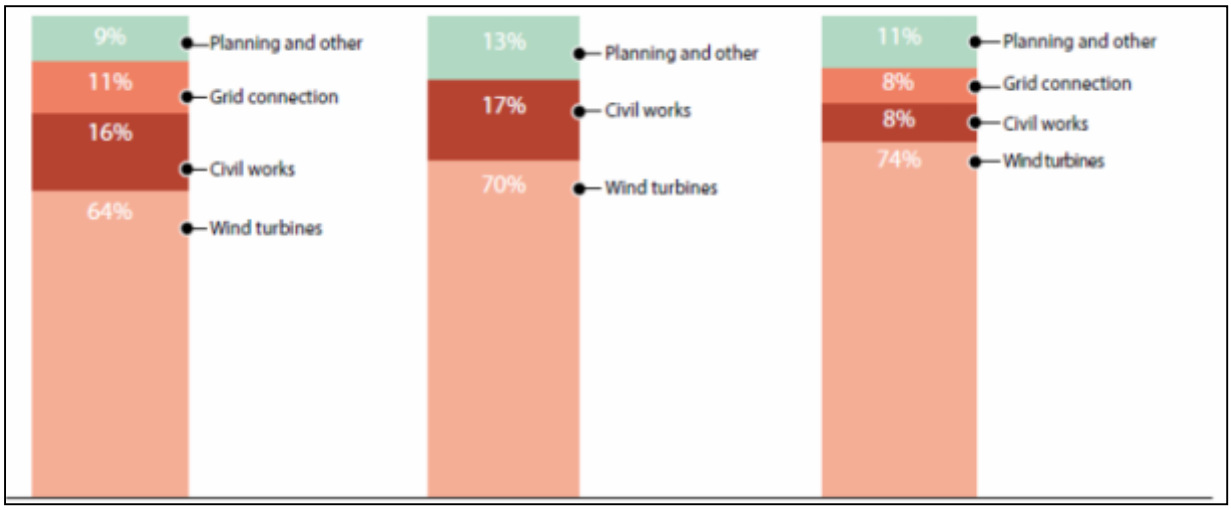
The capital costs of a wind power project can be broken down into the following major categories:

- Turbine cost: rotor, blades, gearbox, generator, power converter, nacelle, tower and transformer;
- Civil works: construction costs for site preparation and foundations for the towers;
- Grid connection costs: transformers and sub-stations, as well as the connection to the local distribution or transmission network;

- Planning and project costs: development costs and fees, licenses, financial closing costs, feasibility and development studies, legal fees, rights of way fees, owners insurance, debt service reserve etc; and
- Other capital costs: construction of roads, buildings, control systems, etc.

As per the available literature, in the total capital cost of wind power project, wind turbines account for between 64% and 74% of total installed costs. Furthermore, grid connection costs can vary between 8% and 11%, construction and civil works from 8% and 17%, while other capital costs typically range between 4% and 10%.

Figure 3.1 Comparison of Wind Power total installed cost breakdown from different sources



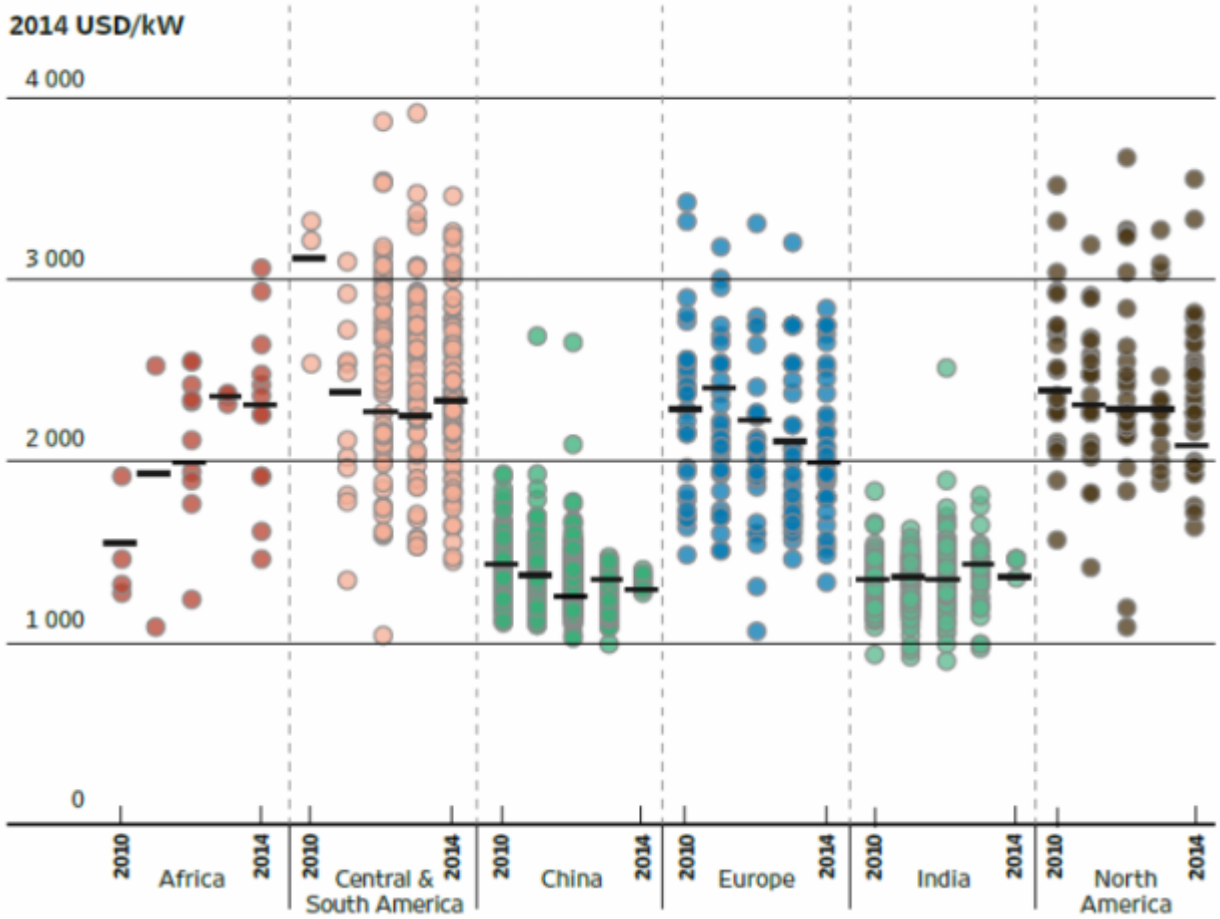
(Source: IRENA: "Renewable Power Generation Costs in 2014", January 2015)

