TAMIL NADU ELECTRICITY REGULATORY COMMISSION

Consultative Paper on "Procurement of Power from Biogas and Biogasification based Power Plants"

(Comments/Suggestions are invited on or before 25-08-2011)

1.0 Need for the consultative paper:

1.1 Commission in its hearing held on 03-12-2010 on the petition filed by M/s. Pallava Water and Power Pvt. Ltd. (P.P.A.P. No. 6 of 2010) for fixation of tariff to their proposed poultry litter based biogas plant, has passed the following order:

"Petition admitted. Consultative paper be prepared after consultation with the Expert Committee and thereafter the matter may be taken to the State Advisory Committee. An expert committee may be convened for the purpose."

Accordingly, an expert committee meeting on power generation based on Biogas / Biogasification technology was conducted by the Commission on 18-02-2011.

1.2 As per MNRE report, the potential for biogas power plants using the bio waste generated by Sago & Starch mills and Poultry farms in Salem and Namakkal districts is around 100 MW. Such biogas plants will also address the environment pollution caused by Sago & Starch mills and Poultry farms waste significantly.

1.3 Similarly, there is a considerable potential for bio-gasification based power generation in Tamil Nadu due to availability of biomass. Bio-gasification systems are inherently clean, relatively efficient, and commercially available for converting inexpensive fuels such as biomass. Biogas and Biogasification based power generation will create local employment and community development. Commission feels that a focused effort should be made to implement such biogas / bio-gasification based power plants. Considering the

above, the Commission floats this Consultative Paper to elicit the views of stakeholders.

2.0 Technology

2.1 Biogas

2.1.1 Biogas is a clean fuel produced through anaerobic digestion of a variety of organic wastes such as animal, agricultural, domestic and industrial wastes. The anaerobic digestion comprises three steps, namely, -

1. Decomposition (hydrolysis) of plant or animal matter to break down complex organic materials into simple organic substances,
2. Conversion of decomposed matter into organic acids, and
3. Conversion of acids into methane gas.

Biogas consists of methane and carbon-di-oxide and traces of other gases such as hydrogen, carbon monoxide, nitrogen, oxygen and hydrogen sulphide. The percentage of methane in the gas determines its calorific value as the other constituents do not contribute to the energy content. This gas has a relatively high calorific value (5000 kCal/m^3).The methane content of biogas is appreciably high, at 60%.

2.1.2 In India, especially in Tamil Nadu, biodegradable organic wastes such as cow dung, kitchen waste, Sago & Starch Mills / Poultry farms waste, etc. can be potential energy sources for power generation from biogas based power plants.

2.1.3 There are also collateral benefits of the by-products from the biogas plants such as superior quality organic fertilizer and waste heat utilization of biogas engines, either to meet thermal energy needs of Sago mills or to establish cold storages.

2.2 Biogasification

Gasification is a process in which solid biomass material (wood waste, agro

residues, branches and twigs of plants etc.) is subjected to partial combustion in the presence of a limited supply of air. The ultimate product is a combustible gas mixture termed as producer gas. This gas has a relatively low calorific value (900 – 1110 kCal/m^3). The typical composition of this gas is methane, carbon monoxide, hydrogen, nitrogen and carbon-di-oxide. This gas can be burnt easily and used for process heat or power generation. The plants operate totally on biomass with absolutely no input of fossil fuels.

2.3 Benefits

1. These technologies eliminate all the pollution related problems associated with biomass power plants.
2. The leftover sludge in the Biogas plant is a valuable by-product, extremely useful in farms. While it keeps its nutrients for the crops, with the gas removed, the fertiliser does not smell. It can be sprayed directly onto the crops.
3. Biogas is a renewable, low carbon fuel that is already widely, and often economically available throughout the country. Its production and use also brings additional environmental and social benefits. Correctly managed, biogas is a sustainable fuel that can deliver a significant reduction in net carbon emissions when compared with fossil fuels.
4. It leads to employment generation in the rural areas.
5. The Plant Load Factors of these power plants are high when compared to other renewable power plants.
6. It has a very short gestation period of a few months.

3.0 Legislative and Regulatory Framework for development of biogas / bio-gasification based power Projects.

3.1 Related Provisions of Electricity Act, 2003

Section 3(1): *The Central Government shall, from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilisation of resources such as coal, natural gas, nuclear substances or materials,* ***hydro and renewable sources of energy.***

Section 61(h): *The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for determination of tariff and in doing so shall be guided by the following namely,*
(h) the promotion of cogeneration and generation of electricity from renewable sources of energy,
(i) the National Electricity Policy and Tariff Policy.

Section 62(1)(a): *The appropriate Commission shall determine the tariff in accordance with the provisions of this Act for –*

(a) supply of electricity by a generating company to a distribution licensee:

Section 62(2): *The appropriate Commission may require a licensee or a generating company to furnish separate details, as may be specified in respect of generation, transmission and distribution for determination of tariff.*

Section 62(5): *The Commission may require a licensee or a generating company to comply with such procedures as may be specified for calculating the expected revenues from the tariff and charges which he or it is permitted to recover.*

Section 86(1)(e): *The State Commission shall promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee.*

3.2 Related Provisions of National Electricity Policy:

"5.2.20 Feasible potential of non-conventional energy resources, mainly small hydro, wind and bio-mass would also need to be exploited fully to create additional power generation capacity. With a view to increase the overall share of non-conventional energy sources in the electricity mix, efforts will be made to encourage private sector participation through suitable promotional measures."

"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 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."

3.3 Related Provisions of National Tariff Policy:

Para 6.4"(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 April 1, 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 within 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."

