Discussion Paper

DETERMINATION OF TARIFF FOR PROCUREMENT OF POWER BY DISTRIBUTION LICENSEES AND OTHERS FROM BIOMASS BASED POWER PROJECTS AND BAGASSE BASED CO-GENERATION PROJECTS FOR THE STATE OF GUJARAT

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Gujarat Electricity Regulatory Commission

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Executive Summary

The Gujarat Electricity Regulatory Commission (GERC) has initiated the process for determination of tariff for procurement of power by Distribution Licensees and others, from biomass power and bagasse based co-generation projects to be commissioned from 1 August 2013 under the powers conferred to the Commission under Sections 61(h), 62(1)(a), and 86(1)(e) of The Electricity Act, 2003, and guidelines of the National Electricity Policy, 2005, and Tariff Policy, 2006. The Commission earlier had issued generic tariff orders for procurement of power by distribution licensees and others, from biomass power and bagasse based cogeneration projects in Gujarat on 17 May 2010 and 31 May 2010 respectively. The control period of the GERC biomass power tariff order was up to 31 March 2013. The control period of bagasse based co-generation tariff order was up to on 31 May 2013. The Commission has already extended the control periods of both the orders up to 31 May 2013 up to 31 July 2013 and initiate the regulatory process simultaneously for determination of tariff for procurement of power by distribution licensees and others from biomass based power projects and bagasse based co-generation projects commissioning on or after 1 August 2013, through this discussion paper and invite comments from stakeholders. The control period for new tariff orders will commence from 1 August 2013 and shall expire on 31 March 2016.

The Commission, while evolving the benchmark operating and financial parameters for determination of generic tariff for biomass power and bagasse based co-generation projects for the next control period starting from 1 August 2013 has extensively studied the following aspects.

- In order to arrive at a benchmark capital cost for biomass power and bagasse based co-generation projects to be commissioned in the next control period starting from 1 August 2013, the Commission has examined the biomass power and bagasse based co-generation projects' capital cost trends during the last control period, along with the change in Wholesale Price Index (WPI) of steel and Electrical & Mechanical (E&M) (major component of capital cost) during the last control period and corresponding growth rate thereof. The Commission has examined the approach followed by the Central Electricity Regulatory Commission (CERC) as well as State Electricity Regulatory Commissions (SERCs) while fixing benchmark wind power capital cost under Renewable Energy (RE) tariff Order for FY 2012-13. The Commission has also noted the capital cost related recommendations provided by Ministry of New and Renewable Energy (MNRE) and Indian Renewable Energy Development Agency (IREDA) to CERC while finalizing the RE tariff Regulations 2012.
- The Commission has noted that biomass procurement and transportation are handled by a highly unorganized sector and the prices are greatly influenced by the local factors and are at the mercy of traders. By recognizing the fact that the gross calorific value (GCV) of fuel and cost of the fuel parameters have direct bearing on the variable component of tariff



under the two-part tariff structure, the Commission has analyzed this aspect in detail. The Commission has examined various approaches for determination of GCV of representative biomass, and cost of biomass for tariff computation during the next control period. A similar exercise was performed for setting the normative values of GCV and cost of fuel in case of bagasse based co-generation projects.

- While proposing the normative operational parameters such as station heat rate, auxiliary consumption, plant load factor, O&M expenses etc. the Commission has considered the approach followed by the CERC as well as SERCs in India. The Commission has also studied the recommendation of the Central Electricity Authority (CEA) contained in its report on operating norm for biomass based power projects, published during September 2005.
- In case of financial parameters for tariff determination, the Commission has examined the SBI base rate over the past one year and noted that the base rate is in declining mode. Hence, the Commission has considered the past one year's weighted average base rate of SBI for determination of normative interest rate on debt and working capital. The Commission has also studied the interest rates offered by IREDA while financing the biomass power and bagasse based co-generation projects in India. The Commission has proposed interest rate of term loan as weighted average base rate of SBI over the past one year plus 250 basis points. Based on the prevailing market practices, the tenure of term loan is proposed as 10 years. The interest on the working capital is proposed as 50 basis points lower than that of interest rate on long-term loan.
- The Commission has defined the metering and interconnection point as follows: metering point and interconnection point will be at the line isolator on outgoing feeder on HV side of generator transformer.
- The biomass power and bagasse based co-generation projects have to lay comparatively shorter transmission lines than that of the wind power projects and the size of these projects is in the range of 1 to 25 MW. Therefore, generated power can be evacuated through 11/33/66 kV line, which can be easily connected to nearby GETCO/DISCOM substation. In view of this the Commission proposes that the GETCO/DISCOM shall take the responsibility of laying the power evacuation line from the interconnection point to the nearest GETCO/DISCOM substation. The Commission has not included cost associated with laying power evacuation line beyond interconnection point as a part of capital cost.
- The Commission proposes the following normative operating and financial parameters and two-part tariff design in two options (with and without AD benefit) for biomass power and bagasse based co-generation projects to be commissioned during the next control period starting from 1 August 2013.



Parameters	Biomass based Power Projects with Water-Cooled Condensers		Biomass based Power Projects with Air-Cooled Condensers		
	As GERC per tariff orderProposed for next controldated 17/05/2010period (FY 13-14 to FY 15-16)		As GERC per tariff order dated 7/02/2011	Proposed for next control period (FY 13- 14 to FY 15-16)	
Project Cost and O&M					
Land + Plant & Machinery + Evacuation cost up to interconnection point (Rs. Lakh/MW)	425	468	455	498	
Evacuation Infrastructure Cost (Rs. Lakh/MW)	29	Nil	29	Nil	
Total Project Cost (Rs. Lakh/MW)	454	468	484	498	
Normative O&M Cost for first year (Rs. Lakh/MW)	5% of project cost	5% of project cost	5% of project cost	5% of project cost	
Escalation in O&M (per annum from 2nd year)	5%	5.72%	5%	5.72%	
Performance Parameters					
CUF	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards	
Auxiliary Consumption	10%	10%	10%	10%	
Project Life in Years	20	20	20	20	
Station Heat Rate kCal/kWh	3800	3800	3950	3950	
Gross Calorific Value of Fuel kCal/kg	3300	3688	3300	3688	
Cost of Fuel	Rs. 1600 per MT for biomass and Rs. 1775 per MT for coal	Rs. 2816 per MT for biomass and Rs. 2773 per MT for coal	Rs. 1600 per MT for biomass and Rs. 1775 per MT for coal	Rs. 2816 per MT for biomass and Rs. 2773 per MT for coal	
Fuel Cost Escalation	5%	5%	5%	5%	
Financial Parameters					
Debt-Equity ratio	70:30	70:30	70:30	70:30	
Term of Loan in Years	10	10	10	10	
Interest on Term	11.75%	12.36%	11.75%	12.36%	

Table A: Benchmark parameters for tariff computation of biomass based power projects

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Parameters	Biomass based Power Projects with Water-Cooled Condensers		Biomass based Power Projects with Air-Cooled Condensers		
	As GERC per tariff order dated 17/05/2010	Proposed for next control period (FY 13-14 to FY 15-16)	As GERC per tariff order dated 7/02/2011	Proposed for next control period (FY 13- 14 to FY 15-16)	
Loan					
Interest on Working Capital	erest on Working 11.75%		11.75%	11.86%	
Depreciation	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)	
Minimum Alternate Tax	16.995%	20.008%	16.995%	20.008%	
Corporate Income Tax	33.99%	32.45%	33.99%	32.45%	
Return on Equity	14%	14%	14%	14%	
Tariff	Option 1 Levelised tariff without AD benefit: Rs.4.45/kWh (1 to 10 yr), Rs.4.80/kWh (11 to 20 yr) Levelised tariff with AD benefit: Rs.4.40/kWh (1 to 10 yr), Rs.4.75/kWh (11 to 20 yr) Option 2 Levelised fixed tariff (without AD benefit) Rs. 1.59 /kWh for 20 years and Levelised fixed tariff (with AD benefit) Rs. 1.59 /kWh for 20 years and Levelised fixed tariff (with AD benefit) Rs 1.54/kWh and Year-wise variable tariff of Rs. 2.08/kWh, 2.18, 2.29,, 4.77, 5.01, 5.26	Tariff without AD benefit: Levelised fixed component of tariff - Rs. 1.75 /kWh for 20 years And *variable component of tariff for FY 2013- 14 - Rs.3.22/ kWh, FY 2014-15 - Rs. 3.39/kWh, FY 2015-16 - Rs. 3.55/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.46 /kWh for 20 years And *variable component of tariff for FY 2013- 14 - Rs.3.22/ kWh, FY 2014-15 - Rs. 3.39/kWh, FY 2015-16 - Rs. 3.55/kWh	$\begin{array}{c} \textbf{Option 1}\\ \textbf{Levelised tariff}\\ \textbf{without AD}\\ \textbf{benefit}\\ Rs.4.66/kWh (1)\\ to 10 yr),\\ Rs.5.06/kWh (11)\\ to 20 yr)\\ \textbf{Levelised tariff}\\ \textbf{with AD benefit:}\\ Rs.4.60/kWh (1)\\ to 10 yr),\\ Rs.5.00/kWh (11)\\ to 20 yr)\\ \textbf{Option 2}\\ \textbf{Tariff without}\\ \textbf{AD benefit}\\ Year wise total\\ tariff - Rs 3.85 /\\ kWh, 3.96,\\ 4.07,, 6.65,\\ 6.90, 7.16\\ \textbf{Tariff with AD}\\ \textbf{benefit}\\ Year wise total\\ tariff - Rs 3.80 /\\ kWh, 3.91,\\ 4.02,, 6.60,\\ 6.85, 7.11\\ \end{array}$	Tariff without AD benefit: Levelised fixed component of tariff - Rs. 1.86 /kWh for 20 years And *variable component of tariff for FY 2013-14 - Rs.3.35/ kWh, FY 2014-15 - Rs. 3.52/kWh, FY 2015-16 - Rs. 3.69/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.55 /kWh for 20 years And *variable component of tariff for FY 2013-14 - Rs.3.35/ kWh, FY 2014-15 - Rs. 3.52/kWh, FY 2015-16 - Rs. 3.69/kWh	

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Table B : Benchmark parameters for tariff computation of bagasse based co-generation projects

Parameters	Bagasse based Co-generation Projects				
	As GERC per tariff order dated 31/05/2010	Proposed for next control period (FY 13-14 to FY 15-16)			
Project Cost and O&M					
Land + Plant & Machinery + Evacuation cost up to interconnection point (Rs. Lakh/MW)	415	457			
Evacuation Infrastructure Cost (Rs. Lakh/MW)	29	Nil			
Total Project Cost (Rs. Lakh/MW)	444	457			
Normative O&M Cost for First Year (Rs. Lakh/MW)	3% of project cost	3% of project cost			
Escalation in O&M (per annum from 2nd year)	5%	5.72%			
Performance Parameters					
CUF	60%	60%			
Auxiliary Consumption	8.5%	8.5%			
Project Life in Years	20	20			
Station Heat Rate kCal/kWh	3600	3600			
Gross Calorific Value of Fuel kCal/kg	2250	2250			
Cost of Fuel	Rs. 1200 per MT for biomass and Rs. 1775 per MT for coal	Rs. 1289 per MT for bagasse and Rs. 2773 per MT for coal			
Fuel Cost Escalation	5%	5%			
Financial Parameters					
Debt-Equity Ratio	70:30	70:30			
Term of Loan in Years	10	10			
Interest on Term Loan	11.75%	12.36%			
Interest on Working Capital	11.75%	11.86%			
Depreciation	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)			
Minimum Alternate Tax	16.995%	20.008%			
Corporate Income Tax	33.99%	32.45%			
Return on Equity	14%	14%			
	<u>Option 1</u> Levelised tariff without	Tariff without AD benefit:			
Tariff	AD henefit.	Rs 183 /kWh for 20 years			
	Rs.4.61/kWh (1 to 10 vr)	And *variable component of tariff for			
	Rs.4.96/kWh (11 to 20 yr)	FY 2013-14 - Rs.2.42/ kWh,			



Parameters	Bagasse based Co-generation Projects				
	As GERC per tariff order dated 31/05/2010	Proposed for next control period (FY 13-14 to FY 15-16)			
	Levelised tariff with AD benefit: Rs.4.55/kWh (1 to 10 yr), Rs.4.90/kWh (11 to 20 yr) Option 2 Levelised fixed tariff (without AD benefit) Rs. 1.66 /kWh for 20 years and Levelised fixed tariff (with AD benefit) Rs	FY 2014-15 - Rs. 2.54/kWh, FY 2015-16 - Rs. 2.67/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.51 /kWh for 20 years And *variable component of tariff for FY 2013-14 - Rs.2.42/ kWh, FY 2014-15 - Rs. 2.54/kWh, FY 2015-16 - Rs. 2.67/kWh			
	1.61/kWh and year wise variable tariff of Rs.2.10/ kWh , 2.21, 2.32,4.82, 5.06, 5.31				

(* Commission will revisit the cost of biomass / bagasse at the end of control period and re-determine the variable component of tariff for the new control period.)

Other Commercial issues

Transmission and Wheeling Charges

- For wheeling of power to consumption side at 66 kV voltage level and above, the Commission has specified transmission charges and transmission lossed as applicable to normal open access consumers.
- For wheeling of power to consumption side below 66 kV voltage level, transmission charges as per normal open access consumer are allowed; whereas, transmission and wheeling loss @ 10% of the energy fed into the grid is to be allowed.
- For wheeling of power by the small investors below 5 MW plant capacity, transmission charges as per normal open access consumer are allowed; whereas, transmission and wheeling loss @ 7% of the energy fed into the grid is to be allowed.
- When the injection and drawal is at 11 kV or below voltage level, wheeling charges @ 5 paisa per unit and wheeling loss @ 6% is applicable.