3.3.1.1 Wind turbine prices increased in the initial period and peaked in 2009. After that wind turbine prices began to decrease. The Bloomberg New Energy Finance (BNEF) wind turbine price index (WTPI) decreased 35% for wind turbines of less than 95 metres in diameter and 20% for wind turbines with rotor diameters greater than 95 metres, resulting in an overall average decrease of 28% during year 2011 to 2014. The decline in wind turbine prices occurred at a time when wind turbine technology had improved significantly due to larger rotor diameters and higher towers, allowing for higher electricity output.

3.3.1.2 Total project cost of wind power project has followed similar trend. In USA, 28% drop in project cost was observed. India also has low total project costs, which averaged around USD 1370/kW in 2013 and 2014. The total project cost in India is broadly stable, which suggests that onshore wind costs are

approaching a mature level. The figure given below has shown the global trend of total project cost in the 2010 to 2014 period.

Figure 3.2 Wind Power Total Project Cost By Region and Country, 2010-2014



(Source: IRENA: "Renewable Power Generation Costs in 2014", January 2015)

3.3.1.3 Under the Regulatory approach, the Commission has studied the approach followed by CERC as well as other SERCs under the recent wind tariff orders notified by them. The capital cost approved by CERC and other SERCs under the regulatory approach are presented below:

Table No.3.1: Capital cost approved by CERC and other SERCs

CERC (31.03.15)	MERC (11.11.2015)	KERC (10.10.2013) Amended on 24.02.2015	RERC (29.05.15)	MPERC (17.03.2016)	GERC (Existing Order)
Rs 6.19 Cr/ MW for 2015-16	Rs 6.00 Cr/MW for 2015-16	Rs 6.00 Cr/MW	Rs 5.79 Cr/ MW + 0.2 Cr/MW towards interconnection to RVPN	Rs 5.75 Cr/MW	Rs. 5.68 Cr/MW

The capital cost benchmark for wind power projects fixed by CERC in its RE Tariff Regulations, 2012 is the most recent and based on comprehensive study. The Commission noted that the capital cost formulation of CERC is based on detailed analysis of capital cost under regulatory approach, actual project cost approach and market based approach. The Commission has observed that the change in capital cost approved by CERC from 2012-13 to 2015-16 based on change in WPI of electrical machinery, iron and steel is as given in Table No 3.2 below:

Table No. 3.2 CERC Approved Wind Power Project Capital Cost

Financial Year	2012-13	2013-14	2014-15	2015-16	CAGR
Capital Cost in Cr/MW	5.75	5.97	6.03	6.19	2.49%

3.3.1.4 Some of the public sector companies in Gujarat have installed wind power projects in Gujarat during the control period of previous tariff order. PSUs have installed around 149.5 MW capacity wind power projects during the last control period. **The weighted average capital cost works out to be around Rs 5.94 Cr/MW.**

The capital cost related data was also collected from the leading financial institutions like Indian Renewable Energy Development Agency (IREDA), who provides loans for the wind power projects. IREDA has financed 3 wind power projects totalling 90.4 MW capacity during the last control period in the State. It is noted that variance in the capital cost of wind power projects financed by IREDA in Gujarat ranges from Rs 5.56. Cr/MW to Rs 6.25 Cr /MW.

The project cost declared by the wind investors in Gujarat in the Project Design Documents submitted to the UNFCCC for availing CDM benefits has also been analysed.

The capital cost data of 10 projects totalling 137.7MW capacity registered with UNFCCC and commissioned during the last control period have been analysed. The variance in the capital cost of wind power projects ranges from Rs 5.5. Cr/MW to Rs 7.36 Cr /MW.

3.3.1.5 The change in WPI of steel and E&M (major component of capital cost) during last control period and corresponding growth rate based on the data published by the Office of Economic Advisor, Ministry of Commerce and Industry, GoI has been examined. The WPI data of steel and E&M for FY 2012-13 to 2015-16 indicates negative weighted average growth rate, indicating no major change in the cost of steel and E&M equipment which constitute a major part of capital cost.