3.4 Commission's Regulations on Power Procurement from New and Renewable Sources:

In exercise of the powers conferred under section 61(h) read with section 86(1)(e) and section 181 of the said Electricity Act, 2003, the Commission notified the "Power Procurement from New and Renewable Sources of Energy Regulations 2008" on 8.02.2008.

4.0 Power position in Tamil Nadu

4.1 The generating capacity connected to TNEB's grid including the allocation from Central Generating Station is 10,214.55 MW as on 01-04-2011 comprising 2,970 MW from TNEB's four thermal stations, 516 MW from four gas turbine stations, 2,187 MW from 33 hydro stations, 17.55 MW from TNEB's wind farm, 1,180 MW from private sector power projects, 214 MW as contribution to Tamil Nadu grid by sale of electricity from captive generating plants, 2,825 MW as Tamil Nadu's share from central generating stations and 305 MW as external assistance.

4.2 Generating capacity from privately owned wind farms is 5,887.165 MW as on 01-04-2011. The installed capacity of cogeneration in sugar mills is 609.9 MW and biomass power project is 139.09 MW. The installed capacity of Solar PV power project is 5 MW.

4.3 The average power availability during the last quarter of 2010-11 was around 9,000 MW. The expected peak demand for 2011-12 may vary from

11,000 to 11,500 MW which leaves a deficit of around 2,000 to 2,500 MW. The deficit in the State is likely to continue for few more years since the capacity addition in the next few years is expected to be less than the projected increase in demand. Therefore, any capacity addition will help the State to a great extent to tide over the shortage of power prevailing in the State.

5.0 Biogas / Biogasification power projects in Tamil Nadu

As of now, four grid connected bio-gas power plants to the tune of 5.85 MW and one grid connected bio-gasification Power Plant of 2 MW capacity are in service in Tamil Nadu. Apart from the above, there are many off-grid bio-gas / bio-gasification based power plants in Tamil Nadu.

6.0 Applicability of proposed order

The order shall come into force from the date of its issue. The tariff fixed in the proposed order shall be applicable to all the biogas / biogasifier based power generation projects commissioned on or after the date of this order. It should be noted that the existing contracts and agreements between the biogas / biogasifier generators and the distribution licensee signed prior to this order would continue to remain in force. However, the biogas / biogasifier generators and the distribution licensee shall have the option to mutually re-negotiate the existing agreements / contracts in line with this order before the expiry of the contracts / agreements. Any renewal of the said contracts / agreements, new contracts / agreements shall be in conformity with this order.

7.0 Tariff Determination Process

With regard to tariff determination process, the relevant portion of Regulation 4 of the Power Procurement from New and Renewable Sources of Energy Regulation, 2008 is reproduced below:

The Commission shall follow the process mentioned below for the determination of tariff for the power from new and renewable sources based generators, namely;-

a) *initiating the process of fixing the tariff either suo motu or on an application filed by the distribution licensee or by the generator.*
b) *inviting public response on the suo motu proceedings or on the application filed by the distribution licensee or by the generator.*

c) *issuing general / specific tariff order for purchase of power from new and renewable sources based generators.*

In accordance with the above regulations, the Commission has prepared this consultative paper to elicit the views and suggestions of the stake holders.

8.0 Tariff / Pricing Methodology

The relevant portion of Tariff / Pricing Methodology as specified in Regulation 4 of the Commission's above said Regulation is reproduced below.

(2) While deciding the tariff for power purchase by distribution licensee from new and renewable sources based generators, the Commission shall, as far as possible, be guided by the principles and methodologies specified by:

(a) Central Electricity Regulatory Commission
(b) National Electricity Policy
(c) Tariff Policy issued by the Government of India
(d) Rural Electrification Policy
(e) Forum of Regulators (FOR)
(f) Central and State Governments

(3) The Commission shall, by a general or specific order, determine the tariff for the purchase of power from each kind of new and renewable sources based generators by the distribution licensee.

Provided where the tariff has been determined by following transparent process of bidding in accordance with the guidelines issued by the Central Government, as provided under section 63 of the Act, the Commission shall adopt such tariff.

(4) While determining the tariff, the Commission may, to the extent possible consider to permit an allowance / disincentive based on technology, fuel, market risk, environmental benefits and social impact etc., of each type of new and renewable source.

(5) While determining the tariff, the Commission shall adopt appropriate financial and operational parameters.

(6) While determining the tariff the Commission may adopt appropriate tariff methodology.

8.1 Preferential tariff or by bidding process

8.1.1 In this connection, it is relevant to discuss the following stipulations of National Tariff Policy which are reproduced below:

Section 6.4(1): *……. 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.*

Section 6.4(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 within 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.*

8.1.2 There are very few grid connected biogas / Biogasification based power plants in Tamil Nadu. The cost of generation from biogas / Biogasification based power plants are generally higher than the coal based generation. These plants are not in a position to compete with conventional power plants in terms of tariff. Hence, it is felt that the biogas / Biogasification based power plants should be promoted at preferential tariff. It also promotes local community development and creates local employment. It helps to exploit the biomass / wastes from cattle, birds, industries in the State. Therefore, the Commission proposes that the energy procurement from biogas / Biogasification based power plants by distribution licensees shall be done at preferential tariff as determined by the Commission as per 6(4) (1) of the tariff policy.

8.2 Project Specific or Generalized Tariff

A Generalized tariff mechanism would provide incentive to the investors for use of most efficient equipment to maximize returns and for selecting the suitable site while a project-specific tariff would provide each investor, irrespective of the machine type, the stipulated return on equity which, in effect, would shield the investor from the uncertainties involved. Capacity of most of the proposed biogas / Biogasification based power plants is limited to a few MWs. Almost, the conditions prevail in different sites are same. Hence, it is not advisable to adopt project specific tariff in such a context. It is suggested that the Commission may issue a generalized tariff order for biogas / Biogasification based power plants. It is proposed that whenever there is a petition from large biogas / Biogasification based power plants, the Commission may consider project specific tariff order.