Cross-Subsidy Surcharge

 Not be applicable to captive use and for third party sale of power generated from biomass power/bagasse based co-generation project.

Energy Metering

Biomass power and bagasse based co-generation projects shall have to provide availability based tariff (ABT) compliant meters at the interface points and shall conform to the Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006.



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 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.

Sharing of Clean Development Mechanism (CDM) Benefits

Sharing of CDM benefits on net 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 Energy and Purchase of Surplus Power

- No banking facility offered to captive or third party sale of electricity generated from biomass power and bagasse based co-generation projects.
- Purchase of un-settled surplus power from biomass power and bagasse based co-generation projects opting for captive use and third party sale will be governed as per the provisions under GERC intra-state ABT Regulations.

Renewable Energy Certificates for Third party sale and Captive Use

Biomass power and bagasse based co-generation projects availing open access for third party sale and captive use will be eligible for availing REC benefit as per CERC REC Regulations 2010 and its subsequent amendments.

Security Deposit

- Security deposit of Rs. 5 Lakh/MW in the form of bank guarantee shall be paid by the project developer to the GETCO in order to assure the GETCO for timely completion of the project.
- In case of delay in project commissioning beyond the prescribed period of 4 years, GETCO will forfeit the security deposit.





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Abbreviations

- **ABT** Availability-Based Tariff
 - AC Alternating Current
- AD Accelerated Depreciation
- APERC Andhra Pradesh Electricity Regulatory Commission
 - **APPC** Average Pooled Purchase Cost
 - **CDM** Clean Development Mechanism
 - **CEA** Central Electricity Authority
 - **CERC** Central Electricity Regulatory Commission
 - **CPP** Captive Power Producer
 - CSS Cross-Subsidy Surcharge
 - EA Electricity Act 2003
 - FY Financial Year
 - **GBI** Generation-Based Incentives
 - **GCV** Gross Calorific Value
- GEDA Gujarat Energy Development Agency
- GERC Gujarat Electricity Regulatory Commission
- **GETCO** Gujarat Energy Transmission Corporation Ltd.
 - GoG Government of Gujarat
 - GoI Government of India
- **IREDA** Indian Renewable Energy Development Agency
- **IRENA** International Renewable Energy Agency
 - **IRR** Internal Rate of Returns
- **KERC** Karnataka Electricity Regulatory Commission **Kg** Kilogram
- **kg/m³** Kilogram per cubic meter
 - **kW** Kilo Watt
 - **kWh** Kilo Watt hours
 - **m** Meter
 - MAT Minimum Alternate Tax
- MERC Maharashtra Electricity Regulatory Commission
- MNRE Ministry of New and Renewable Energy
- MPERC Madhya Pradesh Electricity Regulatory CommissionMT Metric Tonne
 - **MW** Mega Watt
 - **MWh** Mega Watt hour
 - MYT Multi Year Tariff
- NAPCC National Action Plan for Climate Change
 - **NEP** National Electricity Policy
 - NTP National Tariff Policy
 - **O&M** Operation and Maintenance
 - **PDD** Project Design Document



- **PLR** Prime Lending Rate
- **PPA** Power Purchase Agreement
- **PSERC** Punjab State Electricity Regulatory Commission
 - **PU** Per Unit (kWh)
 - **RBI** Reserve Bank of India
 - **RE** Renewable Energy
 - **REC** Renewable Energy Certificate
- **RERC** Rajasthan Electricity Regulatory Commission
- **RoE** Return on Equity
- **RPO** Renewable Purchase Obligation
- **RRF** Renewable Regulatory Fund
- Rs. Rupees
- SBI State Bank of India
- SERC State Electricity Regulatory Commission
- SHR Station Heat Rate
- **SLDC** State Load Dispatch Centre
- STU State Transmission Utility
- TNERC Tamil Nadu Electricity Regulatory Commission
- **UNFCCC** United Nations Framework Convention on Climate Change**V** Volt
 - **WACC** Weighted Average Cost of Capital
 - **WDV** Written-down Value
 - **WPI** Wholesale Price Index



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 guidelines of the National Electricity Policy (NEP) 2005 and Tariff Policy (TP) 2006 and all other powers enabling it on 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 biomass power and bagasse based co-generation projects to be commissioned in the control period starting from 1 August 2013. The biomass power and bagasse based co-generation tariff proposed under this discussion paper is based on the broad principles contained under the (i) GERC (Multi Year Tariff) Regulations, 2011, (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.

The Commission earlier had issued generic tariff orders for procurement of power by distribution licensees and others from biomass power and bagasse based co-generation projects in Gujarat on 17 May 2010 and 31 May 2010 respectively. The control period of the GERC biomass power tariff order was up to 31 March 2013. The control period of bagasse based co-generation tariff order was up to 31 May 2013. The Commission has already extended the control periods of both these orders up to 31 July 2013 and initiate the regulatory process simultaneously for determination of tariff for procurement of power by distribution licensees and others from biomass based power projects and bagasse based co-generation projects commissioning on or after 1 August 2013, through this discussion paper.

1.2 The Electricity Act, 2003

The following provisions of the Act provide the enabling legal framework for promotion of 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 co-generation and generation of electricity from renewable sources of energy which reads as under:

"Promote co-generation 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.

Both these sections i.e. Section 86(1)(e) and Section 61(h) are mandatory in nature and therefore put significant responsibility on the regulators to promote renewable sources of energy in the respective states.

1.2.3 The Section 62(1)(a) of the Act provides for determination of tariff for supply of electricity by a generating company to a distribution licensee as under:

"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;"

1.3 National Electricity Policy (NEP)

Clause 5.12 of the NEP 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)

This policy further elaborates the role of regulatory commissions, the mechanism for promoting renewable energy, the time-frame for implementation, etc. Clause 6.4 of the policy addresses various aspects associated with promoting and harnessing 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 for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by 1 April 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.

(2) Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act among suppliers offering energy from same type of non-conventional sources. In the long term, these technologies would need to compete with other sources in terms of full costs.

(3) The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding."

1.5 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.

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.

Year	Total RPO	Non Solar RPO		Solar RPO
		Wind Biomass		Solar
		bagasse and		
			other	
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%

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

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

Further, this regulation recognises 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 the 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).

Fossil fuel based CPPs in Gujarat have approached the Hon'ble High Court of Gujarat and filed petition on the issue of applicability of RPO on the CPPs in Gujarat. The said case is still pending with the Hon'ble High court of Gujarat.

1.6 Biomass Power Tariffs in Other States

The comparison of biomass tariffs in other states with the GERC biomass tariff order 2010 is tabulated in Table No. 1.2. The Central Electricity Regulatory Commission (CERC) under its RE Tariff Regulations 2012 has adopted a two-part tariff for biomass-based power projects. CERC has calculated a two-part tariff for different states by considering the state-specific biomass prices. The biomass tariff proposed by CERC for the state of Gujarat for FY 2013-14 is considered for comparison in this table. Similar methodology is being adopted by the Maharashtra Electricity Regulatory Commission (MERC). The RERC, considering the geographical area of the state and water scarcity in some of the regions has specified separate tariffs for biomass based power projects using water-cooled condensers and air-cooled condensers. In case of the biomass based power projects using air-cooled condensers, the RERC has made distinction while benchmarking tariff parameters like project costs, auxiliary consumptions and PLF. The GERC initially specified generic tariff for biomass based power projects using water-cooled condensers vide order dated 17 May 2010. Subsequently, while disposing of the petition filed by M/s Abellon Clean Energy Ltd. the Commission had specified generic tariff for biomass power project using air-cooled condenser vide order dated 7 February 2011.



It has been noticed that, while determining the two-part tariff for biomass power and bagasse based co-generation projects the SERCs have adopted different approaches. Some SERCs have specified levelised fixed cost component of tariff considering the life of plant. Whereas, some other SERCs have determined year-wise fixed cost component of tariff linked to the year of operation. In case of variable cost component of tariff, some SERCs have preferred to specify the same on yearly basis during the control period by considering appropriate escalation factor on the fuel price of the base year of the control period. Whereas, some SERCs have determined the year-wise variable cost component of tariff is linked with the financial year in progress. Apart from above, the GERC had offered levelised biomass power tariff for two sub-periods i.e. 1 to 10th year and 11th to 20th year of project life and given a choice to the developer to opt for either of the tariffs determined by the Commission.

CERC (28.02.2013) for FY 2013-14	MERC (22.03.2013) for FY 2013- 14	MPERC (02.03.2012)	RERC (21.12.2012 (17.08.2009)	TNERC (31.07.2012)	GERC (17.05.2010)
Rs. 2.23 /kWh Fixed cost component of tariff for FY 2013- 14	Rs. 2.17 /kWh Fixed cost component of tariff for FY 2013-14	Fixed cost component of tariff in the range of Rs. 2.50 /kWh to Rs. 1.77/kWh	Fixed cost component of tariff Rs. 2.23/kWh for water-cooled & Rs. 2.47/kWh for air-cooled (Fix for three Yr FY 12-13 to FY 14-15)	Fixed cost component of tariff in the range of Rs. 1.658/kWh to Rs. 1.580/kWh (from Yr 1 to Yr 20 of Project Life)	Fixed cost component of tariff Rs. 1.59/kWh (Levelised for 20 Yr for projects commissioned in FY 2010 to 2013)
Variable cost component of tariff Rs. 3.57/kWh for FY 2013-14	Variable cost component of tariff Rs. 3.70/kWh for FY 2013- 14	Variable cost component of tariff Rs. 2.66 /kWh during 1 st six months of first year of commissioning (FY 2012-13), Rs. 2.88 /kWh during last six months of first year of commissioning (FY 2012-13) and Rs. 2/kWh during FY 2012-13 for projects prior	Variable cost component of tariff Rs. 2.73, Rs. 2.82, Rs 2.97 for water- cooled & Rs. 2.95, Rs. 3.05, Rs. 3.21 for air-cooled condenser. For FY 2012- 13, FY 2013- 14 and FY 2014-15 resp.	Variable cost component of tariff Rs. 3.036 and 3.188/kWh for FY 12-13 and FY 13-14 respectively	Variable cost component of tariff in the range of Rs. 2.08 to Rs. 5.80 /kWh depending on financial year in progress

Table No 1.2 Comparison of biomass power tariff



CERC (28.02.2013) for FY 2013-14	MERC (22.03.2013) for FY 2013- 14	MPERC (02.03.2012)	RERC (21.12.2012 (17.08.2009)	TNERC (31.07.2012)	GERC (17.05.2010)
		to FY 2012-13			
Gross Tariff Rs. 5.80/kWh	Gross Tariff Rs. 5.87/kWh				Levelised Tariff of Rs.4.40/kWh
AD benefit Rs. 0.14/kWh	AD Benefit Rs. 0.21/kWh	AD benefit			(1 to 10 yr) Rs. 4.75 / kWh (11 to 20 yr)with
Net Tariff	Net tariff				AD and
Rs. 5.66/kWh	Rs. 5.66/kWh				Rs.4.45/ kWh
					(1 to 10 yr) ,
					Rs.4.80 per
					kWh (11 to 20
					vr) without AD

1.7 Bagasse based Co-generation Projects Tariff in Other States

The comparison of tariffs of bagasse based co-generation projects in other states with the GERC bagasse based co-generation tariff order 2010 is tabulated in Table No. 1.3. The CERC under its RE Tariff Regulations 2012 has adopted two-part tariff for bagasse based co-generation projects. The CERC has calculated two-part tariff for different states by considering the state-specific bagasse prices. The bagasse based co-generation tariff proposed by CERC for the state of Gujarat for FY 2013-14 is considered for comparison in the table below. The Maharashtra Electricity Regulatory Commission (MERC) had specified a fixed cost component of tariff based on average capital cost of three technologies used in co-generation as ceiling tariff, the variable component of tariff is specified for FY 2013-14. The SERCs of Madhya Pradesh and Karnataka have specified a single levelised tariff for bagasse based co-generation projects.

Like biomass based power projects, the SERCs in case of bagasse based co-generation projects also preferred to specify the year-wise variable component of tariff during the control period by considering appropriate escalation factor on the fuel price of the base year of the control period. Whereas, some SERCs have determined the year-wise variable cost component over the life of the plant by considering appropriate fuel cost escalation factor and such variable component of tariff is linked with the financial year in progress.

Apart from above, the GERC had offered single-part tariff for two sub-periods i.e. 1 to 10th and 11th to 20th year of project life and given a choice to the developer to opt for either of the tariffs determined by the Commission.