3.3.1.6 The cost incurred by the wind developers /investors for creation of power evacuation infrastructure during the last control period has been examined as per the data provided by GETCO. In the last control period around 26 wind farms were developed which required laying of total 830 RKM of evacuation line for power evacuation up to GETCO substations.

3.3.1.7 After considering all the aspects as discussed above, it is proposed to fix benchmark capital cost of Rs 6.13 Cr/MW including the cost of power evacuation infrastructure from wind farm substation to GETCO substation for tariff determination in new control period.

3.3.2 Operation and Maintenance Cost

Operations and Maintenance (O&M) cost consists of the statutory charges, spares, employee cost, administrative and general expense, consumables, repairs and maintenance, and insurance expenses etc. The maintenance of wind farm is carried out through a centralized maintenance system which results in a lower amount of employee expenses as well as administrative and general expenses. The Commission had, in its earlier order, considered the O&M expenses at Rs 9 Lakhs per MW for the year 2012-13 with escalation of 5.72% from second year onward. These charges were as per the then CERC tariff order 2012.

In view of above, the Commission proposes the O&M charges of Rs 10.63 Lakhs/MW with annual escalation of 5.72% during the control period.

3.3.3 Capacity Utilisation Factor

Capacity Utilization Factor (CUF) influences the economics of wind project at a particular wind site. The CUF at a given location would depend on (i) site specific parameters like wind velocity, wind density and weibull parameters as well as (ii) machine specific parameters like hub height, rotor diameter, micro-sitting technique used and power curve of the machine. Wind power density which is the function of wind velocity and air density present better indicator for determination of normative CUF.

As discussed above, the CUF at given location predominantly depends upon (i) site specific parameter , in more broad sense State specific parameters and (ii) machine specific parameters. It is imperative to analyze these two parameters in the context of State of Gujarat before arriving at benchmark normative capacity utilization factor for wind power tariff determination.

Analysis of machine specific parameters

Currently the market trend is towards higher hub height and higher turbine capacity because of simple reasons that for a given capacity lower number of higher capacity WEGs are required which ultimately cut down the land costs, O&M cost and extract more energy from the wind due to higher hub height.

The State of Gujarat is not exception to this as can be seen from the WEG installation trend in Gujarat during the control period of Wind Tariff Order 2012.

Table No. 3.3 MW Class and Sub MW Class WTG Installations in Gujarat

Duration	Total Installed Capacity in MW	Total installations (in MW) with sub MW class WTG	Total installations (in MW) with MW class machine
01.04.2012 to 31.03.2013	208.3	97.55	110.75(53.3%)
01.04.2013 to 31.03.2014	279.8	134.05	145.75(51.1%)
01.04.2014 to 31.03.2015	190.725	47.775	142.95(76.0%)
01.04.2015 to 31.12.2015	269.40	29.40	240.0(88.9%)
Total	948.225	308.775	639.45(67.6%)

(Source: GEDA)

The above table clearly underlines the fact that MW class machine with higher hub height are being preferred by the developers/investors in Gujarat. Therefore, it is imperative that the benchmark normative capacity utilization factor should capture the wind resource at the preferred hub height of the WTG i.e 100m.

Analysis of Site/State specific parameters

1. NIWE in association with Riso DTU National Laboratory for Sustainable Energy (NLSE), Denmark developed the Indian Wind Atlas which has been published in December 2015. In the wind atlas meso scale models have been used to develop the wind resource map of India for 100 m level. The results generated from the meso scale models have been correlated with the actual measured data from various wind monitoring stations to arrive at certain accuracy of the meso scale wind mapping. Map shows that most of the areas in Gujarat are having wind power density

between 200-350 W/m^2 at 100 m hub height and there are very less areas with wind power density lower than 200 W/m^2.

2. The Lawrence and Berkley National Laboratory (LBNL) under a study "Reassessing Wind potential estimates for India : Economic and policy implications" published in March 2012 has assessed that at 80m hub height the wind power density in Gujarat is in the range of 200 – 375 W/m^2.
3. WinDForce and CSTEP submitted "Report on India's Wind Power Potential" to MNRE on July 2015.The report assessed wind power potential using 3Dx5D and 5Dx7D turbine spacing and LULC land cover with scale of 1:250k. According to the report, the Gujarat State's wind potential was estimated at 275-642 GW at 100m and 285-666 GW at 120m hub height considering areas with CUF of more than 20%. According to the study the CUF of Gujarat State ranges from 25 to 40% and wind speeds range from 6 to 9 m/s.

Determination of normative CUF

It is preferable to continue the normative benchmark CUF approach as adopted in previous tariff orders. In order to determine the normative CUF for the State of Gujarat, the Commission has analysed the CUF from theoretical and practical point of view as given below.