8.3 Cost-Plus Tariff Determination

Cost-plus tariff determination is a more practical method. It can be easily designed to provide adequate returns to the investor and a surety of returns will lead to larger investment in biogas / bio-gasification based power plants. It is also in line with Regulation 4(6) of "Power Procurement from New and Renewable Sources of Energy Regulations 2008".

8.4 Single Part vs. Two Part Tariff

The tariff of bio-gas / bio-gasification based power plants depends upon the availability and cost of the fuel. The availability and cost also varies with location and season. Therefore, two part tariff is proposed for bio-gas / bio-gasification based power plants. Two part tariff is applied in order to recover fixed and variable costs through the fixed and variable components of tariff. Variable component of tariff takes care of the escalation in fuel price.

9.0 Tariff Components

The Commission has carried out a detailed analysis of the existing policies/procedures and commercial mechanisms in respect of power generation from Biogas / Biogasification based power plants. The tariff determined in a cost-plus scenario, would depend significantly on the following operating and financial parameters:

1. Capital investment
2. Plant Load factor
3. Debt-equity ratio
4. Term of Loan and Interest
5. Life of plant and machinery
6. Depreciation rate applicable
7. Interest on working capital
8. Return on equity
9. Operation and maintenance expenses
10. Auxiliary consumption

11. Fuel cost, Calorific value of fuel, Station Heat Rate and cost of By-product
12. Tariff rate

Each of the above parameters are discussed below in detail.

9.1 Capital Investment

9.1.1 Gross capital cost

9.1.1.1 The capital cost is one of the most important parameters for Biogas / Biogasification based power projects tariff determination. The cost of the gas engines is an important factor in determination of overall cost of the plants. The details of capital cost furnished by various agencies are tabulated below:

Sl. No.	Agencies and reference	Capital Cost (Rs. in Crores /MW)	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	Rs.12 Crores for 1 MW plant and Rs.11 Crores/MW for 2 MW power plants.	
2.	IREDA (Letter dated 25-03-2011)	Rs.7.87 Crores/MW	Rs.5.82 Crores/MW
3.	TEDA (Letter dated 20-04-2010)	Rs.8 Crores/MW (Sago based) Rs.10 Crores/MW (Poultry litter based)	
4.	Gujarat ERC (Order No. 2 of 2007)	----	Rs.2 Crores/MW after adjusting CFA of Rs.1.5 Crores/MW.
5.	Haryana ERC (Order dated 21-09-2010)	Rs.10.5 Crores/MW (Poultry based)	
6.	CMWSSB	Rs.12.54 Crores/MW to 11.14 Crores/MW for Perungudi and Nesapakkam STP.	
7.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	Rs.10 Crores/MW	

9.1.1.2 Mr. Krishan, M/s. Grameena Abhivrudhi Mandali (Chairman of SPV M/s.Pallava Water and Power (P) Ltd.) in his presentation during the Expert Committee meeting held on 18-02-2011 has stated that the capital cost of the proposed biogas project is Rs.10 Crores/MW with Rs.1.5 Crores/MW as subsidy from MNRE. The Chennai Metro Water and Sewerage Board (CMWSSB) in their presentation have stated that the latest capital cost of the project is around Rs.20.00 Lakh / ML of sewage.

9.1.1.3 Indian Renewable Energy Development Agency (IREDA) a financing institution of Government of India, has reported a capital cost of **Rs. 7.87 Crores / MW for biogas power plants and Rs.5.82 Crores / MW for Biogasification based Power Plants.** Commission proposes that it is prudent to adopt the capital cost furnished by IREDA. The capital cost furnished by IREDA is inclusive of power evacuation cost.

9.1.2 Capital Subsidy

MNRE has provided Central Financial Assistance (CFA) of Rs.1.5 Crores / MW to the grid connected power projects with 100% producer gas engines. Similarly, the CFA provided for a biogas power project is Rs.1.5 Crores / MW. Hence, the Commission considers that the above capital subsidy shall be available for such projects and therefore shall be reduced from the capital cost.

9.1.3 Infrastructure Development Charge for evacuation of power.

9.1.3.1 The Hon'ble Appellate Tribunal for Electricity in its judgment dated 08-01-2010 against the Appeal No. 93/2009 filed by TNEB has ruled that a generating company is liable to pay the TNEB the Infrastructure Development Charges (IDC) fixed by the TNEB for establishing, operating and maintaining the sub-stations on behalf of the generators to do the evacuation work. Therefore, the generating company is liable to pay the Infrastructure Development Charges (IDC) to the Distribution Licensee / State Transmission Utility for establishing, operating and maintaining the sub-stations. The matter with regard to levy of IDC is subject to the outcome of the Civil Appeal No.1304 of 2010 filed by Indian Wind Energy Association before the Hon'ble

Supreme Court of India.

9.1.3.2 As the project cost furnished by the IREDA is already inclusive of IDC, it is not necessary to reload the IDC cost to be collected by the Distribution Licensee / State Transmission Utility with the project cost.

9.1.4 Net Capital Cost

After deducting the capital subsidy, the net capital cost works out as follows:

Biogas Plants: [7.87 – 1.5) = 6.37] **Rs. 6.37 Crores per MW.**

Biogasification based Plants: [5.82 – 1.5) = 4.32] **Rs.4.32 Crores per MW.**

This net capital cost is inclusive of all the costs such as plant and machineries, civil works, land cost/rent/lease, Power evacuation cost, etc.