CERC	MERC	MPERC	KERC	TNERC	GERC
(28.02.2013)	(22.03.2013)	(03.09.2008)	(11.12.2009)	(31.07.2012)	(31.05.2010)
for FY 2013-	for FY 2013-				
14	14				
Rs. 2.59 /kWh	Rs. 2.38 /kWh			Fixed cost	Fix cost
Fixed cost	Fixed cost			component of	component of
component of	component of			tariff Rs.	tariff Rs.
tariff	tariff			1.90/kWh to	1.66/kWh
				Rs. 1.61/kWh	(levelised for 20
				(from Yr 1 to	Yr for projects
				Yr 20 of	commissioning
				project life)	from FY 2010 to
					2013)
Variable cost component of tariff Rs. 2.97/kWh	Variable cost component of tariff Rs. 3.43/kWh For FY 13-14			Variable cost component of tariff Rs. 1.86/kWh for FY 2012- 13 and 5% escalation	Variable cost component of tariff in the range of Rs. 2.10 to 5.85/kWh
Gross tariff Rs	Gross tariff Rs	Rs 280/kWh	Rs 359/kWh		Levelised tariff
5.56/kWh	5.81/kWh	(Year 1)	to Rs.		of
AD benefit Rs. 0.20/kWh	AD benefit Rs. 0.27/kWh	to Rs.3.81/kWh (Year 20)	4.14/kWh levelised Tariff		Rs.4.55/kWh (1 to 10 yr) Rs. 4.90/kWh (11 to 20 yr)With AD
Net tariff Rs.	Net tariff Rs.	levelised			and
5.36/kWh	5.54/kWh	Tariff			Rs.4.61/kWh (1
					to 10 yr),
					(11 to 20 yr)
					Without AD

Table No 1.3 Comparison of bagasse based co-generation tariff

1.8 GERC Biomass Tariff Order 2010 and 2011

The GERC, in its Order No. 5 of 2010 dated 17 May 2010, determined generic tariff for procurement of power by Distribution Licensees and others from biomass based power projects with water-cooled condensers for the state of Gujarat. Subsequently, GERC vide its order dated 07 February 2011 on petition no. 985 of 2009 determined generic tariff for biomass-based power projects using air-cooled condensers for the state of Gujarat. After due public consultation and regulatory process, GERC determined two-part tariff for the new biomass projects commissioning in FY 2010-11 to FY 2012-13. The fixed cost component of the tariff was levelised over the life of the plant. Whereas, the variable cost component of tariff was worked out separately for each year by considering an annual escalation of 5% on fuel cost over the tariff period. As the biomass projects were allowed to account for the accelerated depreciation



(AD) benefits, the GERC has worked out two separate tariffs with and without AD for the projects commissioning between FY 2010-11 to FY 2012-13. The generic tariff specified by the Commission for Biomass based power projects using water-cooled condensers is tabulated in Table No. 1.4.

Two-Part tariff for:	Fixed levelised	Variable cost	Total tariff	Total tariff
	tariff	tariff	without AD	with AD
	Rs./kWh	Rs./kWh	Rs./kWh	Rs./kWh
Projects to be Commissioned in FY	1.59	In the range	In the range	In the range
2010-11 (from June 2010)		of 2.08 to	of 3.67 to	of 3.62 to
		5.26	6.85	6.80
Projects to be Commissioned in FY	1.59	In the range	In the range	In the range
2011-12		of 2.18 to	of 3.77 to	of 3.72 to
		5.52	7.11	7.06
Projects to be Commissioned in FY	1.59	In the range	In the range	In the range
2012-13		of 2.29 to	of 3.88 to	of 3.83 to
		5.80	7 39	7 34

Table No. 1.4 Tariff for biomass based power projects with water-cooled condensers

Apart from above, the developers were given an option of choosing single levelised tariff for two sub-periods starting from the project commissioning to 10 years and from 11th year to 20th year as follows:

 Table No. 1.5 Single levelised tariff for two sub-periods for biomass based power projects

 with water-cooled condensers

	Initial 10 years	11 th year to 20 th year
With AD	Rs. 4.40/kWh	Rs. 4.75 /kWh
Without AD	Rs. 4.45/kWh	Rs. 4.80/kWh

The control period of this order was from 1 June 2010 to 31 March 2013.

The biomass based power projects tariff using air-cooled condensers is tabulated in Table No. 1.6.



Tariff for biomass	Levelised tariff	Initial 10 years	11^{th} year to 20^{th}
based power projects	for whole life of		year
with air-cooled	the project		
condenser	Rs./ kWh		
With AD	Rs. 4.70/kWh	Rs. 4.60 /kWh	Rs. 5.00/kWh
Without AD	Rs. 4.76/kWh	Rs. 4.66/kWh	Rs. 5.06/kWh

Table No. 1.6 Tariff for biomass based power projects with air-cooled condensers

Apart from above, the GERC has also specified the year-wise two-part tariff as specified for the biomass based power projects using water-cooled condenser.

1.9 GERC Bagasse based Co-generation Tariff Order 2010

The GERC, in its Order No. 4 of 2010 dated 31 May 2010, determined the tariff for procurement of power by the Distribution Licensees and others from bagasse based co-generation projects for the state of Gujarat. After due public consultation and regulatory process, GERC determined two-part tariff for bagasse based co-generation projects commissioning in FY 2010-11 to FY 2012-13. The fixed cost component of the tariff was levelised over the life of the plant. Whereas, the variable cost component of tariff was worked out separately for each year by considering an annual escalation of 5% on fuel cost over the tariff period. As the bagasse based co-generation projects were allowed to account for the AD benefits, the GERC worked out two separate tariffs with and without AD. for the projects commissioning between FY 2010-11 to FY 2012-13 as tabulated in Table No. 1.7.

Tariff for bagasse based co-	Levelised fixed	Variable cost	Total tariff	Total tariff
generation projects	tariff	tariff	without AD	with AD
· · ·	Rs./ kWh	Rs./kWh	Rs./kWh	Rs./kWh
Projects to be Commissioned in FY	1.66	In the range	In the range	In the range
2010-11 (from June 2010)		of 2.10 to	of 3.76 to	of 3.71 to
		5.31	6.97	6.92
Projects to be Commissioned in FY	1.66	In the range	In the range	In the range
2011-12		of 2.21 to	of 3.87 to	of 3.82 to
		5.57	7.23	7.18
Projects to be Commissioned in FY	1.66	In the range	In the range	In the range
2012-13		of 2.32 to	of 3.98 to	of 3.93 to
		5.85	7.51	7.46

Table No. 1.7 Tariff for bagasse based co-generation projects

Apart from this two-part tariff, the developers were give the option to chose a single levelised tariff for two sub-periods starting from the project commissioning to 10 years and from 11th year to 20th year as follows:



	Initial 10 years	11 th year to 20 th year
With AD	Rs. 4.55/kWh	Rs. 4.90 /kWh
Without AD	Rs. 4.61/kWh	Rs. 4.96/kWh

Table No. 1.8 Single-part levelised tariff for two sub-periods

The control period of this order was from 1 June 2010 to 31 May 2013.

1.10 Biomass Power and Bagasse based Co-generation Project Developments in Gujarat during the Control Period of Tariff Orders dated 17 May 2010 and 31 May 2010

The installed capacity of biomass based power projects in Gujarat was 31.2 MW till March 2013. All the four biomass based power projects aggregating 31.2 MW capacities as given in Table No 1.9 below were commissioned during the control period of the last tariff order dated 17 May 2010.

Sr. No.	Name of biomass power project	Location	Type of biomass	Installed capacity in	Date of commissioning
			used	MŴ	U U
1	M/s. Amreli Power	Village:	Cotton stalk,	10	01.03.2011
	Projects Ltd.	Savarsampadar	Groundnut		
		Taluka:	shell &		
		Savarkundla	prosopis		
		Dist.: Amreli	juliflora.		
2	M/s Junagadh Power	Village: Khokharda	Cotton stalk,	10	22.05.2011
	Projects Pvt. Ltd.	Taluka: Vanthali	Groundnut		
		Dist.: Junagadh	shell &		
			prosopis		
-			juliflora.		
3	M/s. Bhavnagar Biomass	Village: Vavadi	Cotton Stalk,	10	19.03.2012
	Power Projects Pvt. Ltd.	(Gajabhai)	Groundnut		
		Taluka: Shihor	shell &		
		Dist.: Bhavnagar	prosopis		
4			juliflora.	1.0	20 10 2011
4	M/s. Ankur Scientific	Village: Sankheda	Prosopis	1.2	20.10.2011
	Energy Technologies Pvt.	Taluka: Sankheda	juliflora &	(Gasification	
	Limited,	Dist.: Vadodara	woody	Koute using	
			biomass.	100%	
				Producer	
	T-+-1			Gasj	
	Iotal			31.2	

Table No. 1.9	Biomass based	nower nro	iects commis	sioned till	31 03 2012
Table No. 1.7	Diomass Dascu	power pro	jeeus commis	sioneu un .	J1.0J.2012

(Source: Gujarat Energy Development Agency)

Apart from the above, the following two biomass based power projects are in the development stage.



Sr.	Name of Biomass Power Project	Location	Installed capacity
1	M /a Alasllar Class Ensure Limitad	Village Vithlage av	10
1	M/s. Abelion Clean Energy Limited	village: vitniapar	10
		Taluka: Lakhtar	
		Dist.: Surendranagar	
2	M/s Abellon Clean Energy Limited	Village: Khas	10
		Taluka: Ranpur	
		Dist.: Ahmedabad	
	Total		20

(Source: Gujarat Energy Development Agency)

With regard to bagasse based co-generation projects, the state is yet to commission a gridconnected bagasse based co-generation project. However, as per the information gathered from the office of Directorate of Sugar, Government of Gujarat, there are around 18 operational sugar mills where the potential for bagasse based co-generation projects exists.



2. Biomass Power and Bagasse based Co-generation Technology

2.1 Biomass to Power Conversion Technology

Biomass based power projects are those that use biomass as basic source of fuel. Biomass is the wastes produced during agricultural and forestry operations (for example straws and stalks) or produced as a by-product of processing operations of agricultural produce (e.g., husks, shells, de-oiled cakes, etc); wood produced in dedicated energy plantations or recovered from wild bushes/weeds; and wood waste produced in some industrial operations. As per the guidelines of MNRE, these projects are allowed to use 15% fossil fuel on annual basis for meeting biomass shortfalls and for extended days of operation.

Energy available in biomass is converted for power generation through two basic conversion process as follows:

- 1) Thermo-chemical conversion process: through direct combustion technology or gasification technology or pyrolysis technology.
- 2) Bio-chemical conversion process: through bio-degradation of biomass/anaerobic digestion of biomass.

Thermo-Chemica	al Process
Combustion	The cycle used is the conventional rankine cycle with biomass being burned
	(oxidised) in a high pressure boiler to generate steam. The net power cycle
	efficiencies that can be achieved are about 23% to 25%. The exhaust of the steam
	turbine can be fully condensed to produce power.
Gasification	Gasification is achieved by the partial combustion of the biomass in a low oxygen
	environment, leading to the release of a gaseous product (producer gas or syngas).
	The gasifier can either be of a "fixed bed", "fluidised bed" or "entrained flow"
	configuration. The resulting gas is a mixture of carbon monoxide, water, CO ₂ , char, tar
	and hydrogen, and it can be used in combustion engines, micro-turbines, or gas
	turbines.
Pyrolysis	Pyrolysis is a subset of gasification systems. In pyrolysis, the partial combustion is
	stopped at a lower temperature (450°C to 600°C), resulting in the creation of a liquid
	bio-oil, as well as gaseous and solid products. The pyrolysis oil can then be used as a
	fuel to generate electricity.
Bio-Chemical Pro	DCess
Anaerobic	Anaerobic digestion is a process which takes place in almost any biological material
digestion	that is decomposing and is favoured by warm, wet and airless conditions. The
	resulting gas consists mainly of methane and carbon dioxide and is referred to as
	biogas. The biogas can be used, after clean-up, in internal combustion engines, micro-
	turbines, gas turbines, fuel cells and sterling engines or it can be upgraded to bio
	methane for distribution.

The biomass based power projects based on rankine cycle are well established in India. In the combustion process, biomass is directly combusted by using rankine cycle technology where as in the gasification process, partial combustion of biomass takes place in the absence of air.



Rankine Cycle Technology: In this process, thermal decomposition of organic matter is carried out in the presence of excess air, liberating heat and leaving behind incombustible ash.



Fuel + Air \rightarrow Heat + Ash + Inert Gases



(Source: website www.unfccc.int)

Direct combustion of biomass uses conventional rankine cycle technology. This technology is well proven, indigenised and used in conventional coal-based power plants. The power plant will have one condensing steam turbine-generator unit with a matching boiler of stoker grate/travelling grate/fluidised bed type design capable of firing multi-fuel with one of the largely available agriculture waste as a primary fuel. Fluidized bed combustion (FBC) type boiler has the advantages of high thermal and combustion efficiency reducing quantity of agro waste needed for power production which also reduces need for manpower. The process flow diagram of rankine cycle technology based biomass power project is as shown in the Figure 2.1. Such power projects are generally set up in the range of 5 MW to 20 MW capacities depending on the availability of surplus biomass in the catchment area of power project. Such projects are further bifurcated as per the condenser used in the project. The air-cooled condensers are comparatively expensive as compared to water-cooled condensers. However, the air-cooled condenser.

Gasification Technology: 'Biomass gasification' means a process of incomplete combustion of biomass resulting in production of combustible gases consisting of a mixture of Carbon monoxide (CO), Hydrogen (H₂) and traces of Methane (CH₄), which is called producer gas. In gasification the thermo-chemical conversion of agro waste/solid fuels (wood/wood-waste, agricultural residues etc.) is done to obtain producer gas. In principle, the process is a thermal



decomposition of organic matter in the presence of limited supply of air or oxygen to produce combustible gases thus converting calorific value of organic material into a gaseous energy carrier. The schematic diagram of gasification process is shown in Figure No.2.2.



Figure 2.2 Biomass gasification process

(Source: website www.unfccc.int)

2.2 Bagasse Based Co-generation Technology

In sugar mills, the waste or leftover after cane crushing is called bagasse and it is used as a main source of fuel for direct combustion in boiler for generation of process steam as well for generation of power from high pressure steam. In a traditional sugar factory, with backpressure steam turbine, bagasse (fuel) is burned in the boiler furnace to produce steam, which is further supplied to the turbine. The turbine drives an electrical generator and the steam leaving the turbine exhaust flows to the heating equipment for sugar manufacturing. However, using traditional equipment such as low pressure boilers and counter pressure turbo alternators, the level and reliability of electricity production is not sufficient to change the energy balance and to permit exports to the grid. In typical conditions the steam circuit of the plant is generally balanced, i.e. the steam supply sufficiently meets the plant's own requirements. Typically, the processing of one tonne of cane yields about 250- 280 kg of bagasse (with moisture level of 50%), which can generate 500-600 kg of steam, close to the 400-600 kg of steam consumed in the processing. On the other hand, the use of more efficient high pressure boilers together with condensing extraction steam turbines can substantially increase the level of exportable electricity. A typical bagasse based co-generation arrangement using extractioncum-condensing steam turbine is as shown in Figure 2.3





Figure 2.3 Extraction-cum-condensing steam turbine arrangements in sugar factory (Source: website www.unfccc.int)

Furthermore, by improving the efficiency of the sugar process the steam consumption for the process can be reduced which will further increase the surplus steam available for power generation.