1. Wind resource survey of India published by NIWE gives the WPD data for the wind monitoring masts installed in Gujarat under the Wind Power Program of the GoI. NIWE has conducted the wind resource assessment studies at 81 locations in Gujarat at 20-120 m mast height. The wind resource data books published by NIWE gives wind speed frequency distribution data, power law index values and energy pattern measured at mast height. The available NIWE data at 20m-100 m height is extrapolated at 100 m level by using WAsP software for all the 81 potential locations as data is available for 81 locations identified in Gujarat. The 81 potential locations identified in the State are grouped into the seven groups of the wind power density at 100 m hub height. As evident from the map given in Figure 2.1, the sites in Gujarat are having WPD of 200 – 350 W/m^2. The corresponding CUF, as given in the report, are in the range of 20 – 28%.
2. Gujarat Energy Development Agency (GEDA) has provided the data with regard to wind power project installation in the State during the control period of GERC Wind Power Tariff Order 2012 (i.e. from FY 2012-13 to 2014-15). The project–wise/investor-wise actual energy generation for the last three years was worked out from the data provided by the State Load Dispatch Centre (SLDC) and GEDA for FY 2012-13 to 2014-15.

   In order to examine the actual CUF achieved by the WTG at 80-100m hub height, MW class machine installed in the State are separated out from available data.

The analysis shows that 110 MW of wind power project having MW scale WTG commissioned in FY 2012-13 have achieved CUF in the range of 18.8% to 34.1% and 18.2% to 31.3% during 2013-14 and 2014-15 respectively. Around 57.9MW out of 110 MW of projects (52.63%) have achieved more than 23% CUF during FY 2013-14 and 74.7MW out of 110 MW of projects (67.9%) have achieved more than 23% CUF during FY 2014-15. Similarly the wind farm projects commissioned in FY 2013-14 have achieved CUF in the range of 11.53% to 28.5% and 9.7% to 25.1% during 2014-15 and 2015-16 respectively. Around 69.3MW out of 134 MW of projects (51.71%) have achieved more than 23% CUF during FY 2014-15. Similarly, 44.1MW out of 134 MW of projects (32.9%) have achieved more than 24.5% CUF during FY 2014-15.

As mentioned earlier, the CUF depends on machine specific conditions such as the hub height, rotor diameter, micro-sitting techniques adopted and power curve of WTG. By considering this fact and the wind power potential assessment results at 100 m hub height, 24.5% CUF can be the representative CUF for determination of tariff for wind power projects to be commissioned in new control period.

3.4 Evolution of Financial Parameters

3.4.1 Debt-Equity Ratio

GERC Multi Year Tariff (MYT) Regulations 2011 provide the normative debt-equity ratio of 70:30 for Generating Company/Licensees. Therefore the Commission decides to consider the debt equity ratio as 70:30 as considered in the previous wind tariff order.

3.4.2 Loan Tenure

GERC in its last Wind Tariff Order dated 08.08.2012 had stipulated the loan tenure of 10 years. . It is noticed that the investors did not face any problems in obtaining the loan during last control period. Therefore, it is proposed to keep loan tenure equal to 10 years while determining the tariff during the next control period.

3.4.3 Interest on Term Loan

In Wind Tariff Order dated 08.08.2012 the long term interest rate of 13% was considered. This was equivalent to prevailing SBI base rate with a spread of 300 basis point. While all banks have their own base rates, the project financing interest rates are typically indicated by the SBI base rate. A reasonably sound project usually gets funding at 300 basis points above the base rate.

The Commission has observed the movement of SBI base rate from FY 2013-14 onwards. The details are given in the Table below:

Table No. 3.4 SBI base rates from February 2013 to February 2016

Period	SBI Base Rate
4 February 2013 to 18 September 2013	9.70%
19 September 2013 to 06 November 2013	9.80%
07 November 2013 to 09 April 2015	10.00%
10 April 2015 to 07 June 2015	9.85%
08 June 2015 to 04 October 2015	9.70%
05 October 2015 to 29 February 2016	9.30%

The Commission considers the existing SBI base rate of 9.30% with a spread of 300 basis points to arrive at the interest rate on term loan for tariff determination purpose.

Hence, the interest rate on term loan for tariff computation is determined as 12.30%.

3.4.4 Rate of Depreciation

CERC, in its (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012 had considered the Capital Cost of the assets admitted by the Commission as value base for the purpose of depreciation . Further, the salvage value of the assets considered as 10% and depreciation is allowed up to maximum of 90% of the Capital Cost of the assets. Depreciation per annum shall be based on 'Differential Depreciation Approach' over loan tenure and the period beyond loan tenure over useful life computed on 'Straight Line Method'.

The Commission had, in its earlier Wind Tariff Order dated 08.08.2012 considered a higher rate of depreciation in the first 10 years of the project as a promotional measure equating with loan tenure, and the balance depreciation was spread over the remaining useful life of the plant. In view of above, the Commission decides to continue the same approach for the tariff order under discussion.

Hence, depreciation @ 6% per annum is considered for the first 10 years and 2% from 11th year to 25th year.

3.4.5 Working Capital

The Commission in its earlier wind tariff order had considered the components of working capital as follows:

1) Receivable of one month.

2) O&M cost for one month.

The Commission proposes to continue the above components as the part of the working capital for determination of tariff for next control period.

3.4.6 Interest on Working capital

The Commission in its Wind Tariff Order dated 08.08.2012 had considered the interest rate on working capital at 12%, which was 200 basis points above the SBI base rate. The Commission is of the opinion that requirement of working capital is recurring and is for a shorter time period. Hence, it is possible to get the same at the rate lower than the long term interest rate. The Commission, therefore, decides to consider the interest on working capital at 200 basis points over the current SBI base rate.

Hence, the interest rate on working capital is considered as 11.30%.