9.2 Plant Load Factor (PLF)

9.2.1 PLF has always been a parameter of utmost importance. Normative values of PLF of Biogas / Biogasification based power projects adopted by various agencies are as follows:

Sl. No.	Agencies and reference	PLF in %	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	80%	
2.	IREDA (Letter dated 25-03-2011)	80%	80%
3.	TEDA (Letter dated 20-04-2010)	60-70% (Sago based) 80% (Poultry litter based)	
4.	Gujarat ERC (Order No. 2 of 2007)		80%
5.	Haryana ERC (Order dated 21-09-2010)	65% - First year 80% - Subsequent years	
6.	CMWSSB	25-40%	
7.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	90%	

9.2.2 The petitioner M/s. Pallava Water and Power (P) Ltd. claims 90% PLF

for their project. But, this concept paper demands for generalized tariff order. It is reasonable to adopt the PLF recommended by IREDA for both biogas and Biogasification based power plants. **Therefore, Commission proposes 80% PLF for both biogas and Biogasification based power plants.**

9.3 Debt-equity ratio

The Tariff Policy lays down a debt equity ratio of 70: 30 for power projects. The Commission has proposed to adopt this ratio as specified in its Tariff Regulations 2005.

9.4 Term of the Loan and interest

9.4.1 The interest rates suggested / adopted by various agencies are as follows:

Sl. No.	Agencies and reference	Interest on Loan	
		Biogas power plants	Biogasification based power plants
1.	IREDA (Letter dated 25-03-2011)	12.25%	12.25%
2.	TEDA (Letter dated 20-04-2010)	13% (Sago based) 14.29% (Poultry litter based)	
3.	Gujarat ERC (Order No. 2 of 2007)		12%
4.	Haryana ERC (Order dated 21-09-2010)	12.75%	
5.	CMWSSB	10%	
6.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	11% for 50% of INR debt 6% for 50% of Euro debt	

9.4.2 CERC has considered the long-term PLR of State Bank of India plus 150 basis points as adequate. Mr. Krishan, M/s. Grameena Abhivrudhi Mandali (Chairman of SPV M/s.Pallava Water and Power (P) Ltd.) in his presentation during the Expert Committee meeting held on 18-02-2011 has stated that they got cheaper loan due to their tie up with European firms. The Commission fixed a tenure of ten years with moratorium of one year and 12%

interest in its Tariff Order Nos.1, 2 and 3 of 2009 and 1 and 2 of 2010 as suggested by IREDA at that time. IREDA has now recommended 12.25% interest rate. **Therefore, the Commission proposes to adopt the interest rate of 12.25% with loan tenure of 10 years with 1 year moratorium period.**

9.5 Life of Plant and machinery

9.5.1 The life of Biogas / Biogasification based power projects suggested / adopted by various agencies are tabulated below:

Sl. No.	Agencies and reference	Life of the Plant	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	Civil works – 30 years Electro-Mechanical equipments – 10 years	
2.	IREDA (Letter dated 25-03-2011)	20 years 5% for equipments and 10% for others.	20 years 5% for equipments and 10% for others.
3.	TEDA (Letter dated 20-04-2010)	20 years (Sago based) 20 years (Poultry litter based)	
4.	Gujarat ERC (Order No. 2 of 2007)		20 years
5.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	10 years	

9.5.2 Most of the experts participated in the expert committee meeting held on 18-02-2011 have stated that the life of the biogas plant can not be more than 15 years. Therefore, Commission proposes to consider a useful life of 15 years for biogas plants and 20 years for bio-gasification plants.

9.6 Depreciation

M/s.Pallava Water and Power (P) Ltd. considered depreciation of 4.5 % in their petition filed before TNERC vide PPAP 6 of 2010. The CERC's renewable regulations recommended 'Differential Depreciation Approach'

over loan tenure and period beyond loan tenure over useful life computed on 'Straight Line Method'. Since the Commission proposed to consider 'cost plus single part average tariff' for fixing tariff in this case, 'Differential Depreciation Approach' has not been considered. Hence, for the purpose of tariff determination, it is prudent to assume depreciation based on Straight Line Method (SLM) wherein the asset life is to be depreciated to a residual value of 10% of its initial value over the entire asset life. **This translates to an SLM depreciation rate of 6% per annum for biogas projects and 4.5% for bio-gasification projects.**

9.7 Interest on working capital

9.7.1 The working capitals suggested / adopted by various agencies along with the interest are as follows:

Sl. No.	Agencies and reference	Working capital	
		Biogas power plants	Biogasification based power plants
1.	IREDA (Letter dated 25-03-2011)	Raw material and O&M cost with 12.25% interest.	Raw material and O&M cost with 12.25% interest.
2.	TEDA (Letter dated 20-04-2010)	1.46 Crores (Poultry litter based)	
3.	Gujarat ERC (Order No. 2 of 2007)		Cost of fuel – 1 ½ months; O&M expenses – 1 month; Receivables – 2 months sale and Maintenance spares with 10.75% interest.
4.	Haryana ERC (Order dated 21-09-2010)	Receivables – 1 month sale with 12.25 % interest.	
5.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	1 Month O & M Charges +Maintenance Spares (15% of O & M charges) + 2 Months receivables from Debtors + 4 months Feedstock inventory with 12% interest.	

9.7.2 CERC fixed an interest rate equivalent to average State Bank of India short term PLR during the previous year plus 100 basis points.

9.7.3 Commission in its order Nos. 2 and 3 of 2009 has included the following components in the working capital with 12% interest:

1. Fuel stock-1 month,
2. O&M expenses – 1 month and
3. Receivables – 1 month.

9.7.4 Therefore, the Commission has proposed to adopt the above working capital with 12.25% interest rate as suggested by IREDA.