However, such bagasse based co-generation projects/non fossil fuel based co-generation projects have to satisfy the minimum qualifying requirements as stated below:

2.2.1 Qualifying criteria for bagasse based co-generation/non fossil fuel based co-generation projects

A project may qualify to be termed as a bagasse based co-generation project/non fossil fuel based co-generation project, if it is in accordance with the definition specified by Ministry of Power and also meets the qualifying requirement outlined below.

- Ministry of Power, GoI in its resolution dated 6 November 1996 has defined cogeneration as: "A Co-generation facility is defined as one, which simultaneously produces two or more forms of useful energy such as electrical power and steam, electric power and shaft (mechanical) power etc."
- Topping cycle mode of co-generation: Any facility that uses non-fossil fuel input for the power generation and also utilizes the thermal energy generated for useful heat applications in other industrial activities simultaneously.



Provided that for the co-generation facility to qualify under topping cycle mode, the sum of useful power output and one half the useful thermal output be greater than 45% of the facility's energy consumption, during season.

Explanation

- (a) 'Useful power output' is the gross electrical output from the generator. There will be an auxiliary consumption in the co-generation plant itself (e.g. the boiler feed pump and the FD/ID fans). In order to compute the net power output it would be necessary to subtract the auxiliary consumption from the gross output. For simplicity of calculation, the useful power output is defined as the gross electricity (kWh) output from the generator.
- (b) 'Useful thermal output' is the useful heat (steam) that is provided to the process by the co-generation facility.
- (c) 'Energy consumption' of the facility is the useful energy input that is supplied by the fuel (normally bagasse or other such biomass fuel).



3. Computation of Tariff for Biomass Power and Bagasse based Co-generation Projects

3.1 Approach and Methodology

3.1.1 The Commission notes that the Tariff Policy notified by the Central Government 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. The relevant extract of para 6.4 of the Tariff Policy is given below.

"(1) Pursuant to provisions of Section 86 (1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by 1 April 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission".

3.1.2 The Commission notes that the *Report on Policies on Renewable* prepared by the Working Group constituted by the Forum of Regulators consisting of chairpersons of some State Electricity Regulatory Commissions and external experts including a representative from the MNRE, has recommended preferential tariff for renewable sources at least during their loan tenure. The report urges the Ministry of Power, Government of India, to frame guidelines and standard bid documents for competitive bidding for renewables under Section 63 of the Act.

3.1.3 The Commission also notes that the MNRE has finalised the Guidelines as well as Standard Bidding Documents for Tariff-Based Competitive Bidding process for grid-connected power projects based on renewable energy sources. The Guidelines and Standards Bidding Documents have been forwarded to Ministry of Power for notification as required under Section 63 of Electricity Act, 2003 with the recommendation that these documents can be used for procurement of solar power at state level. The competitive bidding guidelines are yet to be notified by the Ministry of Power, GoI.

In view of above, the Commission proposes to continue with the cost-plus tariff as adopted in the previous biomass power/bagasse based co-generation tariff orders issued by the Commission during year 2010



3.2 General Principles

In this section, the general principles for biomass power and bagasse based co-generation tariff determination such as control period, tariff period, tariff structure, tariff design, plant life, etc., has been discussed.

3.2.1 Control period: The control period of the GERC Biomass power Tariff Order No. 5 of 2010 dated 17 May 2010 was up to 31 March 2013. The control period of the GERC bagasse based cogeneration Tariff Order No. 4 of 2010 dated 31 May 2010 was up to 31 May 2013. The Commission has decided to extend the control period of biomass power project Tariff Order dated 17 May 2010 and that of bagasse based co-generation tariff order dated 31 May 2010 up to 31 July 2013 and initiate the regulatory process simultaneously for determination of tariff for procurement of power by distribution licensees and others from biomass based power projects and bagasse based co-generation projects to be commissioning from 1 August 2013 during the next control period.

The Commission proposes that the control period for the biomass power and bagasse based cogeneration tariff order under discussion will be from 1 August 2013 to 31 March 2016.

3.2.2 Useful life of plant: The Commission in its biomass power and bagasse based cogeneration tariff orders dated 17 May 2010 and 31 May 2010 respectively had considered the project life of 20 years for biomass power and bagasse based co-generation projects. Further, the CERC in its RE Tariff Regulations 2012 dated 6 February 2012 has also considered the project life of 20 years for biomass power and bagasse based co-generation projects. In view of above, the Commission proposes 20 years as useful life for the biomass power and bagasse based co-generation projects, including the evacuation line for tariff determination purpose.

3.2.3 Tariff period: The tariff period for the tariff determined by the Commission for procurement of electricity from biomass power and bagasse based co-generation projects to be commissioned during next control period starting from 1 August 2013 will be of 20 years from the date of commissioning of such projects.

3.2.4 Tariff structure & design: The Commission proposes to determine a two-part tariff for procurement of electricity from biomass based power and bagasse based co-generation projects commissioned during the next control period starting from 1 August 2013 by the distribution licensees in the state. The Commission proposes the following tariff structures for procurement of power by the distribution licensees from the biomass power and bagasse based co-generation projects to be commissioned in the next control period :

Fixed component of tariff shall be levelised over the life of the plant. Variable cost component of tariff shall be specified separately for the 3 years of the control period by considering annual



fuel cost escalation of 5% during the control period. The biomass power and bagasse based cogeneration project to be commissioned during the control period will get variable component of tariff as specified for 3 years. At the end of control period, the Commission shall re-assess the fuel price market and re-determine the variable component of tariff which will be specified in the subsequent tariff orders to be issued by the Commission. All biomass based power and bagasse based co-generation projects commissioned during the control period (1 August 2013 to 31 March 2016) will be eligible for getting the variable component of tariff as per the subsequent tariff orders of the Commission. The Commission proposes to specify tariff with and without accelerated depreciation benefit.

3.2.5 Eligibility criteria: The biomass power project based on rankine cycle technology, gasification technology and bagasse/non-fossil fuel based co-generation projects using new turbine generators and associated auxiliaries, to be commissioned after 1 August 2013 and during the control period of this tariff order will be eligible to sell power to distribution licensees of Gujarat at tariff determined by the Commission under the new tariff order. Further the bagasse/non fossil-fuel based co-generation projects to be commissioned during the control period starting from 1 August 2013 have to fulfil the minimum qualification requirements of bagasse/non fossil-fuel based co-generation project as specified under **clause 2.2.1** of this discussion paper.

3.2.6 Scheduling of power: Generation from biomass power and bagasse based co-generation projects is predictable and hence, can be scheduled in accordance with the intra-state ABT guidelines. The Commission proposes to cover the generation from the biomass power and bagasse based co-generation projects under the ambit of intra-state ABT order during the next control period. However biomass power and bagasse based co-generation projects having installed capacity up to 4 MW and selling power to GUVNL / DISCOMs or wheeling the energy for captive use or IPPs selling to third party consumers shall not be covered under provisions of intra-state ABT mechanism in view of their smaller size and difficulties of monitoring by SLDC.

3.2.7 Applicability of merit order despatch principle: The biomass power and bagasse based co-generation projects irrespective of the plant capacity shall be treated as 'MUST RUN' power plants and shall not be subjected to merit order despatch principles.

3.2.8 Interconnection point and Metering point : The interconnection point will be at the line isolator on outgoing feeder on HV side of generator transformer and the metering point shall be at the interconnection point of the generator bus-bar with the transmission or distribution system concerned, as the case may be.



The interconnection point referred to above means interface point of biomass power/bagasse based co-generation project facility with the transmission or distribution system as the case may be.

3.2.9 Subsidy or incentive by the Central/State Government: The Commission shall take into account any incentive or subsidy offered by the Central and State Government. In case Biomass and Bagasse based Co-generation power producers avail the benefits provided by Central/State Government, it should be passed on to the beneficiaries.

3.3 Benchmarking of Capital Cost and Other Performance Parameters

3.3.1 Benchmark capital cost for biomass based power projects in Gujarat: Capital cost is the most critical component while determining tariff in a regulated environment. The capital cost of biomass project comprises the cost of (i) boiler, (ii) turbine and generators, (iii) condenser, (iv) control cabinets, (v) chimney for flue gases, (vi) transformer and associated equipments, (vii) land and its development, (viii) processing fee of Gujarat Energy Development Agency(GEDA), (ix) erection and commissioning charges, (x) creation of evacuation system up to the interconnection point of State Transmission Utility. The above components can be grouped in to four important categories i.e. (i) plant and machinery, (ii) land cost (iii) evacuation infrastructure and (iv) associated service charges.

In order to arrive at benchmark capital cost for the biomass based power projects to be commissioned in the next control period starting from 1 August 2013, the Commission has analysed the biomass power project capital cost data of the projects commissioned in Gujarat during the control period of previous tariff orders as well as the approach followed by CERC and SERCs while fixing benchmark biomass based power projects capital cost under FY 2012-13/2013-14 tariff orders. The Commission has also examined the capital cost of biomass based power projects commissioned in the state and registered with UNFCCC for availing CDM benefit. The Commission has referred to the International Renewable Energy Agency (IRENA), Costing benchmark for biomass power projects, July 2012. The Commission has also considered the capital cost related recommendations provided by MNRE and IREDA to CERC while finalizing the RE tariff Regulations 2012.

3.3.1.1 The Commission has studied biomass based power projects capital cost considered by other SERCs in their tariff order. Most of the SERCs including CERC have defined the interconnection point at line isolator on outgoing feeder on HV side of generator transformer and included the evacuation line cost up to interconnection point under capital cost. However, MPERC and GERC have defined the interconnection point at DISCOM/GETCO substation and considered the additional cost towards construction of transmission line up to utility substation as part of capital cost. The capital cost of biomass based power projects using water-cooled



condenser considered by various SERCs for FY 2012-13/2013-14 is in the range of Rs. 4.45 Cr/MW to Rs. 5.21 Cr/MW. Whereas the CERC in its tariff order for FY 2013-14 has specified Rs. 4.63 Cr/MW as a capital cost for biomass based power projects using water-cooled condenser.

The Commission noted that the capital cost of biomass power projects varies with the system configuration viz. size of the project, low pressure steam cooling system (e.g. air-cooled condenser/water-cooled condenser), configuration of boiler steam temperature and pressure, suitability of boiler for variety of biomass, combustion system (e.g. stoker grate, travelling grate, fluidised bed combustion system) etc.

3.3.1.2 The Commissions has also examined capital cost of biomass based power projects commissioned in the state and registered with UNFCCC for availing CDM benefit. The capital cost reported by three commissioned biomass based power projects in the project design documents submitted to UNFCCC is as shown in Table No 3.1. All these projects are of 10 MW capacity and have almost the same technical specification.

Name of Project	Capacity	Capital cost	Location	Technical Specification
		admitted		
M/s. Amreli	10 MW	4.94 Cr/MW	Savar-	Air-cooled Condenser.
Power Projects			Samapadar	
Pvt. Ltd.			area,	Boiler: 48 TPG, 67 ata, 480+/- 5
			Savarkundla	°C , Travelling Grate
			Taluka	
			District:	66/220 kV S/s approx. 9 km
			Amreli	from site
M/s. Bhavnagar	10 MW	4.95 Cr/MW	Vavadi	Air-cooled condensing system
Biomass Power			(Gajabhai)	
Projects Pvt. Ltd.			Village, Sihor	Boiler: 48 TPH, 67 ata, 480+/- 5
			Taluka, in the	°C , Travelling Grate
			district of	
			Bhavnagar	66 kV Sonasara S/S Approx. 2.5
				km from the plant site
M/s.Junagadh	10 MW	4.92 Cr/ MW	Khokharada	Air-cooled condensing system
Power Projects			Village,	
Pvt.Ltd.			Vanthali	Boiler: 48 TPH, 67 ata, 480+/- 5
			Taluk of	°C , Travelling Grate
			Junagadh	
			district in	66 kV Kanja S/S Approx. 2 km
			Gujarat	from project site

Table No. 3.1. Details of commissioned biomass projects as per PPDs submitted with UNFCCC

(Ref: www.unfccc.int)

3.3.1.3 The GERC under its biomass power Tariff Order dated 17 May 2010 has specified capital cost of Rs. 4.25 Cr/MW for biomass power project using water-cooled condenser to be commissioned during the control period.



In order to determine the benchmark capital cost for the biomass based power projects for the next control period starting from 1 August 2013, the Commission has observed the change in Wholesale Price Index (WPI) of steel and E&M (major component of capital cost) during last control period and corresponding rate of increase. Accordingly a rate of increase of 4.91% is considered for determination of year-wise capital cost and average capital cost for the new control period starting from 1 August 2013. After considering all the options discussed above, the **Commission proposes to fix benchmark capital cost of Rs. 4.68 Cr/MW for biomass based power projects using water-cooled condenser**.

In case of biomass based power projects using air-cooled condensers the Commission proposes to allow additional amount of Rs. 30 Lakh/MW on account of additional technological features over the biomass based power projects using water-cooled condenser. Accordingly the Commission proposes to fix benchmark capital cost of **Rs. 4.98 Cr/MW for biomass based power projects using air-cooled condenser**.