3.4.7 Return on Equity

The equity base for computing return will be 30% of the project capital cost considered by the Commission. If the equity deployed by project developer is more than 30%, the amount of equity for the purpose for determining the tariff will be limited to 30% only and the rest to be treated as loan. In case the equity employed is less than 30%, the actual equity employed will be considered.

The GERC Multi Year Tariff Regulations, 2012, notified by the Commission provides norms for the Return on Equity as 14% per annum. Any further enhancement in the RoE will burden the consumers. Hence, the Commission has considered the return on equity as 14% for the next control period. Also the tax payment in the form of MAT for first 10 years and corporate tax for the next 15 years has been considered as cost in tariff calculation as per earlier order of the Commission.

3.4.8 Discount Rate

The discount rate has been considered by CERC and other SERCs as weighted average cost of capital (WACC). The formula for computation of WACC is given below.

WACC = Cost of Debt + Cost of Equity
Where, Cost of Debt (For first 10 Years) =0.70 x (Market Rate of Interest) x (1- MAT)
Cost of Debt (11th Year to 25th Year) =0.70 x (Market Rate of Interest) x (1- Corporate tax)

Cost of Equity = 0.30 x Return on Equity (i.e. 14%)
Resulting WACC = {(WACC For first 10 Years X 10) + (WACC 11th Year to 25th Year X 15)}/ (10 + 15)
Cost of Debt (For first 10 Years) = 0.70 x 12.30% x (1- 21.34%) = 6.77%
Cost of Debt (11th Year to 25th Year) = 0.70 x 12.3% x (1- 34.61%) = 5.63%
Cost of Equity = 0.30 x 14% = 4.2%

Keeping in view the above calculation of WACC, the Commission proposes to consider the discount rate of 10.29% for determination of levellised tariff of wind power projects to be commissioned during the control period as stated in this discussion paper.

3.5 Incentives for Wind Energy Projects

The incentives/subsidies offered by Central Government/State Government to be considered while calculating tariff for wind power projects are given below.

3.5.1 Accelerated Depreciation

Following principles have been considered for ascertaining the Income Tax benefit on account of accelerated or additional depreciation for the purpose of tariff determination:

a. The assessment of benefit shall be based on normative Capital Cost, accelerated/ additional depreciation rate as per the relevant provisions of the Income Tax Act and the Corporate Income Tax rate;
b. Capitalisation of RE Projects for the full financial year;
c. Per-unit benefit shall be derived on levellised basis at a discounting factor equivalent to the post-tax weighted average cost of capital.

   As per the Budget Speech made by Hon Finance Minister, the Government of India during FY 2016-17 has allowed the wind project owners to avail accelerated depreciation at the rate of 40% in the first year on a written-down value (WDV) basis. In addition to this 40% depreciation, the amendment in the Finance Act has allowed an additional depreciation of 20% to the power projects during first year of project commissioning. With this, the wind projects can avail 60% depreciation in the first year of commissioning. The Commission has considered above depreciation rate while calculating per unit AD benefit.

3.5.2 Treatment for Generation based Incentive (GBI)

Ministry of New and Renewable Energy (MNRE), Government of India had announced the continuation of the scheme of Generation based Incentive (GBI) on 04 September 2013. The scheme was applicable

for 15000 MW installed during the 12th Plan period. Under this scheme, a GBI was offered to wind energy generators at Rs. 0.50 per kWh of electricity fed into the grid for a period not less than 4 years and a maximum period of 10 years with a cap of Rs 100 lakh / MW. The total disbursement in a year was limited to one fourth of the maximum limit of the incentive i.e. Rs.25 lakh per MW during the first four years. MNRE /IREDA has further revised the GBI scheme on 22.04.2015. As per the operational guidelines issued by MNRE /IREDA, the GBI incentive is over and above the tariff that may be approved by the State Electricity Regulatory Commissions (SERC's) in various States. The GBI would be available for grid connected wind power projects set up for sale of electricity to the grid, at a tariff notified by SERC and /or State Govt. and also for Captive Wind Power Projects including Group Captive to the extent of sale of electricity to the grid only. GBI would not be available to any wind power project selling power to third party, viz. merchant power plants. The eligibility of particular project for availing GBI shall be as per the eligibility conditions specified under the operational guidelines notified by MNRE /IREDA dated 22.04.2015.

The Commission under the present discussion paper has followed cost plus approach for arriving at tariff for sale of electricity generated from wind power projects to the distribution licensees during the new control period. While working out the representative tariff, all types of cost underlying the project including the cost associated with laying of the evacuation infrastructure has been considered plus a reasonable return on equity is also provided to the investor. It is proposed that the GBI incentive which is available to the developer/investor over and above the tariff shall be shared with the distribution licensee / end consumer in equal proportion i.e. 50-50% basis.