9.8 Return on Equity

9.8.1 The Return on Equity proposed / adopted by different agencies are tabulated below:

Sl. No.	Agencies and reference	Return on Equity	
		Biogas power plants	Biogasification based power plants
1.	TEDA (Letter dated 20-04-2010)	19% Crores (Poultry litter based)	
2.	Gujarat ERC (Order No. 2 of 2007)		14%
3.	Haryana ERC (Order dated 21-09-2010)	16%	
4.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	19%	

9.8.2 The Tariff Regulations of the Commission stipulates 14% post tax RoE for conventional fuel based generating stations. With the objective of promoting renewable energy, Commission in its NCES Tariff Order Nos.1, 2 and 3 of 2009 and 1 and 2 of 2010 have considered 19.85% pre-tax return on equity from 01-04-2009. The CERC has adopted RoE of 19% pre tax for the first ten years and 24% for the remaining 15 years for renewable projects. The

Commission proposes to adopt 19.85% pre-tax return on equity for this order, which translates in to 15.5% post-tax.

9.9 O&M and Insurance expenses

9.9.1 The O&M expense includes the expenditure on manpower, repairs, spares, consumables and overheads. The O&M expenses suggested / adopted by other agencies are as follows:

Sl. No.	Agencies and reference	O&M expenses	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	Rs. 2 /kWh.	
2.	IREDA (Letter dated 25-03-2011)	3% of the capital cost for O&M and 0.5% for insurance	3% of the capital cost for O&M and 0.5% for insurance.
3.	TEDA (Letter dated 20-04-2010)	10% (Sago based) 5% (Poultry litter based)	
4.	Gujarat ERC (Order No. 2 of 2007)		7% of the capital cost with 5% escalation.
5.	Haryana ERC (Order dated 21-09-2010)	6% of the project cost	
6.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	5.25% of capital cost with 5.72% escalation	

9.9.2 IREDA has recommended 3% of the capital cost for O&M expenses and 0.5% for insurance, while HERC has considered 6% of the capital cost for the biogas power plants. The GERC has considered 7% of the capitals cost for Biogasification based power plants. Commission considered O&M rate of 4.5% for plant and machineries with 5% escalation per year in its order No. 2 and 3 of 2009 for biomass and Bagasse based co-generation projects.

9.9.3 Unlike the biomass and Co-generation based power plants, the biogas and Biogasification based power plants do not consist of boiler, turbine, high pressure and temperature pipelines, etc. **Therefore, Commission proposes to adopt the O&M cost of 3% of the capital cost for the first year with 5%**

escalation thereafter for Biogas and Biogasification based Power Plants as recommended by IREDA.

9.9.4 Regarding insurance expenses, Commission considered an insurance rate of 0.75% of the machinery cost for the first year with reduction by half a percent of the previous year's insurance cost every year thereafter in order No. 2 and 3 of 2009. IREDA has recommended an insurance cost of 0.5% of the capital cost for biogas and Biogasification based power plants. Considering the nature of biogas / Biogasification based power plants, **Commission proposes an insurance rate of 0.5% of the capital cost for the first year and to be reduced by half a percent of the previous year's insurance cost every year thereafter.**

9.10 Auxiliary consumption

9.10.1 In case of biogas plant, considerable amount of power is required for the associated water treatment system that purifies and recycles the water to facilitate zero effluent discharge to the ground. The auxiliary consumption suggested / adopted by other agencies are as follows:

Sl. No.	Agencies and reference	Auxiliary consumption	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	10-12%	
2.	IREDA (Letter dated 25-03-2011)	10%	10%
3.	TEDA (Letter dated 20-04-2010)	14.60% (Sago based) 15% (Poultry litter based)	
4.	Gujarat ERC (Order No. 2 of 2007)		10%
5.	Haryana ERC (Order dated 21-09-2010)	12.74%	
6.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	13%	

9.10.2 Commission considered Auxiliary consumption of 10% in its order No. 2 and 3 of 2009 for biomass and Bagasse based co-generation projects. Considering the special nature involved in bio-gas plants such as effluent treatment system, etc. **it is proposed to consider 12% of auxiliary consumption for Biogas plants and 10% of auxiliary consumption for Biogasification based power plants.**

9.11 Fuel cost, Calorific value of fuel, Station Heat Rate (SHR) and cost of by-product.

9.11.1 The fuel cost, calorific value of fuel and station heat rate (SHR) suggested / adopted by other agencies are as follows:

Sl. No.	Agencies and reference	Fuel cost, Calorific value of fuel and SHR	
		Biogas power plants	Biogasification based power plants
1.	MNRE (Letter dated 19-07-2010)	Rs.1/kWh 4500-5000 Kcal/cum.	
2.	IREDA (Letter dated 13-01-2010)	Rs.450/Tonne at present (Poultry Litter based). 3000-3500 Kcal/kg.	Rs.2500/Tonne at present 3629 Kcal/kg.
3.	IREDA (Letter dated 25-03-2011)	5000 kCal/m³, 1 m³/4 kWh	1200 kCal/kg, 1 m³/1.4 kWh
4.	TEDA (Letter dated 20-04-2010)	Rs.1100/Tonne (Poultry litter based) 5000 Kcal/kg (Sago based) & 4300 Kcal/kg (Poultry litter based)	
5.	Gujarat ERC (Order No. 2 of 2007)		Rs.1000/Tonne with 5% annual escalation 3300 Kcal/kg. 4290 Kcal/kWh.
6.	Haryana ERC (Order dated 21-09-2010)	Rs.370/Tonne (Poultry litter based) Specific fuel consumption 4.21kg/kWh	
7.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	Rs.1020/Tonne with 5% escalation Specific fuel consumption 3 kg/kWh	

9.11.2 The survey on efficiency of new generation gas engines reveals a range of 35% to 45% depending upon the capacity. Therefore, assuming an electrical efficiency of 40% for bio gas based power plants is reasonable and this translates in to the station heat rate of 2150 kCal/kWh. Regarding calorific value of the bio gas, the MNRE has reported a calorific value of 4500 to 5000 kCal/cum, whereas, the IREDA has mentioned a calorific value of 5000 kCal/cum. Since there is no data available on the conversion ratio of poultry litter in to Biogas, the above data could not be used to find out the specific consumption of fuel.