3.3.2 Benchmark capital cost for biomass based power projects based on gasification technology: The Commission noticed that, the CERC under its RE Tariff Regulations 2012 has provided capital cost benchmark and other performance parameters for determination of tariff for biomass based power projects based on gasification technology. CERC in its RE tariff Order for FY 2013-14 has considered benchmark capital cost of Rs. 5.72 Cr/MW for determination of tariff for biomass based power projects based on gasification technology. M/s Ankur Scientific Energy Technologies Pvt. Ltd had commissioned a grid-connected biomass power project of 1.2 MW capacity based on gasification technology in October 2011 at Sankheda near Vadodara. The Commission has noticed considerable variation amongst the cost related data / performance data submitted by the company, reported in the project design document registered with UNFCCC and that is being considered by the CERC.

The Commission has observed that very few biomass based power projects based on gasification technology are operational in India and the capital cost of such projects varies based on the type of gas engine used for power generation. The Commission has noticed wide variation in the technical and operational parameters like PLF, SHR and specific fuel consumption considered in above three cases. In view of the limited data and operational experience of biomass gasification based power projects, the Commission is not inclined to determine a generic tariff for this technology at this stage and would like to continue with its earlier approach to allow such projects to sell electricity to the utilities at the tariff determined for biomass based power projects using water-cooled condensers.

However, the Commission allows investors opting for gasification technology to approach the Commission for a project-specific tariff with the supporting documents, in case the investors feel that the tariff specified by the Commission for biomass based power projects using water-cooled condensers are not remunerative.



3.3.3 Benchmark capital cost for bagasse based co-generation projects in Gujarat: In case of bagasse based co-generation projects the capital cost components are more or less similar to that of biomass based power projects. However, in bagasse based co-generation project the power project is set up in the premises of existing sugar factory, hence such projects practically do not require to incur cost on procuring land for the project. Further, the steam generated is used for power generation and processing of sugar. Hence, the cost of boiler and steam turbine cannot be fully loaded on the project capital cost and needs to be apportioned appropriately.

3.3.3.1 The Commission has studied the bagasse based co-generation projects capital cost considered by the other SERCs in their tariff orders. Most of the SERCs including CERC have defined the interconnection point at line isolator on outgoing feeder on HV side of generator transformer and included the evacuation line cost up to interconnection point under capital cost. However, MPERC and GERC have defined the interconnection point at DISCOM/GETCO substation and considered the additional cost towards construction of transmission line up to utility substation as part of capital cost. The capital cost of bagasse based co-generation projects considered by various SERCs for FY 2012-13/2013-14 is in the range of Rs. 4.20 Cr/MW to Rs. 4.66 Cr/MW. Whereas the CERC in its Tariff Order for FY 2013-14 has specified Rs. 4.37 Cr/MW as a capital cost for bagasse based co-generation projects.

3.3.3.2 The Commission noted that the capital cost of bagasse based co-generation projects financed by IREDA during FY 2010-11 and 2011-12 ranges from Rs. 4.39 Cr/MW to Rs. 5.31 Cr/MW.

3.3.3.3 The GERC under bagasse based co-generation Tariff Order dated 31 May 2010 has specified capital cost of Rs. 4.15 Cr/MW for bagasse based co-generation projects to be commissioned during the control period. The Commission has noted that there are no bagasse based co-generation projects commissioned in the state till date and hence no state specific data is available.

In order to determine the benchmark capital cost for the bagasse based co-generation projects for the next control period starting from 1 August 2013, the Commission has considered the capital cost specified in the previous Tariff Order dated 31 May 2010 and the growth rate as considered in case of the biomass based power projects to determine the year wise and average capital cost for bagasse based co-generation projects. Accordingly, the **Commission proposes to fix benchmark capital cost of Rs. 4.57 Cr/MW for bagasse based co-generation**.

3.3.4 Power evacuation system cost: The Commission in its Order No. 4 & 5 of 2010 dated 17 May 2010 and 31 May 2010 on Determination of the Tariff for biomass based power projects and bagasse based co-generation projects had allowed the investors to construct the power evacuation line from the plant switchyard to GETCO substation and included Rs. 29 Lakh/MW



towards cost of evacuation line for constructing the evacuation line as part of capital cost in its earlier order.

It has been observed that the biomass power and bagasse based co-generation projects have to lay comparatively shorter transmission lines than that of the wind power projects and the size of these projects is in the range of 1 to 25 MW. Therefore, generated power can be evacuated through 11/33/66 kV line and which can be easily connected to nearby GETCO/DISCOM substation. In view of this the Commission proposes that GETCO/DISCOM shall take the responsibility of laying the power evacuation line from the interconnection point to the nearest GETCO/DISCOM substation. Hence, the Commission has not included the cost associated with laying power evacuation line beyond interconnection point as a part of capital cost. The cost associated with erection of transformer, associated equipment and creation of evacuation system up to interconnection point is already included in the capital cost as discussed in 3.3.1.3 and 3.3.3.3 above.

3.3.5 Operations and maintenance cost: Operations and Maintenance (0&M) cost consists of the statutory charges, spares, employee cost, administrative and general expense, consumables, repairs and maintenance, and insurance expenses, etc.

In case of biomass based power projects, the Commission in its 2010 tariff order had considered the O&M charges as 5% of the capital cost in the first year of project commissioning and escalation of 5% thereafter. In the Commission's earlier tariff order for biomass, these O&M charges were determined as Rs. 22.7 Lakh/MW. CERC in its recent RE Tariff Order dated 28 Feb 2013 had considered O&M charges of Rs. 25.37 Lakh/MW for 2013-14 with 5.72% escalation thereafter.

In case of bagasse based co-generation projects, the Commission in its 2010 tariff order had considered the O&M charges as 3% of the capital cost in the first year of project commissioning and escalation of 5% thereafter. These O&M charges were Rs. 13.32 Lakh/MW in year 2010 tariff order. For bagasse based co-generation projects, CERC had specified O&M charges of Rs. 16.92 Lakh/MW for 2013-14 with 5.72% escalation thereafter.

The Commission proposes to retain the same percentages for determination of base O&M charges for biomass and bagasse based co-generation projects during the new control period. However, in line with the GERC MYT Regulations, the Commission proposes to revise the annual O&M escalation for biomass power and bagasse based co-generation projects from 5% to 5.72%.

3.3.6 Plant load factor: In case of biomass based power projects, the Commission in its earlier tariff order dated 17 May 2010 had considered a PLF of the 70% during 1st year covering the stabilisation period and 80% from 2nd year onward. Further, CERC in its RE Tariff



Regulations 2012, had considered the PLF of 60% (during stabilisation period of 6 months), 70% (during remaining period of the first year (after stabilization), 80% (second year onwards). The CEA report on 'operating norm for biomass based power projects', September 2005 recommended PLF of 80% for recovery of the full fixed cost. After considering all above, the Commission proposes to retain the normative PLF as specified in previous tariff order dated 17 May 2010.

In case of bagasse based co-generation projects, the Commission in its earlier tariff order dated 31 May 2010 had considered the plant load factor of the 60%. This was based on the estimate that co-generation plant operates for 240 days (180 days of season and 60 days of off-season) at load factor of 92%, which comes to around 60% load factor on annual basis. However, the CERC in its RE Tariff Regulations had considered 210 days of operation of sugar factories for Gujarat (160 days of season and 60 days of off-season) and considered 53% PLF for tariff determination.

The Commission has analysed the number of operating days of the sugar factories in Gujarat for the crushing season of FY 2010-11 & FY 2011-12 and found that sugar factories in Gujarat had average crushing season of 182 and 171 days for FY 2010-11 and 2011-12 respectively. As crushing season depends on the cropping pattern, year on year rainfall etc., hence there could be minor variations in number of days of operation of sugar factories over the years. Further, with improvement in technology, sugar factories can save more bagasse for off-season operation and this saved bagasse can be used for the extended days of operation along with the permissible quantity of coal. Hence, the Commission feels that 240 days (180 days of season and 60 days of off-season) of operational period of sugar factories is reasonable and proposes 60% PLF for the next control period.

3.3.7 Auxiliary consumption: In case of biomass based power projects, the Commission in its earlier tariff orders for biomass based power projects using water-cooled and air-cooled condenser has considered the auxiliary consumption of 10% of gross generation. The Commission had analysed the auxiliary consumption considered by different state electricity regulatory commissions in their tariff orders for biomass based power projects for finalising the same for new control period. It is observed that most of SERCs have specified auxiliary consumption as 10%. The Commission has noted that the CEA report on 'operating norm for biomass based power projects', September 2005 has also recommended auxiliary consumption of 10% for biomass based power projects. With regard to the biomass based power projects using air-cooled condenser, the matter was examined by the Commission in petition number 985 of 2009, the Commission did not find any reason to allow higher auxiliary consumption for the biomass projects using air-cooled condenser. Hence, the Commission proposes to allow 10% auxiliary consumption for both i.e biomass based power projects using water-cooled and air-cooled condenser.



In case of bagasse based co-generation projects, the Commission in its earlier tariff order dated 31 May 2010 had considered the auxiliary consumption of 8.5%. The Commission had analysed the auxiliary consumption considered by different state electricity regulatory commissions in their tariff orders for bagasse based co-generation projects for finalising the same for this control period. It is observed that the auxiliary consumption considered by MPERC, KERC and TNERC is in the range of 8% to 9% and that considered by CERC is 8.5% which is in line with the Commission's estimate of auxiliary consumption. Hence, the Commission proposes to retain the auxiliary consumption for determining the tariff for bagasse based co-generation projects at 8.5% for the next control period.

3.3.8 Station heat rate: The Commission has noted that in case of biomass based power projects, the SHR depends on factors such as plant capacity, plant design and its configuration, technology employed, O&M practices and quality of fuel received. Biomass project developers, as industry practice have deployed predominantly travelling grate type boilers for rankine cycle based biomass based power projects. The station heat rate of such projects varies in the range of 3400 –3900 kCal/kWh. The Commission in its earlier biomass power tariff order dated 17 May 2010 had considered an SHR of 3800 kCal/kWh for biomass based power projects using water-cooled condenser. In case of the biomass based power projects using air-cooled condensers, the Commission in the tariff order dated 07.02.2011 has considered the SHR of 3950 kCal/kWh by recognising the fact that the condenser pressure in such projects required to be kept at high level which resulted in higher SHR than the water-cooled condenser. The Commission has also examined the SHR considered by different state electricity regulatory commissions in their tariff orders for biomass based power projects as given in the following table.

CERC	MERC	Madhya Pradesh	RERC	TNERC
4000 kCal/kWh	3800 kCal/kWh	3800 kCal/kWh	4200 kCal/kWh	3840 kCal/kWb
			condenser	KCal/ KWII
			and 4440 kCal/kWh	
			for air-cooled	

Table No. 3.2. Station heat rate considered by SERCs in biomass tariff orders

Considering various factors as discussed above, the Commission proposes to retain the SHR of 3800 kCal/kWh for biomass based power projects using water-cooled condenser and SHR of 3950 kCal/kWh for biomass based power projects using air-cooled condensers during the control period starting from 1 August 2013.

In case of bagasse based **co-generation projects**, the Commission in its earlier tariff order dated 31 May 2010 had considered the Station Heat Rate (SHR) of 3600 kCal/kWh. The SHR considered by MPERC, TNERC and KERC in the recent bagasse based co-generation project tariff orders is 3700 kCal/kWh. Whereas, the CERC in its bagasse based co-generation projects



tariff order for FY 2013-14 has considered the SHR of 3600 kCal/kWh. In view of this, the Commission proposes to retain the SHR of 3600 kcal/kWh while determining the tariff for the next control period for bagasse based co-generation projects.

3.3.9 Gross calorific value (GCV) of Fuel: In case of biomass based power projects, the gross calorific value of fuel depends upon the type and quality of biomass available in the particular state. Therefore, this aspect has been studied in detail. The Commission has analyzed the GCV of representative biomass for the state by adopting different approaches.

3.3.9.1 Based on the data provided by the Directorate of Agriculture , Government of Gujarat (GoG) and the biomass resource assessment study conducted by the Indian Institute of Science, (IISC) Bangalore, the type and quantity of surplus biomass available in the state for power generation has been studied. An analysis of the percentage share of yearly surplus biomass availability in the state and their calorific values were tabulated and based on that the weighted average calorific value of representative surplus biomass has been determined for the state as given in the following table:

Major Crops	Avg. Surplus Biomass during 2009-10 to 2011-12 (kT/year)	Percentage share	GCV (kCal/kg)
Bajra (Cobs and			
husk)	315.34	1.86%	3950
Cotton	14169.82	83.61%	3636
Groundnut	1099.93	6.49%	4200
Jowar (Cobs and			
husk)	34.66	0.2%	3500
Maize (Cobs)	108.03	0.6%	3500
Moong	10.81	0.06%	3820
Moth	1.35	0.01%	3850
Tobacco	22.05	0.1%	2910
Urad	40.62	0.2%	3820
Wheat (Pods)	1143.66	6.7%	3800
Weighted Average bi	e GCV of representative iomass		3688 kCal/kg

Table No 3.3. GCV of representative surplus biomass available in Gujarat

(Source: Directorate of Agriculture, GoG, IISc Bangalore)

3.3.9.2 The Commission has also studied the operational data of the biomass based power projects commissioned in the state during the last control period available with GEDA. The GCV of the biomass used in three biomass based power projects varies in the range of 2932-3847 kCal/kg for FY 2010-11 and FY 2011-12 as per the records available with GEDA as tabulated below:



Table No. 3.4. Data of GCV of biomass reported by commissioned biomass based power

 projects

Biomass Power Project	Data for FY 2010-11	Data for FY 2011-12
Amreli	3665-3847	3358-3638
Bhavnagar		2932-3600
Junagadh		3599-3600

(Source: GEDA, Data submitted to GEDA by the biomass power generators in the state)

3.3.9.3 The Commission has also analysed the GCV of representative biomass for tariff determination by considering the major sources of biomass in the state and the possible combinations of surplus biomass used for power generation. The GCV arrived by considering this approach varies from 3348 kCal/kg to 3676 kCal/kg.