3.6 Computation of tariff for Wind Energy Project

The benchmark parameters proposed for tariff determination during the control period starting from the date of new order have been compared with the parameters considered by the Commission in the previous wind tariff order

Table No. 3.5 Comparison of proposed benchmark parameters with wind tariff order dated 08.08.2012

Parameters	As per Existing Wind Tariff Order	Proposal for new control period starting from the date of new order
Project Cost		
Capital Cost including Land, Plant & Machinery, Erection and evacuation infrastructure Cost (Rs. Lakh/MW)	606	613
Normative O&M cost for first year (Rs. Lakh/MW)	8	10.63
Escalation in O & M (per annum from 2nd year)	5.72%	5.72%
Performance Parameters		
CUF	24.5%	24.5%
Project life in Years	25	25
Financial Parameters		
Debt-Equity ratio	70:30	70:30
Term of Loan in Years	10	10
Interest on term Loan	13%	12.3%
Interest on working capital	12%	11.30%
Depreciation	6% (for first 10 years) 2% (from 11 to 25years)	6% (for first 10 years) 2% (from 11 to 25 years)
Minimum Alternate Tax (MAT)	20.008%	21.34%
Corporate Income Tax	32.445%	34.61%
Return on Equity	14%	14%
Tariff	Levelised tariff of Rs. 4.15 / kWh	Levelised tariff of Rs 4.19/kWh

evellised Tariff Computation Sheet

Tariff Calculations for Wind Power Plant																									
Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Net Energy sold (lakh kWh)	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46
Costs																									
O&M	10.63	11.24	11.88	12.56	13.28	14.04	14.84	15.69	16.59	17.54	18.54	19.60	20.72	21.91	23.16	24.48	25.88	27.37	28.93	30.59	32.34	34.18	36.14	38.21	40.39
Depreciation	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	36.78	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26	12.26
Interest on term loan	50.14	44.86	39.58	34.31	29.03	23.75	18.47	13.19	7.92	2.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on working capital	1.33	1.29	1.25	1.21	1.18	1.14	1.10	1.07	1.04	1.01	0.80	0.82	0.84	0.86	0.89	0.91	0.94	0.97	1.00	1.03	1.06	1.10	1.13	1.17	1.21
Return on Equity	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75	25.75
Tax on equity	5.49	5.49	5.49	5.49	5.49	5.49	5.49	5.49	5.49	5.49	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91	8.91
Total Cost (Rs lakh)	**130.12**	**125.41**	**120.73**	**116.10**	**111.50**	**106.95**	**102.44**	**97.98**	**93.56**	**89.20**	**66.25**	**67.34**	**68.48**	**69.69**	**70.96**	**72.31**	**73.74**	**75.25**	**76.84**	**78.53**	**80.31**	**82.20**	**84.19**	**86.35**	**88.58**
Tariff Rs/kWh	6.06	5.84	5.63	5.41	5.20	4.98	4.77	4.57	4.36	4.16	3.09	3.14	3.19	3.25	3.31	3.37	3.44	3.51	3.58	3.66	3.74	3.83	3.92	4.02	4.13
Levellised Gross Tariff Rs / kWh	**4.68**																								

evellised Gross tariff = Rs 4.68/kWh

D Benefit = Rs. 0.49/kWh

et Tariff = Rs. 4.19/kWh

omputation of AD Benefit

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Book Depreciation																									
Book depreciation Rate	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	5.28%	0.24%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Amount of book depreciation (Rs lakh)	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	32.37	1.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Accelerated depreciation																									
Opening	100%	40.0%	24.0%	14.4%	8.6%	5.2%	3.1%	1.9%	1.1%	0.7%	0.4%	0.2%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Allowed during the year	60.0%	16.00%	9.60%	5.76%	3.46%	2.07%	1.24%	0.75%	0.45%	0.27%	0.16%	0.10%	0.06%	0.03%	0.02%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Closing	40.0%	24.00%	14.40%	8.64%	5.18%	3.11%	1.87%	1.12%	0.67%	0.40%	0.24%	0.15%	0.09%	0.05%	0.03%	0.02%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Amount of accelerated depreciation (Rs lakh)	367.80	98.08	58.85	35.31	21.19	12.71	7.63	4.58	2.75	1.65	0.99	0.59	0.36	0.21	0.13	0.08	0.05	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
Net depreciation benefit (Rs lakh)	335.43	65.71	26.48	2.94	-11.18	-19.66	-24.74	-27.79	-29.62	-30.72	-31.38	-31.77	-32.01	-32.15	-32.24	-32.29	-32.32	-1.44	0.02	0.01	0.01	0.00	0.00	0.00	0.00
Tax Benefit (Rs lakh)	116.09	22.74	9.17	1.02	-3.87	-6.80	-8.56	-9.62	-10.25	-10.63	-10.86	-11.00	-11.08	-11.13	-11.16	-11.18	-11.19	-0.50	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Net energy Generation (lakh Units)	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46	21.46
Accelerated depreciation benefit per unit (Rs / kWh)	5.41	1.06	0.43	0.05	-0.18	-0.32	-0.40	-0.45	-0.48	-0.50	-0.51	-0.51	-0.52	-0.52	-0.52	-0.52	-0.52	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Discount factor	1.00	0.91	0.82	0.75	0.68	0.61	0.56	0.50	0.46	0.41	0.38	0.34	0.31	0.28	0.25	0.23	0.21	0.19	0.17	0.16	0.14	0.13	0.12	0.11	0.10
Levellised benefit of accelerated depreciation (Rs / kWh)	0.49																								