9.11.3 Regarding specific consumption of fuel, the Haryana ERC has specified 4.21 kg/kWh for poultry litter based biogas power plants. The petitioner has reported a specific fuel consumption of 3 kg/kWh. Therefore, the Commission considered a specific consumption of 3 kg/kWh in this concept paper.

9.11.4 Regarding bio-gasification based power plants, the specific fuel consumption could not be arrived from the data furnished by different agencies. However, the Gujarat ERC has furnished a calorific value of 3300 kCal/kg and a Station Heat Rate of 4290 kCal/kWh which translates into a specific fuel consumption of 1.3 kg/kWh.

9.11.5 Regarding the cost of the fuel for biogas based power plants, the HERC has considered a cost of Rs.370/tonne after adjusting the cost of by-product. The HERC has not furnished the cost of fuel or the by-product separately. Hence, the actual cost of the fuel could not be ascertained. The Commission proposes to adopt a fuel cost of Rs.1020/MT with 5% escalation as furnished by the petitioner.

9.11.6 The fuel cost for bio-gasification vary from state to state and is state specific. Commission in its order No. 2 of 2009 for biomass power plants has considered a biomass cost of Rs.2000/MT for the year 2009-10 with 5% escalation per year. This translates into a fuel cost of Rs.2200/MT for the year 2011-12. Therefore, Commission proposed to consider a biomass cost of

Rs.2200/MT for the year 2011-12 with 5% escalation thereafter.

9.11.7 The by-product cost adopted by different agencies are as follows:

Sl. No.	Agencies and reference	Cost of by-product	
		Biogas power plants	Biogasification based power plants
1.	Petition filed by M/s.Pallava Water and Power (P) Ltd. Before TNERC vide PPAP 6 of 2010	Rs.110/Tonne with 5% escalation	
2.	Tamil Nadu Poultry Farmers Federation	Rs.1400/Tonne.	
3.	IREDA (Letter dated 25-03-2011)	Quantum of by-product – 0.20 MT (Manure from cow dung), Cost - Rs.2500/MT	Quantum of by-product – 0.038 MT (Charcoal), Cost - Rs.7500/MT

The Khadi & village industries Commission have also estimated the cost of bio-enriched manure as Rs.2268/Tonne.

9.11.8 Regarding, the benefit arrived due to sale of by-product, it is proposed to adopt the figure furnished by IREDA. IREDA has stated that the quantity of by-product for each tonne of fuel (cow dung) is 0.2 MT. If the same analogy is adopted here, the quantum of by-product for each unit of electricity is **0.6 kg / kWh.** Commission has proposed to adopt this quantity for arriving at the benefit accrued out of sale of by-product. Regarding cost of by-product, Commission has proposed to adopt **Rs.2500 / MT** as recommended by IREDA with 5% escalation in the manure price.

9.11.9 Regarding, bio-gasification based power plants, IREDA has stated that the quantum of by-product for each unit of electricity generated is 0.051 kg/kWh and the cost of by-product is Rs.7500 / MT.

9.11.10 It is proposed to deduct the per unit benefit from the sale of by-product from the total per unit cost of energy.

9.12 Tariff rate

9.12.1 The financial and operational parameters proposed in the paper are tabulated below:

Sl. No.	Financial and operational parameters	Financial and operational parameters proposed	
		Biogas power plants	Biogasification based power plants
1.	Net Capital Cost	Rs.6.37 Crores/MW	4.32 Crores/MW
2.	PLF	80%	80%
3.	Loan tenure	10 years with 1 year moratorium period	10 years with 1 year moratorium period
4.	Interest on Loan	12.25%	12.25%
5.	Life of the plant	15 years	20 years
6.	Depreciation	6%	4.5%
7.	RoE	19.85% Pre-Tax	19.85% Pre-Tax
8.	O&M charges including insurance	3% of the capital cost with 5% escalation per year	3% of the capital cost with 5% escalation per year
9.	Insurance Expenses	0.5% of the capital cost for the first year and reduction by half a percent of the previous year's cost every year thereafter	0.5% of the capital cost for the first year and reduction by half a percent of the previous year's cost every year thereafter
10.	Working capital and interest	1. Fuel stock-1 month, 2. O&M expenses – 1 month and 3. Receivables – 1 month with 12.25% interest	1. Fuel stock-1 month, 2. O&M expenses – 1 month and 3. Receivables – 1 month with 12.25% interest
11.	Auxiliary consumption	12%	10%
12.	Fuel cost	Rs.1020/MT with 5% escalation per year	Rs.2200/MT with 5% escalation per year
13.	Specific fuel consumption	3 kg/kWh	1.3 kg/kWh.
14.	Cost of by-product	Rs.2500/MT with 5% escalation per year	Rs.7500/MT with 5% escalation per year
15.	Quantity of by-product production	0.6 kg/kWh	0.051 kg/kWh.

9.12.2 The corresponding tariff has been worked out as below for 15 years considering the above determinants for Biogas based Power Plants. Fixed cost has been tabulated for a period of 15 years. i.e. up to the life of the project. Variable cost has been furnished for the year 2011-12 and 2012-13.