Table No. 3.5. GCV of representative biomass used in combination

Weighted	average	GCV	considering	cotton	stack	and	3676 kCal/kg	
groundnut shell								
Weighted a	average G(3348 kCal/kg						
in equal pr	oportion							

The Commission in its earlier biomass power tariff order dated 17 May 2010 had considered the GCV of Biomass as 3300 kCal/kg for determination of tariff.

Considering all above factors, the Commission feels that the normative GCV for the representative biomass for the state as shown in table 3.3 would be most appropriate for the biomass tariff determination. Hence, the Commission proposes GCV of 3688 kCal/kg for the tariff determination purpose during the next control period starting from June 2009.

In case of bagasse based co-generation projects, the Commission in its earlier tariff order had considered the GCV of bagasse as 2250 kCal/kg. The bagasse is a process waste of sugar factory with moisture content of around 50%. Considering the level of moisture content in bagasse and the GCV of bagasse based considered by different SERCs in the tariff orders for bagasse based co-generation projects, the Commission proposes to retain the GCV of bagasse as 2250 kCal/kg while determining tariff for next control period.

Hence, the Commission proposes to consider the GCV of biomass as 3688 kCal/kg and that of bagasse as 2250 kCal/kg for determination of tariff for the next control period.

3.3.10 Cost of fuel: The Commission in its biomass tariff order dated 17 May 2010 and dated 07 February 2011 had considered the cost of biomass as Rs. 1600 per MT based on the submission made by GEDA. An annual escalation of 5% was allowed from second year onward to determine the variable component of tariff. The Commission recognises the fact that the landed cost of biomass fuel depends on various factors such as remuneration to farmers, cost



related to collection and storage, transportation, loading and unloading cost and money paid to traders etc. The biomass procurement and transportation are handled by a highly unorganised sector and thus the prices are greatly influenced by the local factors. Further, the Commission considered the fact that the successful operation of biomass power project increases the demand for biomass ultimately resulting in shooting up biomass prices.

In the absence of authentic data with regard to biomass fuel prices in the state and varying biomass prices in an un-organised market, the Commission feels that for determination of cost of biomass fuel, the equivalent heat value approach of landed cost of coal for thermal power stations in the state is the most appropriate method. The CERC under RE tariff regulations 2012 has recommended the same approach for determination of biomass fuel cost.

The CERC in its tariff order dated 28 Feb 2013 had considered the cost of biomass for other states including Gujarat as Rs. 2653.07per MT which was determined on the basis of equivalent heat value approach.

However, in order to determine Gujarat specific cost of biomass fuel, the Commission has analysed the landed cost of coal purchased by thermal power projects in Gujarat to determine the cost of biomass.

Name of power station	GCV of coal (kCal/kg)	landed cost of coal (Rs./MT)	GCV of representative biomass (kCal/kg)	Price of biomass (Rs./MT)
Ukai	3834	2512		
Gandhinagar	3934	3399		
Wanakbori	3645	3132	2600	2816
KLTPS	2852	1045	5000	_010
Torrent	3895	3530		
Average	3632	2773		

Table No 3.6. Cost of biomass fuel using equivalent heat approach

(Source: GERC Truing up Tariff orders of GSECL and Torrent for FY 2011-12)

The above analysis shows that the thermal power projects in Gujarat have the landed cost of coal of Rs. 2773 per MT for GCV of 3632 kCal/kg. By using the equivalent heat value approach of landed cost of coal for thermal power station in the state, the cost of biomass having GCV of 3688 kCal/kg comes to Rs. 2816 per MT.

Hence, the Commission proposes to fix the cost of biomass as Rs. 2816 per MT and cost of coal as Rs. 2773 per MT for the first year of new control period starting from 1 August 2013 and considered 5% escalation in biomass and coal cost for the subsequent years during the control period starting from 1 August 2013 to 31 March 2016 for determination of tariff.

In the case of cost of bagasse based co-generation projects, the Commission in its tariff order dated 31 May 2010 had adopted the equivalent heat value approach with landed cost of coal for thermal power station in the state to determine the cost of bagasse as Rs. 1200 per MT.



By adopting the same approach, the cost of bagasse will be Rs. 1718 per MT for bagasse having GCV of 2250 kCal/kg.

However, the cost of bagasse determined through this approach may not be correct as bagasse is a process waste of sugar factory. The sugar factories do not purchase bagasse from open market and the same is available at their factory as a process waste. Hence there is no transportation and processing cost required in case of using bagasse for power generation. In case of equivalent heat approach the cost of bagasse is determined with the landed cost of coal (which includes the cost of coal transportation and processing) on equivalent heat value basis. Further, the cost of bagasse is actually recovered by the sugar factories through their finished product. However, bagasse has alternative market and is used by the paper and pulp industries, particle and fibre board industries, used in furnaces and biomass power plants etc. Hence, bagasse has good market value. But, the selling of bagasse is done in an unorganised market and hence deriving the exact price of bagasse is difficult. Further, price of bagasse depends on the price of finished product where bagasse is used, finished products demand in the market, availability of substitute to bagasse etc. and hence market determined price of bagasse cannot be used for bagasse based co-generation projects. Sugarcane contains around 30% bagasse and the remaining is the sugar and water content. Bagasse based co-generation projects are primarily used to meet captive power requirement of sugar factories and the surplus power is available for sale. Therefore, for the purpose of determination of bagasse price in the case of bagasse based co-generation projects the cost of bagasse is considered as 50% of the landed cost of sugarcane at factory. The same approach is being followed by TNERC in its tariff order dated 31.07.2012 for bagasse based co-generation projects.

The Commission has therefore analysed the landed cost of sugarcane paid by the sugar factories during FY 2011-12 in Gujarat as shown in table 3.7 below.

Sugar Mills in Gujarat	Sugarcane price at factory (2011-12)
Bardoli	3106
Gandevi	3187
Madhi	2846
Chalthan	2801
Maroli	2462
Valsad	2437
Sayan	2706
Mahuva	2786
Ukai	2175
Ganesh	2681
Kamrej	2680
Coper	2756
Pandvai	2478
Narmada	2831
Vadodara	2505

Table No 3.7. Price of sugarcane in Gujarat



Sugar Mills in Gujarat	Sugarcane price at factory (2011-12)
Kodinar	1815
Talala	1584
Average	2578
(2 -	

⁽Source: Directorate of Sugar, Government of Gujarat)

The above analysis shows that the average landed cost of sugarcane at sugar factories in Gujarat is Rs. 2578/MT. The Commission proposes to fix the normative cost of bagasse as Rs. 1289/MT (50% of Rs. 2578/ MT) for bagasse based co-generation tariff determination purpose during new control period starting from 1 August 2013.

Hence, the Commission proposes the cost of bagasse as Rs. 1289 per MT and cost of coal as Rs. 2773 per MT for the next control period starting from 1 August 2013 to 31 March 2016 for determination of tariff.

The Commission in its earlier tariff order for biomass power projects and bagasse based cogeneration project had considered escalation of fuel cost at 5% per annum. Most of the SERCs as well as CERC have adopted the same fuel price escalation factor. The Commission proposes to retain 5% fuel price escalation factor during the new control period starting from 1 August 2013.

3.3.10.1 Fuel mix and types: As provided in the guidelines issued by the MNRE, the Commission proposes to allow use of fossil fuel up to 15% of the energy consumption on kCal basis on annual basis.

3.3.11 Project life and tariff period: The Commission in its Order No. 4 & 5 of 2010 dated 31 May 2010 and 17 May 2010 on determination of the Tariff for bagasse based co-generation projects and biomass based power projects had considered the project life as 20 years. The CERC and other SERCs also have considered the project life as 20 years for biomass power and bagasse based co-generation projects. The Commission proposes to consider 20 years as project life for tariff determination purpose for the next control period.

3.4 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. Also, the CERC RE Regulations 2012 have considered the same debt-equity ratio for biomass power and bagasse based co-generation projects. The Commission proposes to consider the debt-equity ratio as 70:30 as considered in the previous tariff order.

3.4.2 Loan tenure: GERC, in its biomass tariff order dated 17 May 2010 and bagasse based co-generation tariff order dated 31 May 2010 had stipulated the loan tenure of 10 years. The CERC in RE Tariff Regulations 2012 provides 12 years as loan tenure period. The Commission noticed that investors did not face any problems in obtaining the loan for RE projects with 10



years as loan repayment period. Therefore, the Commission prefers to keep loan tenure equal to 10 years while determining the tariff during the next control period.

3.4.3 Interest on term loan: The Commission in its biomass tariff order dated 17 May 2010 and bagasse based co-generation tariff order dated 31 May 2010 had considered the long-term interest rate of 11.75% which was equivalent to the SBI PLR at that time. The banks are now following the base rate system after the RBI guidelines. 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 the rate of 150 to 300 basis points above the base rate.

Period	SBI Base Rate
1 April 2011 To 24 April 2011	8.25%
25 April 2011 to 11 May 2011	8.50%
12 May 2011 to 10 July 2011	9.25%
11 July 2011 to 12 August 2011	9.50%
13 August 2011 to 19 Sept 2012	10.00%
20 Sept 2012 to 3 Feb 2013	9.75%
4 Feb 2013 to 31 March 2013	9.70%

Table No. 3.8. SBI base rates from 1 April 2011 to 31 March 2013

The weighted average base rate of SBI for the period from 1 April 2012 to 31 March 2013 is 9.86%. Further, the Commission noticed that the interest rate of IREDA for biomass power project varies from 12.50% to 13.25% and for bagasse projects varies from 11.90% to 12.50%. In view of the above, it is proposed to use the last one year weighted average base rate of SBI for the tariff under discussion with a spread of 250 basis points above the current SBI base rate for tariff determination purpose.

Hence, the Commission proposes interest rate of 12.36% on term loan for tariff determination purpose during new control period.

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 asset admitted by the Commission as value base for the purpose of determination of depreciation. Further, the salvage value of the asset considered as 10% and depreciation is allowed up to a maximum of 90% of the capital cost of the asset. 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.'

GERC, in its biomass tariff order dated 17 May 2010 and bagasse based co-generation tariff order dated 31 May 2010 had considered a high rate of depreciation (6%) as a promotional



measure during the loan tenure, and then the remaining depreciation is spread over the remaining useful life. In view of the above, the Commission proposes to continue the same approach for the tariff order under discussion.

The Commission proposes depreciation rate of 6% per annum for the first 10 years, and 3% from 11th year to 20th year for tariff determination purpose during new control period.

3.4.5 Working capital: The Commission in its biomass tariff order dated 17 May 2010 had considered the components of working capital as follows.

- 1) Fuel stock for 30 days.
- 2) O&M expenses for one month.
- 3) Receivable of one month charges for sale of electricity.
- 4) Maintenance spare at 1% of the capital cost escalated at 5% per annum.

The Commission in its bagasse based co-generation tariff order dated 31 May 2010 had considered the components of working capital as follows.

- 1) 0&M expenses for one month.
- 2) Receivable of one month charges for sale of electricity.
- 3) Maintenance spare at 1% of the capital cost escalated at 5% per annum.

The Commission proposes to continue the same approach for determination of the working capital and tariff during the next control period.

3.4.6 Interest on working capital: The Commission in its biomass tariff order dated 17 May 2010 and bagasse based co-generation tariff order dated 31 May 2010 had considered the interest on working capital as 11.75% which was equivalent to the SBI PLR at that time. The Commission is of the opinion that requirement of working capital is recurring and is required for a shorter time of period. Hence, it is possible to get the same at a lower rate. Hence, the Commission proposes to consider the interest on working capital equal to 50 basis points lower than that of interest on long-term loan.

Hence, the interest rate on working capital is proposed as 11.86%

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 employed by the project developer is more than 30%, the amount of equity for the purpose of determining the tariff will be limited to 30% only and the rest is to be treated as loan. In case the equity employed is less than 30%, the actual equity employed will be considered. However, for determination of generic tariff for biomass power and bagasse based co-generation projects, the Commission has considered 30% equity and the same is used for calculation of return on equity.



The GERC Multi Year Tariff Regulations, 2011, notified by the Commission provides norms for the Return on Equity as 14% per annum. Further the Commission has allowed MAT at 20.008% per annum for first 10 years and corporate tax at 32.445% per annum for the next 10 years.

3.4.8 Discount rate: The CERC in its RE tariff regulations 2012 has recommended post tax weighted average cost of capital (WACC) as the discount rate for determination of levelised tariff for electricity generated from RE projects.

Post tax WACC = Cost of Debt + Cost of Equity;

Where, Cost of Debt = normative debt * normative rate of interest * (1 – corporate tax rate) and Cost of Equity = normative equity * post tax return on equity.

The Commission proposes to adopt the above approach for the discount rate for determination of levelised tariff, which works out to 10.04%.

3.4.9 Incentives for biomass and bagasse based co-generation projects: The incentives available for biomass power and bagasse based co-generation projects are as follows.

3.4.9.1 Accelerated depreciation: The Government of India had allowed biomass power and bagasse based co-generation project owners to avail accelerated depreciation at the rate of 80% in the first year on a written-down value (WDV) basis as per Section 32 Rule 5 of the Income Tax Act. In addition to this 80% depreciation, the recent amendment in the Finance Act allowed an additional depreciation of 20% to the power projects during the first year of project commissioning. With this, the biomass power and bagasse based co-generation projects can avail 100% depreciation in the first year of commissioning. The commission therefore has decided to propose two tariffs, with and without accelerated depreciation benefit, for procurement of power by utilities from biomass power and bagasse based co-generation project. However, the tariff without accelerated depreciation will be available to only those project developers who cannot avail of the benefit of accelerated depreciation.