4. Other Commercial Issues

4.1 Transmission and Wheeling Charges

In earlier tariff order dated 08.08.2012 ,it has been decided that Wind Power Projects availing Open Access for third party sale shall be liable to pay Open Access charges and losses as applicable to normal Open Access Consumers. However for captive power projects the Commission decided to allow lower transmission and wheeling charges and losses in line with the Govt. of Gujarat amended Wind Power Policy dated 13 January 2009. The wheeling of power generated from wind farm project for consumption at 66 kV voltage level and above 66 kV were required to bear normal transmission charges and transmission losses. In case the wind power is wheeled to consumption site below 66 kV level, the transaction attracted normal transmission charges but considered concessional transmission and wheeling losses at @ 10% of energy fed into grid. The above loss was required to be shared between the transmission and distribution licensee in the ratio of 4:6. These charges were applicable to the generators having more than one WEG. For the small investors, having one WEG in the State, the said order specified the normal transmission charges but concessional transmission and wheeling losses at @ 7 % of energy fed into grid for such transaction. The specified losses should be shared between the transmission and distribution licensee in the ratio of 4:3. The Wind Energy Generator, who desired to wheel electricity to more than two locations, was required to pay 5 paise per unit for energy fed into the grid to the Distribution Company concerned in whose area power is consumed in addition to the above mentioned transmission charges and losses, as applicable.

Following norms are proposed for the Open Access transaction for wheeling wind power for third Party sale and Captive use during new control period.

Third Party Sale

a. Wheeling of Power for third party sale from wind power project shall be allowed on payment of transmission charges, transmission losses, wheeling charges and losses of the energy fed into grid, as applicable to normal open access consumer.
b. 25% of the cross subsidy surcharge as applicable to normal open access consumer shall be applicable.

Wheeling of power for Captive Use

a. Wheeling of power to consumption site at 66 kV voltage level and above

Wheeling of electricity generated from wind power projects to the desired location(s) within the State shall be allowed on payment of transmission charges and transmission losses as applicable to normal open access consumer.

b. Wheeling of Power to consumption site below 66 kV voltage level

In case the injection of power is at 66 KV or above and drawal is at below 66 kV , wheeling of electricity generated from wind power projects to the desired location(s) within the State , shall be allowed on payment of transmission charges and transmission losses applicable to normal open access consumers and 50% of wheeling charges and 50% of distribution losses of the energy fed into the grid as applicable to normal open access consumers.

c. Wheeling of electricity generated by smaller investors having only one WEG

Wheeling of electricity generated by smaller investors having only one WEG in the State, to the desired location(s), shall be allowed on payment of open access charges applicable to normal open access consumers and transmission and wheeling losses at @ 7% of the energy fed to the grid . The above losses shall be shared between the transmission and distribution licensees in the ratio 4:3

Wheeling of power to more than one locations

Wind power projects owners , who decide to wheel electricity for captive use / third party sale, to more than one location, shall pay 5 Paisa/KWh on energy fed into the grid to the distribution company concerned in whose area power is consumed in addition to above mentioned transmission charges and losses, as applicable.

4.2 State Energy Metering

Wind energy projects are kept out of the purview of the intra-State ABT. However, for the purpose of energy accounting, such projects shall have to provide ABT compliant meters at the interface points. Further, the Commission has clarified through its wind tariff review order dated 07.01.2013 that installation of ABT compliant energy meter at each WTG is necessary so as to evaluate the generation of each WTG on real time basis. The Commission proposes to retain the same provision related to energy metering. The metering shall conform to the Central Electricity Authority (Installation and Operation Meters) Regulations, 2006, as amended from time to time. The electricity generated from the wind power generator shall be metered and readings shall be taken jointly by the wind power project developer with the Gujarat Energy Development Agency (GEDA), Gujarat Energy Transmission Company Ltd. (GETCO) or Distribution Company at the metering point. The metering point has been mentioned in the para 3.2.8 of the present discussion paper.

4.3 Pricing of Reactive Power

Some of the wind energy generators require reactive power during initial start-up and its station transformers also continuously require reactive power from grid. Hence, in order maintain the grid stability it is required to limit such reactive power consumption from grid by installation of suitable compensation devices. In order to restrain the wind energy projects to consume more reactive power from grid and to encourage them to install suitable compensation devices to limit such reactive power consumption, the Commission in its earlier order had allowed Reactive Energy Charges to be recovered from Wind Energy Projects. The reactive energy charges as decided and approved in the Commissions Wind Tariff Order dated 08.08.2012 is reproduced as below:

10 paisa/kVARh – *For the drawl of reactive energy at 10% or less of the net energy exported.*

25 paise/kVARh – *For the drawl of reactive energy at more than 10% of the net active energy exported*.

It is proposed to continue the above charges as it is for the next control period.

4.4 Sharing of Clean Development Mechanism (CDM) Benefits

In case of sharing of CDM benefit the Commission; in the previous order dated 08.08.2012 had adopted the recommendations made by the Working Group for Renewable Energy Generation constituted by the Forum of Regulators and provisions under Clause 21 of the CERC (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations 2009.

The Commission noted that Clause 21 of CERC (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012 dated 6th February 2012 and has retained this provision as it is:

> *"a) 100% of the gross proceeds on account of CDM benefit to be retained by the project developer in the first year after the date of commercial operation of the generating station;*
>
> *b) In the second year, the share of the beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, where after the proceeds shall be shared in equal proportion, by the generating company and the beneficiaries."*

It is proposed to retain above provisions for sharing of CDM benefits for Wind Energy Projects in Gujarat for the new control period.