Tariff for Biogas power plants				
Year	Fixed cost (Rs./unit)	Variable Cost (Rs./unit)	Revenue from sale of by-product (Rs./unit)	Total cost (Rs./unit) (2)+(3)-(4)
(1)	(2)	(3)	(4)	(5)
1	2.58	3.48	1.50	4.56
2	2.60	3.65	1.58	4.68
3	2.53			
4	2.46			
5	2.40			
6	2.33			
7	2.27			
8	2.20			
9	2.14			
10	2.08			
11	2.02			
12	1.96			
13	1.99			
14	2.03			
15	2.06			

9.12.3 Similarly, the tariff for Biogasification based power plants is worked out as below for 20 years:

Tariff for Biogasification based power plants				
Year	Fixed cost (Rs./unit)	Variable Cost (Rs./unit)	Revenue from sale of by-product (Rs./unit)	Total cost (Rs./unit) (2)+(3)-(4)
(1)	(2)	(3)	(4)	(5)
1	1.63	3.25	0.38	4.50
2	1.64	3.41	0.40	4.66
3	1.60			
4	1.55			
5	1.51			
6	1.47			
7	1.42			
8	1.38			

9	1.34			
10	1.30			
11	1.27			
12	1.23			
13	1.25			
14	1.28			
15	1.30			
16	1.33			
17	1.36			
18	1.39			
19	1.42			
20	1.45			

9.12.4 The first year tariff is applicable for a period of one year from the date of commissioning of the project. The second year tariff is applicable for one year thereafter and so on. As the control period expires on 31-03-2013, it is expected that the next tariff order would be in position by then. The variable cost for the third year will be determined in the next tariff order. If the variable cost for the third year is not specified by the Commission, the variable cost specified for the second year shall be continued beyond the period till any revision is effected by the Commission in this regard.

10. Related issues

The following are the issues related to power generation, transmission, wheeling and consumption from Biogas / Biogasification based power plants:

1. Transmission and wheeling charges
2. Cross subsidy surcharge
3. CDM benefits
4. Reactive power charges
5. Grid availability charges
6. Adjustment of energy generated
7. Scheduling and system operation charges
8. Application fees and Agreement fees
9. Billing and payments
10. Payment security and Security deposit
11. Power factor disincentive
12. Metering and communication arrangements

13. Evacuation of power
14. Energy purchase agreement
15. Energy wheeling agreement
16. Renewable energy purchase obligation
17. Tariff Review Period / Control Period

10.1 Transmission & Wheeling charges and line losses

Commission has uniformly adopted transmission and wheeling charges including line losses at 5% and 7.5% for HT / EHT and LT services respectively in respect of wind, biomass and bagasse based generation in its orders issued in 2009. Since the TNEB has been unbundled with effect from 01-11-2010, it is prudent to fix the Transmission and Wheeling charges separately. Tamil Nadu has a reasonable penetration of power from renewable energy sources. Hence, it is proposed to fix the transmission and wheeling charges nearer to the level of actual line losses. Therefore, a transmission charges of 3% has been proposed for these power plants. Wheeling charges at HT level is 7% and for LT level is 15%.

10.2 Cross subsidy surcharge

Commission in its order No. 1, 2 and 3 of 2009 fixed 50% of the cross subsidy surcharge for wind, biomass and bagasse based generators as a promotional measure for renewable energy. On similar lines, Commission proposes 50% of the cross subsidy surcharge for Biogas / Biogasification based power projects also.

10.3 CDM Benefits

The Forum of Regulators has recommended that CDM benefits should be shared on gross basis starting from 100% to developers in the first year and thereafter reducing by 10% every year till the sharing becomes equal (50:50) between the developer and the consumer in the sixth year. Thereafter, the sharing of CDM benefits will remain equal till such time the benefits accrue. The Commission adopted this formula in its order Nos. 1, 2 and 3 of 2009 and 1 and 2 of 2010. Commission proposes the same formula for Biogas / Biogasification based power projects. Distribution Licensee shall account for

the CDM receipts in the next ARR filing.

10. 4 Reactive Power Charges

Commission has proposed to adopt the rate specified in Indian Electricity Grid Code for reactive power charges.

10.5 Grid Availability Charges

Grid availability charges shall be collected as per the Commission's order in force.

10.6 Adjustment of generated energy

As per the Commission's Open access regulations open access **is permitted to all the HT consumers (with sanctioned demand of 63 kVA and above).** A person covered by a policy relating to captive generation or generation through non conventional energy sources shall be eligible to avail open access for their own use irrespective of contract demand. Similarly, A person covered by a policy relating to captive generation or generation through non conventional energy sources shall be eligible to avail open access in respect of third party sale subject to the phasing of open access in the Commission's Open Access Regulations.

10.7 Scheduling and system operation charges

The scheduling and system operation charges have been prescribed in Order No.2 dated 15-5-2006 of the Commission. The prescribed charges are Rs.1000 / day irrespective of capacity. With a view to incentivise renewable energy project, the Commission, by an amendment to the Order No.2, prescribed charges of Rs.1000 / day per 1.65 MW and above. For capacity less than 1.65 MW, proportionate charges were prescribed. This order as amended from time to time shall continue to apply for Biogas / Biogasification based generators.

10.8 Application fees and agreement fees

The Intra State Open Access Regulations 2005 of the Commission were

amended in 2008 to provide for concessional application fees and agreement fees for generators of non conventional and renewable sources of energy. The application fees under the Energy Wheeling Agreement was fixed at Rs.200 per MW subject to a maximum of Rs.5000 and the agreement fees under Energy Wheeling Agreement was fixed at Rs.2000 per MW subject to a maximum of Rs.50000 on the consideration that generators of renewable sources of energy have small capacities compared to generators of conventional energy. The agreement fee for Energy Purchase Agreement has been fixed at Rs.2000 per MW or part thereof. As regards the Energy Purchase Agreement, Commission's Fees and Fines Regulations 2004 prescribes Rs.2000 per MW or part thereof as the fees for approval of Power Purchase Agreement by the Commission as against Rs.2500 per MW or part thereof leviable for conventional power plants. This fee shall be collected by the licensee and passed on to the Commission. In case of frequent changes in the usage of the energy as well as the change of drawal point necessitate extra clerical work. Therefore, the Commission proposes that every time a generator seeks such a change either through an amendment to an existing agreement or through a fresh agreement, an additional charge equivalent to the application fees and agreement fees shall be leviable by the licensee on the generator.