3.5 Computation of Tariff for Biomass based Power Projects

The proposed tariff determination parameters and the tariff during the control period starting from 1 August 2013 are compared with the parameters and tariff considered by the Commission in its biomass tariff orders dated 17 May 2010 and dated 07 February 2011 as presented below.



Table No. 3.9. Comparison of the proposed parameters with those in the biomass tariff orderdated 17 May 2010 and 7 February 2011

Parameters	Biomass based with Water-Coo	Power Projects led Condensers	Biomass based Power Projects with Air-Cooled Condensers				
	As GERC per tariff order dated 17/05/2010	Proposed for next control period (FY 13- 14 to FY 15-16)	As GERC per tariff order dated 7/02/2011	Proposed for next control period (FY 13- 14 to FY 15-16)			
Project Cost and O&M							
Land + Plant & Machinery + Evacuation cost up to interconnection point (Rs. Lakh/MW)	425	468	455	498			
Evacuation Infrastructure Cost (Rs. Lakh/MW)	29	Nil	29	Nil			
Total Project Cost (Rs. Lakh/MW)	454	468	484	498			
Normative O&M Cost for first year (Rs. Lakh/MW)	5% of project cost	5% of project cost	5% of project cost	5% of project cost			
Escalation in O&M (per annum from 2nd year)	5%	5.72%	5%	5.72%			
Performance Parameters							
CUF	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards	70% for 1st year & 80% from 2nd year onwards			
Auxiliary Consumption	10%	10%	10%	10%			
Project Life in Years	20	20	20	20			
Station Heat Rate kCal/kWh	3800	3800	3950	3950			
Gross Calorific Value of Fuel kCal/kg	3300	3688	3300	3688			
Cost of Fuel	Rs. 1600 per MT for biomass and Rs. 1775 per MT for coal	Rs. 2816 per MT for biomass and Rs. 2773 per MT for coal	Rs. 1600 per MT for biomass and Rs. 1775 per MT for coal	Rs. 2816 per MT for biomass and Rs. 2773 per MT for coal			
Fuel Cost Escalation	5%	5%	5%	5%			
Financial Parameters							
Debt-Equity ratio	70:30	70:30	70:30	70:30			
Term of Loan in Years	10	10	10	10			

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As GERC per tariff order dated 17/05/2010 11.75%	Proposed for next control period (FY 13-	As GERC per tariff order	Proposed for next control
11.75%	14 to FY 15-16)	dated 7/02/2011	period (FY 13- 14 to FY 15-16)
	12.36%	11.75%	12.36%
11.75%	11.86%	11.75%	11.86%
5% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)
16.995%	20.008%	16.995%	20.008%
33.99%	32.45%	33.99%	32.45%
14%	14%	14%	14%
Option 1 evelised tariff without AD benefit: s.4.45/kWh (1 to 10 yr), .4.80/kWh (11 to 20 yr) evelised tariff with AD benefit: s.4.40/kWh (1 to 10 yr), .4.75/kWh (11 to 20 yr) Option 2 evelised fixed ariff (without D benefit) Rs. .59 /kWh for 20 years and evelised fixed ariff (with AD benefit) Rs .54/kWh and Year-wise miable tariff of s. 2.08/kWh, 2.18, 2.29,, .77, 5.01, 5.26	Tariff without AD benefit*: Levelised fixed component of tariff - Rs. 1.75 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.3.22/ kWh, FY 2014-15 - Rs. 3.39/kWh, FY 2015-16 - Rs. 3.55/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.46 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.3.22/ kWh, FY 2014-15 - Rs. 3.39/kWh, FY 2015-16 - Rs. 3.55/kWh	$\begin{array}{c} \textbf{Option 1}\\ \textbf{Levelised tariff}\\ \textbf{without AD}\\ \textbf{benefit}\\ Rs.4.66/kWh (1)\\ to 10 yr),\\ Rs.5.06/kWh (11)\\ to 20 yr)\\ \textbf{Levelised tariff}\\ \textbf{with AD benefit:}\\ Rs.4.60/kWh (1)\\ to 10 yr),\\ Rs.5.00/kWh (11)\\ to 20 yr)\\ \textbf{Option 2}\\ \textbf{Tariff without}\\ \textbf{AD benefit}\\ Year wise total tariff - Rs 3.85 / kWh, 3.96, 4.07,, 6.65, 6.90, 7.16\\ \textbf{Tariff with AD}\\ \textbf{benefit}\\ Year wise total tariff - Rs 3.80 / kWh, 3.91, 4.02,, 6.60, 6.85, 7.11\\ \end{array}$	Tariff without AD benefit*: Levelised fixed component of tariff - Rs. 1.86 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.3.35/ kWh, FY 2014-15 - Rs. 3.52/kWh, FY 2015-16 - Rs. 3.69/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.55 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.3.35/ kWh, FY 2014-15 - Rs. 3.52/kWh, FY 2015-16 - Rs. 3.69/kWh
	11.75% 11.75% % (up to 10 years) % (11 to 20 years) 16.995% 33.99% 14% Option 1 evelised tariff without AD benefit: \$.4.45/kWh (11 to 10 yr), 4.80/kWh (11 to 20 yr) evelised tariff with AD benefit: \$.4.40/kWh (11 to 20 yr) evelised tariff with AD benefit: \$.4.40/kWh (11 to 20 yr) evelised tariff with AD benefit: \$.4.40/kWh (11 to 20 yr) Option 2 evelised fixed riff (without D benefit) Rs. .59 /kWh for 20 years and evelised fixed riff (without D benefit) Rs. .59 /kWh and Year-wise riable tariff of \$.2.08 / kWh, 2.18, 2.29,, 77, 5.01, 5.26	11.75% 12.36% 11.75% 11.86% i% (up to 10 years) 6% (up to 10 years) 3% (11 to 20 years) 3% (11 to 20 years) 3% (11 to 20 years) 3% (11 to 20 years) 16.995% 20.008% 33.99% 32.45% 14% 14% Tariff without AD benefit: And variable component of tariff r. Rs. 1.75 /kWh (11 to 10 yr), A.45/kWh (11 to 20 yr) 4.45/kWh (11 to 20 yr) component of tariff for FY 2013-14 - Rs.3.22/ kWh, FY 2013-14 - Rs. 3.39/kWh, FY 2015-16 - Rs. 3.55/kWh x4.45/kWh (11 to 20 yr) Tariff with AD benefit: Levelised fixed x4.45/kWh (11 to 20 yr) Tariff with AD benefit: S.3.39/kWh, FY 2015-16 - Rs. 3.55/kWh 20 years and Year-wise riable tariff of s. 2.08/ kWh, S.3.22/ kWh, FY 2013-14 - Rs.3.22/ kWh, FY 2013-14 - Rs.3.22/ kWh, FY 2013-14 - Rs.3.22/ kWh, FY 2013-14 -	11.75% $12.36%$ $11.75%$ $11.75%$ $11.86%$ $11.75%$ $11.75%$ $11.86%$ $11.75%$ $9%$ (up to 10 years) $years$) $years)years3% (11 to 20years)years)3% (11 to 20years)3% (11 to 20years)years)3% (11 to 20years)16.995%20.008%16.995%33.99%32.45%33.99%14%14%14%Tariff withoutAD benefit:component oftariff r. Rs. 1.75/kWh for 20years4.45/kWh (1to 10 yr),4.80/kWh (11to 20 yr)And variablecomponent oftariff for FY2013-14 -S.4.40/kWh (1to 20 yr)Rs.4.66/kWh (11to 20 yr)4.40/kWh (1to 20 yr)Rs.3.39/kWh,FY 2015-16 - Rs.5.9/kWh for2013-14 -K.4.75/kWh (11to 20 yr)Tariff with ADbenefit:Levelised fixedcomponent oftariff - Rs. 1.46/kWh for 20years andyears and5.5/kWh for2013-14 -K.3.32/kWh, FY2013-14 -K.3.35/kWhTariff with ADbenefitYear wise totaltariff or FY2013-14 -K.3.39/kWh,77, 5.01, 5.2611.75%FY 2015-16 - Rs.S.3.55/kWh$



*The biomass power projects owner opting tariff without AD benefit should submit an undertaking at the time of signing the PPA that AD benefit cannot be availed for the generating plant/unit. Thereafter, a certificate from a Chartered Accountant (CA) along with the income tax return filed with Income Tax department indicating that AD benefit is not claimed need to be submitted to GUVNL/ DISCOM.

The detailed tariff calculations for biomass power project are enclosed in Annexure I and II

3.6 Computation of Tariff for Bagasse based Co-generation Projects

The proposed tariff determination parameters and the tariff during the control period starting from 1 August 2013 are compared with the parameters and tariff considered by the Commission in its bagasse based co-generation tariff order dated 31 May 2010 as presented below.

Parameters	Bagasse based	Co-generation Projects
	As GERC per tariff order dated 31/05/2010	Proposed for next control period (FY 13-14 to FY 15-16)
Project Cost and O&M		
Land + Plant & Machinery + Evacuation cost up to interconnection point (Rs. Lakh/MW)	415	457
Evacuation Infrastructure Cost (Rs. Lakh/MW)	29	Nil
Total Project Cost (Rs. Lakh/MW)	444	457
Normative O&M Cost for First Year (Rs. Lakh/MW)	3% of project cost	3% of project cost
Escalation in O&M (per annum from 2nd year)	5%	5.72%
Performance Parameters		
CUF	60%	60%
Auxiliary Consumption	8.5%	8.5%
Project Life in Years	20	20
Station Heat Rate kCal/kWh	3600	3600
Gross Calorific Value of Fuel kCal/kg	2250	2250
Cost of Fuel	Rs. 1200 per MT for biomass and Rs. 1775 per MT for coal	Rs. 1289 per MT for bagasse and Rs. 2773 per MT for coal
Fuel Cost Escalation	5%	5%

Table No. 3.10. Comparison of the proposed parameters with those in the bagasse based co-
generation tariff order dated 31 May 2010



Parameters	Bagasse based Co-generation Projects							
	As GERC per tariff order dated 31/05/2010	Proposed for next control period (FY 13-14 to FY 15-16)						
Financial Parameters								
Debt-Equity Ratio	70:30	70:30						
Term of Loan in Years	10	10						
Interest on Term Loan	11.75%	12.36%						
Interest on Working Capital	11.75%	11.86%						
Depreciation	6% (up to 10 years) 3% (11 to 20 years)	6% (up to 10 years) 3% (11 to 20 years)						
Minimum Alternate Tax	16.995%	20.008%						
Corporate Income Tax	33.99%	32.45%						
Return on Equity	14%	14%						
Tariff	Option 1 Levelised tariff without AD benefit: Rs.4.61/kWh (1 to 10 yr), Rs.4.96/kWh (11 to 20 yr) Levelised tariff with AD benefit: Rs.4.55/kWh (1 to 10 yr), Rs.4.90/kWh (11 to 20 yr) Option 2 Levelised fixed tariff (without AD benefit) Rs. 1.66 /kWh for 20 years and Levelised fixed tariff (with AD benefit) Rs 1.61/kWh and year wise variable tariff of Rs.2.10/ kWh , 2.21, 2.32,4.82, 5.06, 5.31	Tariff without AD benefit*: Levelised fixed component of tariff - Rs. 1.83 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.2.42/ kWh, FY 2013-14 - Rs.2.42/ kWh, FY 2014-15 - Rs. 2.54/kWh FY 2015-16 - Rs. 2.67/kWh Tariff with AD benefit: Levelised fixed component of tariff - Rs. 1.51 /kWh for 20 years And variable component of tariff for FY 2013-14 - Rs.2.42/ kWh, FY 2014-15 - Rs. 2.54/kWh, FY 2015-16 - Rs. 2.67/kWh						

*The bagasse based co-generation projects owner opting tariff without AD benefit should submit an undertaking at the time of signing the PPA that AD benefit can not be availed for the generating plant/unit. Thereafter, a certificate from a Chartered Accountant (CA) along with the income tax return filed with Income Tax department indicating that AD benefit is not claimed need to be submitted to GUVNL/ DISCOM.

The detailed tariff calculations for bagasse based co-generation projects is enclosed in Annexure III



4. Other Commercial Issues

4.1 Transmission and Wheeling Charges

The Commission in its biomass tariff order dated 17 May 2010 and bagasse based co-generation tariff order dated 31 May 2010, had specified transmission charges and transmission losses for wheeling of biomass and bagasse based co-generation power at different voltage levels as specified in case of wind and solar. In case of wheeling of power to consumption site at 66 kV voltage level and above normal transmission charges and normal transmission losses were made applicable to such consumers. In case of wheeling of power below 66 kV voltage level, normal transmission charges and transmission and wheeling losses @ 10% of energy fed into the grid were applicable. For small investors having plant capacity below 5 MW wheeling of electricity were allowed on payment of normal transmission charges and transmission and wheeling losses @ 7% of energy fed into the grid. Injection and drawal of electricity at 11 kV or below voltage level were allowed on payment of wheeling charges @ 5 paisa per unit and wheeling losses @ 6% of energy fed into the grid.

During the control period of the above orders, the Renewable Energy Certificate mechanism (REC) was introduced in India. As per the provisions under the CERC REC Regulations, Renewable Energy projects installed for captive use are allowed to avail RECs on total generation including self-consumption provided that such projects forego the concessional transmission and wheeling charges/losses and other benefits offered by the state Government/SERCs. In this context, the Commission proposes to retain the transmission and wheeling charges for wheeling energy at different voltage level as specified in GERC orders dated 17 May 2010 and 31 May 2010 for the next control period. The biomass power and bagasse based co-generation projects power projects availing open access for captive use/third-party sale and willing to register under REC mechanism shall be governed as per CERC REC Regulations in force.