4.5 Banking of Surplus Wind Energy

The Commission in its Wind Tariff Order dated 08.08.2012, had allowed the captive wind energy projects for setting off captive consumption against the energy generated during peak and normal hours. Considering the infirm nature of the wind and changing electricity rates through the year based on the ABT mechanism, the wind energy projects were allowed for only one month banking for the electricity generated during the month. However, the project proponent was eligible to utilize the same during the month in proportion to the energy generated during peak and normal hour period. Considering the variability and to encourage the use of wind power for captive use the Commission has decided to continue the one month banking facility for captive wind power projects for the next control period. This facility is available for the captive wind power projects that are not registered under REC mechanism. However the banking facility shall not be available for third party sale. It is proposed to continue the above practice for next control period

As promotional measure, it is proposed to continue the banking facility for 1 billing cycle for the wind power captive projects wheeling electricity for own use. However, considering the fact that the intra-State ABT and UI mechanism has been adopted in the State, banking of energy for limited period also have financial impact on utility. It is proposed to levy banking charges in kind. Banking charges shall be adjusted in kind at 2% of energy banked**.**

4.6 Purchase of Surplus Power from Wind Energy Projects Opting for Captive use and Third Party Sale under Open Access

Considering the variability of the wind, the captive wind energy projects, not registered under the REC mechanism, are allowed one billing cycle banking as per the Commission's Wind Tariff Order dated 08.08.2012. The banked energy was allowed for captive consumption during peak and normal hours within a month. If captive wind energy consumers were unable to utilize the surplus within a month it was considered as sale to the concerned distribution licensee. The surplus wind energy available was allowed for purchase by the concerned distribution licensee @ 85% of the feed-in tariff declared by the Commission.

Also in case of open access transactions for third party sale of wind energy not registered under REC mechanism, the surplus wind energy available after set off with open access consumer's consumption in the same 15 minutes time block is treated as sale to the concerned distribution licensee @ 85% of the feed-in tariff declared by the Commission.

In order to promote renewable energy projects, it is proposed to continue with the above provisions for sale of surplus power from the wind energy projects not registered under REC mechanism for the next control period.

4.7 Renewable Energy Certificates for Third-Party Sale and Captive Use of Wind Energy

Qualification of the wind power projects preferring open access for sale of electricity / captive use for availing REC benefit shall be governed by the CERC (Terms and Conditions for Recognition and Issuance of REC) 2010 and the subsequent amendments till date .

In case of wind power projects availing OA for captive use / third-party sale and opting for REC, the surplus power after set off will be purchased by the distribution licensee at Average Pooled Purchase Cost (APPC) applicable for that year. In its wind tariff review order dated 07.01.2013, the commission clarified that the WTGs registered under REC for captive use are not entitled to any concessional/promotional benefits like banking as per the CERC (REC) Regulations. If any set-off is not given in 15 minutes block and the same is allowed to be utilized at any time during the month, it is a banking, which is not allowed. The physical component of electricity under REC mechanism shall be required to be given set-off in 15 minutes time block only against the generated electricity when the same is utilized for captive use. Therefore, under the Intra-State ABT implemented in the State of Gujarat from 01.04.2010, banking facility is not permissible to the CPP holders who set up the WTG under REC schemes. The WTGs registered under REC are entitled to set-off in 15 minutes time block only.

4.8 Security Deposit

Projected Capacity in MW	**Period for commissioning of the entire allotted Pooling Sub Station Capacity**
1 to 100	1.5 years from the date of allotment of transmission capacity
101 to 200	2 years from the date of allotment of transmission capacity
201 to 400	2.5 years from the date of allotment of transmission capacity
401 to 600	3.5 years from the date of allotment of transmission capacity

In order to assure GETCO about the seriousness of wind power projects, the project developers are required to furnish Bank Guarantee of Rs.5 lakhs/MW as a security deposit to GETCO. In the Wind Tariff Order dated 08.08.2012, the Commission has decided the time periods allowed to the developers to complete their projects as given above.

It is proposed to retain the provision of security deposit as per last Wind Tariff Order dated 08.08.2012. Further, GETCO shall be entitled to encash the bank guarantee in case the developer fails to commission the wind farm substation and the transmission line within the time period mentioned in above table. Provided further that, GETCO may allow extension of time period in cases where the developer fails to commission the project within the prescribed period due to unforeseen reasons beyond the control of the project developer.

Provided further that the developer shall commission at least 10% of the allotted capacity within one month of charging of evacuation line. Failing this, the developer shall be liable to pay long term transmission charges for 10% of allotted capacity till such 10% of allotted capacity is commissioned.

GERC presents this Discussion Paper to initiate the regulatory process for determination of wind power procurement tariff for next control period starting from the order on this discussion paper after considering comments received from stakeholders. GERC invites comments from potential stakeholders for fixation of wind power tariff for the new control period. The performance and financial parameters and tariff proposed in this discussion paper are indicative and will be finalised with the tariff order.

Stakeholders may offer their views /objections /suggestions as per the procedure prescribed in the GERC (Conduct of Business) Regulations, 2004 on or before 10/06/2016.

Public hearing in this regard shall be held on 20/06/2016 at 11.30 a.m. in Commission's office. Stakeholders either in person or through their authorized representative may remain present.

Sd/-

[Roopwant Singh, IAS]
Secretary
GERC

Place: Gandhinagar

Date: 07/05/2016

:: End of Chapter 4::