10.9 Billing and Payment

10.9.1 When a renewable energy generator sells power to the distribution licensee, the generator will raise a bill every month for the net energy sold after deducting the charges for start up power and reactive power. The distribution licensee shall make payment to the generator within 30 days of receipt of the bill. Any delayed payment beyond 30 days will attract interest at the rate of 1% per month.

10.9.2 If a Biogas / Biogasification based generator utilizes the power for captive use or if he sells it to a third party, the distribution licensee shall raise the bill at the end of the month for the net energy supplied. The licensee should record the generation and consumption simultaneously. While preparing the bill, peak hour generation shall be adjusted against peak hour

consumption. Off peak generation shall be adjusted against off peak consumption. Normal generation shall be adjusted against normal consumption. Peak hour generation and normal hour generation can be adjusted against lower slot consumption. Excess consumption will be charged at the tariff applicable to the consumer. Transmission and wheeling charges, scheduling and system operation charges and cross subsidy surcharge, wherever applicable, shall be recovered from the bill. The net amount recoverable from the consumer shall be raised in the bill.

10.10 Payment Security and Security Deposit

10.10.1 The National Tariff Policy calls for adequate and bankable security arrangements to the generating companies. This mechanism has been found impractical, as there are more number of generators and distribution licensee is unable to offer security for such numbers. Therefore, the Commission believes that penalty for delayed payment by the licensee would serve the ends of justice.

10.10.2 As regards the security deposit of the consumer, the Commission proposes to retain the present arrangements. i.e., two times the maximum net energy supplied by the distribution licensee in any month in the preceding financial year shall be taken as the basis for the payment of security deposit by the consumers.

10.11 Power factor disincentive.

As per the Commission's retail tariff order, power factor disincentive is applicable to a consumer as a percentage of current consumption charges. The average power factor recorded by the meter shall be the reference for calculation of the disincentive. On the same analogy, captive / third party consumers shall be liable for disincentive based on the gross energy consumption and the applicable demand.

10.12 Metering and Communication Arrangements

The metering and communication arrangements shall be in accordance with the following:

(1) Central Electricity Authority (Installation and Operation of Meters) Regulations,
(2) Tamil Nadu Electricity Distribution Code,
(3) Tamil Nadu Electricity Grid Code,
(4) Tamil Nadu Electricity Intra State Open Access Regulations.

The meters shall be installed by the Distribution Licensee / STU depending upon the injection voltage at the cost of generators.

10.13 Evacuation of power

10.13.1 As per section 10 of the Electricity Act, 2003, the duties of the generating company shall be to establish, operate and maintain generating stations, tie-lines, sub-stations and dedicated transmission lines connected therewith in accordance with the provisions of this Act or the rules or regulations made thereunder. Therefore, a generating company is liable to establish the interfacing line at its cost.

10.13.2 In addition to the above stipulation, the Commission proposes the following procedure for creation of evacuation facilities.

(a) STU shall within 30 days of receipt of application from generators, intimate whether or not the long term access can be allowed without further system strengthening.

(b) If further system strengthening is essential, the results of study conducted by the STU based on the request of generators shall be intimated within ninety days of such request of generators.

(c) Feasibility based on system studies shall be established within six months at the latest.

(d) Clearances, approvals, certificate, if any, required by generators shall be issued within a month time.

(e) The distribution licensee is not liable to pay compensation to the consumer on Open Access for deemed generation benefits in case the distribution licensee is unable to evacuate power due to failure of the Transmission and Distribution facility

10.14 Energy Purchase Agreement

The draft format for the Energy Purchase Agreement (EPA) shall be prepared and submitted to the Commission by the TANGEDCO within 15 days from the date of this tariff order. The agreement shall be co-terminus with the life of the project. The distribution licensee shall execute the Energy Purchase Agreement within a month of receipt of application from the generator. The parties to the agreement may be given the option of exit in case of violation with three months notice to the other party.

10.15 Energy Wheeling Agreement (EWA)

The draft format for the Energy Wheeling Agreement (EWA) shall be prepared and submitted to the Commission by the TANGEDCO within 15 days from the date of this tariff order. The agreement shall be as per Commission's Open Access Regulations. The concerned nodal agency should execute the EWA within one month from the date of submission of application with all relevant details for such agreement by the biogas / bio-gasification based generators or the third party purchaser, as the case may be.

10.16 Renewable Purchase Obligation

As per the Commission's Renewable Energy Purchase Obligation Regulations, 2010, every obligated entity shall purchase not less than defined minimum percentage of its consumption of energy from renewable energy sources under the Renewable Purchase Obligation (RPO) during a year **as specified in the Commission's tariff regulations/orders on renewable energy issued from time to time.**

10.17 Tariff Review Period / Control Period

With regard to tariff Review Period / Control Period, the specific provisions of Regulation 6 of Regulations on "Power Procurement from New and

Renewable Sources of Energy, 2008" are reproduced below:

"The tariff determined by the commission in the tariff order shall be applicable for the power purchase agreement period of ***twenty years****. The control period may ordinarily be* ***two years****. When the Commission revisits the tariff and allied issues after the control period, the revision shall be applicable only to the generator of new and renewable energy sources commissioned after the date of such revised order"*

(By order of the Commission)

Secretary
Tamil Nadu Electricity Regulatory Commission