4.2 Cross-Subsidy Surcharge

As per Section 42 (2) of the Electricity Act, 2003, the cross-subsidy surcharge is not applied to captive open access transactions. However, considering the environmental benefits of RE projects, the Commission had earlier exempted from the cross-subsidy surcharge wheeling of power from biomass power and bagasse based co-generation projects to third party also. Considering the above, the Commission proposes to continue the same for the next control period.



4.3 Energy Metering

Energy metering and communication facility shall be provided by the project developers of biomass power and bagasse based co-generation projects in accordance with the following regulations/codes/orders and their subsequent amendments.

- 1) Central Electricity Authority (Installation and Operation of meters) (Amendment) Regulations 2010
- 2) Gujarat Electricity Grid Code 2004 and its subsequent amendments
- 3) GERC (Terms and Conditions of Intra-State Open Access) Regulations, 2011 and its subsequent amendments
- 4) GERC Distribution Code 2004 and its subsequent amendments

However, for the purpose of energy accounting, such projects shall have to provide ABT compliant meters at generators and if the power is to be wheeled to consumer's premises, then ABT compatible meter is to be installed at the consumer premises also.

4.4 Pricing of Reactive Power

In the earlier tariff order on biomass power and bagasse based co-generation projects, the Commission had proposed that the reactive energy pricing should be uniform for all type of renewable sources. As the Commission had decided the reactive energy tariff for solar and wind energy projects the same tariff is being proposed for the biomass power and bagasse based co-generation projects for the next control period. The Commission proposes the reactive energy tariff as follows:

"10 paise/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".

4.5 Sharing of Clean Development Mechanism (CDM) Benefits

In case of sharing of CDM benefit, the Commission in its biomass and bagasse based cogeneration tariff order dated 17 May 2010 and 31 May 2010 has adopted the recommendations made by the Working Group on Renewable Energy Generation constituted by the Forum of Regulators. The relevant clause of the previous Wind Tariff Order is as below:

"The CDM benefits should be shared on a 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. Thereafter, the sharing of CDM benefits should remain equal till the time that benefit accrues."



The Commission proposes to retain the above provisions for sharing of CDM benefits for the next control period. However, such projects availing CDM benefit shall share the net CDM proceeds annually as per above, by 31 March of every year with an affidavit stating the annual energy generation (date of commissioning as starting point of the first year), CER generated, gross receipts, and net receipts.

4.6 Banking of Surplus Energy

Biomass and bagasse based co-generation projects generate power with controlled supply of fuel and hence the power generated from such projects can be predicted and scheduled to maintain grid discipline. Hence, such projects are required to schedule their power. The Commission did not allow any banking facility to biomass based power projects and bagasse based co-generation projects either selling power to third party or wheeling for self-use. The Commission proposes to continue the same for the next control period.

4.7 Purchase of Surplus Power from Biomass Power and Bagasse based Cogeneration Projects Opting for Captive Use and Third Party Sale under Open Access

Biomass power and bagasse based co-generation projects of capacity above 4 MW wheeling power for captive use or for third party sale are required to schedule the power. Further, biomass power and bagasse based co-generation projects come under the ambit of Intra-State ABT order. Financial charges on account of any deviation from scheduled generation shall be governed by the provisions of the Intra-State ABT Order of the Commission in force. The Commission proposes to continue the same treatment for purchase of un-settled surplus power from captive or third party sale of electricity for the next control period.

4.8 Renewable Energy Certificates for Third Party Sale and Captive Use of Electricity Generated from Biomass Power and Bagasse based Co-generation Project

Power generated from biomass power and bagasse based co-generation projects, if wheeled to third party or for captive use, will be eligible for availing the Renewable Energy Certificates under the CERC REC mechanism. Further, Captive Power Producer (CPP) based on RE sources shall be eligible for the entire energy generated from such plant, including self consumption for participating in the REC scheme, subject to the condition that such CPP has not availed or does not propose to avail any benefit in the form of concessional/promotional transmission or wheeling charges, banking facility benefit and waiver of electricity duty. The accreditation and registration of biomass and bagasse based co-generation projects under REC mechanism shall be as per the CERC REC Regulations 2010 and its subsequent amendments if any.



4.9 Security Deposit

In order to assure GETCO about the project developer's seriousness, the project developers are required to furnish bank guarantee of Rs. 5 Lakh/MW as a security deposit to GETCO in the form of bank guarantee. Project developers are required to commission the project within 4 years from the date of sanction of the power evacuation line. In case of default, GETCO forfeits the same. The Commission proposes to consider the same security deposit for the next control period.

4.10 Applicability of Intra-State ABT

Generation from biomass power and bagasse based co-generation projects is predictable and hence, it is proposed to cover the Biomass and bagasse based co-generation projects under the ambit of intra-state ABT order. Further the biomass power and bagasse based co-generation projects having installed capacity up to 4 MW, connected to distribution voltage level for sale of power to DISCOM or wheeling the energy for captive use or IPPs selling to third party consumers are exempted from the applicability of intra-state ABT order of the Commission.

4.11 Monitoring Mechanism for the Use of Fossil and Non-fossil Fuel

The availability of surplus fuel like biomass and bagasse is dependent on rainfall, cropping pattern, land-use pattern, usage of biomass for various activities, natural calamities etc. Hence, in order to assure continuous supply of fuel for such projects the Ministry of New and Renewable Energy has allowed use of certain percentage of fossil fuel along with the main biomass fuel. However, in order to restrict such projects to use the prescribed allowed minimum percentage of fossil fuel and to keep monitor the same, the Commission has outlined a procedure for submission of information to GEDA. The Commission proposes to continue the same for the next control period. The biomass based power project and bagasse based cogeneration project developers need to submit the following information.

4.11.1 Fuel usage statement

The Commission had nominated GEDA as the nodal agency for monitoring the usage of fossil fuel by the Bio-mass based generation projects. The biomass based power project and bagasse based co-generation project developers are required to furnish a monthly fuel usage statement and monthly fuel procurement statement duly certified by Chartered Accountant to the nodal agency for each month, along with the monthly energy bill. The statement should cover following details:

i. Quantity of fuel (in tonnes) for each fuel type (biomass fuel and fossil fuel) consumed and procured during the month for power generation purposes,



- ii. Cumulative quantity (in tonnes) of each fuel type (biomass fuel and fossil fuel) consumed and procured till the end of that month during the year,
- iii. Actual (gross and net) energy generation (denominated in units) during the month,
- iv. Cumulative actual (gross and net) energy generation (denominated in units) until the end of that month during the year,
- v. Opening fuel stock quantity (in tones),
- vi. Receipt of fuel quantity (in tonnes) at the power plant site and,
- vii. Closing fuel stock quantity (in tonnes) for each fuel type (biomass fuel and fossil fuel) available at the power plant site.

In case the project owners fails to comply with the condition of limited use of fossil fuel, during any financial year, the benefits under the tariff order and preferential tariffs shall be withdrawn.

4.12 Information System for Creation of Database

The Commission proposes to continue the maintenance of data-base for further review of the technical/financial parameters for the next tariff order. Hence, the biomass based power project and bagasse based co-generation project developers shall have to keep the records of the following data and provide the same to GEDA and the Commission annually to create data-base for future.

- i. Number and categories of employees for different purposes.
- ii. Administrative and General Expenses.
- iii. Repair and Maintenance work carried out during the year specifying activities carried out with time period and spare/ material replaced and its cost.
- iv. Details of Spare parts of the plant / machines replaced during the year with justification and cost.

4.13 Applicability of the Order

The tariff proposed in this discussion paper will be made applicable for the biomass based power projects and bagasse based co-generation projects commissioned during the control period from 1 August 2013 to 31 March 2016. Further, the proposed tariff will be applicable to the biomass based power projects using rankine cycle technology with water-cooled condensers or air-cooled condensers and in case of qualified topping cycle based bagasse / non-fossil fuel based co-generation projects. The bagasse / non-fossil fuel based co-generation projects opting for the tariff proposed in this discussion paper will have to undertake annual energy audit through empanelled energy auditors of state nodal agency to produce the report fulfilling topping cycle mode of co-generation as defined in clause 2.2.1 of this discussion paper.



GERC presents this discussion paper to initiate the regulatory process for determination of biomass power and bagasse based co-generation projects tariff for the next control period starting from 1 August 2013. GERC invites comments from stakeholders for determination of biomass power and bagasse based co-generation projects tariff for the new control period.

Sd/-

[Mukesh Kumar] Secretary GERC

Place: Ahmedabad

Date: 24/06/2013



Annexure I

Tariff for biomass power project with water-cooled condenser

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Net Energy sold (lakh kWhs)	55.19	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07
Costs																				
0&M	23.40	24.74	26.15	27.65	29.23	30.90	32.67	34.54	36.52	38.60	40.81	43.15	45.61	48.22	50.98	53.90	56.98	60.24	63.69	67.33
Depreciation	28.08	28.08	28.08	28.08	28.08	28.08	28.08	28.08	28.08	28.08	14.04	14.04	14.04	14.04	14.04	14.04	14.04	14.04	14.04	14.04
Interest on term loan	38.47	34.42	30.37	26.32	22.27	18.22	14.17	10.12	6.07	2.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on working capital	5.48	6.20	6.43	6.68	6.94	7.21	7.50	7.81	8.13	8.47	8.74	9.16	9.61	10.07	10.57	11.08	11.62	12.19	12.79	13.42
Return on Equity	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66	19.66
Tax on equity	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	3.93	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.38	6.38
Fixed cost (Rs lakh)	119.02	117.03	114.63	112.32	110.11	108.00	106.01	104.14	102.39	100.77	89.63	92.38	95.30	98.37	101.62	105.05	108.68	112.51	116.55	120.82
Fuel cost (Rs lakh)	177.92	213.50	224.18																	
Tariff																				
Fixed tariff (Rs / kWh)	2.16	1.86	1.82	1.78	1.75	1.71	1.68	1.65	1.62	1.60	1.42	1.46	1.51	1.56	1.61	1.67	1.72	1.78	1.85	1.92
Variable tariff (Rs / kWh)	3.22	3.39	3.55																	
Levelised Fixed tariff (Rs / kWh)	1.75																			



Annexure II

Tariff for biomass power project with air-cooled condenser

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Net Energy sold (lakh kWhs)	55.19	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07	63.07
Costs																				
0&M	24.90	26.32	27.83	29.42	31.10	32.88	34.77	36.75	38.86	41.08	43.43	45.91	48.54	51.31	54.25	57.35	60.63	64.10	67.77	71.64
Depreciation	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88	29.88	14.94	14.94	14.94	14.94	14.94	14.94	14.94	14.94	14.94	14.94
Interest on term loan	40.93	36.62	32.32	28.01	23.70	19.39	15.08	10.77	6.46	2.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on working capital	5.74	6.50	6.74	6.99	7.26	7.55	7.85	8.17	8.50	8.86	9.14	9.58	10.04	10.53	11.04	11.58	12.15	12.74	13.37	14.03
Return on Equity	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92	20.92
Tax on equity	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	6.79	6.79	6.79	6.79	6.79	6.79	6.79	6.79	6.79	6.79
Fixed cost (Rs lakh)	126.56	124.43	121.86	119.40	117.04	114.80	112.67	110.67	108.80	107.08	95.21	98.13	101.22	104.49	107.94	111.58	115.43	119.49	123.78	128.31
Fuel cost (Rs lakh)	184.94	221.93	233.03																	
Tariff																				
Fixed tariff (Rs / kWh)	2.29	1.97	1.93	1.89	1.86	1.82	1.79	1.75	1.73	1.70	1.51	1.56	1.60	1.66	1.71	1.77	1.83	1.89	1.96	2.03
Variable tariff (Rs / kWh)	3.35	3.52	3.69																	
Levelised Fixed tariff (Rs / kWh)	1.86																			



Annexure III

Tariff for bagasse based co-generation projects

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Net Energy sold (lakh kWhs)	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09	48.09
Costs																				
0&M	13.71	14.49	15.32	16.20	17.13	18.11	19.14	20.24	21.39	22.62	23.91	25.28	26.73	28.25	29.87	31.58	33.39	35.29	37.31	39.45
Depreciation	27.42	27.42	27.42	27.42	27.42	27.42	27.42	27.42	27.42	27.42	13.71	13.71	13.71	13.71	13.71	13.71	13.71	13.71	13.71	13.71
Interest on term loan	37.56	33.61	29.65	25.70	21.75	17.79	13.84	9.88	5.93	1.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Interest on working capital	2.86	2.92	2.99	3.06	3.14	3.22	3.31	3.41	3.52	3.63	3.65	3.82	3.99	4.18	4.37	4.57	4.79	5.01	5.25	5.50
Return on Equity	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19	19.19
Tax on equity	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	6.23	6.23	6.23	6.23	6.23	6.23	6.23	6.23	6.23	6.23
Fixed cost (Rs lakh)	104.59	101.48	98.42	95.42	92.47	89.58	86.75	83.99	81.29	78.68	66.70	68.23	69.85	71.56	73.37	75.28	77.30	79.44	81.69	84.08
Fuel cost (Rs lakh)	116.40	122.22	128.33																	
Tariff																				
Fixed tariff (Rs / kWh)	2.17	2.11	2.05	1.98	1.92	1.86	1.80	1.75	1.69	1.64	1.39	1.42	1.45	1.49	1.53	1.57	1.61	1.65	1.70	1.75
Variable tariff (Rs / kWh)	2.42	2.54	2.67																	
Levelised Fixed tariff (Rs / kWh)	1.83																			