CHAPTER - II

BIOMASS POWER PLANTS IN ANDHRA PRADESH

Andhra Pradesh is the fifth largest economy in the Country and second largest in South India. The State is a key player in the country's power sector with the highest hydel power generation. Andhra Pradesh was given the highest score of 78 among the 12 states assessed by the CRISIL, a global analytical company providing Ratings, Research and Risk & Policy Advisory services. The top rating of the State was given by CRISIL on the basis of the credibility of reforms undertaken in the power sector in Andhra Pradesh.

The last decade has witnessed a number of changes in the power sector. These constitute capacity expansion and production, evolution of new institutions and shifts in ownership structures and fuel mixes like Biomass. All these developments have mainly taken place on the generation side because the initial reforms started with particular focus on the supply side.

2.1 ELECTRICITY DEVELOPMENT IN ANDHRA PRADESH – A HISTORICAL PERSPECTIVE:

Electricity development was not new to Andhra Pradesh. As early as in 1934, Messers Chary and Chary Company started generation of electricity at Nellore. Similarly, electricity generation was also started at Ongole by Messers Guntur Power and Lights Company in 1935.

In 1932, the Department of Electricity was formed for proper amalgamation of the activities of the hydro-electric development. In 1940, the Andhra Power Systems comprised the steam stations at Visakhapatnam and Vijayawada and the Oil Engine Station at Kakinada with their respective distribution. In view of the expansion of the work of the Electricity Department, the need for reorganizing the department was felt. After the reorganization of the department, the Visakhapatnam Power House Extension

Schemes were sanctioned by the Government in December, 1945 which provided for the installation of two 1,500 K.W. turbo-generating sets to meet the demand of the Chittivalasa and Nellimarla Jute Mills, additional load of the ship-building Yard, and other load development in Visakhapatnam area.

In April, 1949 the Andhra Power Systems extended its activities and comprised all the steel electric stations at Kurnool, Kadapa, Anantapur, etc., to which distribution is fed from hydro-power under Mysore Jog Scheme. A renovated and more purposeful 'Andhra State Electricity Department' was formed on 1st October, 1953, the date on which the Andhra State was born. A full-fledged grid, by name 'the Andhra Grid' was constituted by the Department. The Andhra Grid, then, consisting of three thermal stations – Visakhapatnam, Vijayawada and Nellore with an installed capacity of about 24,000 KW and '13 diesel stations, with an aggregate capacity of 11,000 KW.

In addition, bulk supply of hydro power was taken from the then neighbouring states of Mysore and Madras about 2,000 KW of Mysore Jog Power at Bellary; and 3,400 KW of Madras-Mettur power at Kuppam, and 700 MW of Mysore Sivasamudram at Hindupur. The total bulk supply was about 6,000 KW.

When combined State of Andhra Pradesh was formed in 1956 with Telangana region, many parts of the State did not have power supply due to inadequate generation and transmission facilities. Electricity was unknown in rural areas and the backwardness of the State in power generation can be understood by its per-capita consumption which was only seven units.

Indian Constitution provides, in its seventh schedule, concurrent status to electricity thereby enjoining responsibility for its supply, production and development on both Central and State Governments. The State Governments shall play their respective roles in the power development, as electricity is a necessity in day to day life. As a powerful tool and basic infrastructure in multifarious fields of development, it is a perennial source of prosperity and happiness for human society.

Andhra Pradesh State Electricity Board (APSEB) was formed on 1st April, 1959. By recognizing the fact that the degree of power development in the State was very low relative to the resources available, the Board has determined to take effective steps to create abundant power generation facilities in the successive plan periods so as to be on the threshold of achieving self-sufficiency in power generation to meet the requirements.

Similar to other State Electricity Boards (SEBs) in the country, APSEB had a monopoly in the power sector and functioned under the overall control of the State Government, interacting with the central power agencies for planning and co-ordination. With headquarters at Hyderabad, APSEB is a part of the Southern Regional Power Grid (SRPG), which was monitored from Bangalore, capital of the Karnataka state. APSEB controls 100 per cent power distribution and around 73 per cent of the generation capacity in the State.

2.2 GENESIS AND GROWTH OF BIOMASS POWER PLANTS IN ANDHRA PRADESH

Biomass based power projects are promoted in Andhra Pradesh by Ministry of Non-Conventional Energy Sources (MNES), Non-Conventional Energy Development Agency (NEDA) and Government of Andhra Pradesh.

The selection of appropriate location for Biomass Power Plants is generally done on the basis of the following criteria:

(1) Ensuring the availability of biomass resources, in surplus.
(2) Only one or two Biomass plants in the district.
(3) Adequate availability of ground water resources.
(4) Location of the plant adjacent to the existing grid of 132 kV sub-station located on the National Highway No.5 connecting Howrah and Chennai.
(5) Ensured logistic requirement, including biomass mobilization.

In Andhra Pradesh the first biomass power project was commissioned in 1996 and the rest of the plants were established in 2001-04. Initially during 2001-04, 31 biomass power were commissioned with 164 MW capacity and subsequently 3 more biomass power projects were added. All these 34 biomass power plants were spread all over Andhra Pradesh with an installed capacity of 202.75 MW. The typical size of the plants is 6 MW. The details of the biomass power plants are given in Table 2.1.

Table 2.1 – Details of Biomass Power Plants.

S.No.	Biomass power project	Location	Capacity (in mw)	Date of commissioning
1	Agri Gold Projects Ltd, Prakasam Dist.	Hansapur (V), Tripuranthakam (M)	IPP 6.0	2003-May
2	Balaji Agro Oils Ltd, Krishna District.	Davuluru (V) Kankipadu (M)	IPP 4.5	2003-May
3	Bollineni Castings & Steels Ltd, Nellore District.	Suryapalem (V) Podalakuru (M)	IPP 6.0	2003-October
4	Clarion Power Corporation Ltd, Prakasam District.	Tangutur (V& M)	IPP 12.0	2003-January
5	Gowthami Bio Energies Pvt Ltd, Khammam District.	Gopalapuram (V), Khammam (M)	IPP 6.0	2001-August
6	The Gowthami Solvent Oils Pvt Ltd,West Godavari Dist.	Pydiparru (V) Tanuku (M)	2.75	1996- March
7	Indur Green Power Pvt Ltd, Nizamabad District.	Renjal (V & M)	IPP 6.0	2003-February
8	Jocil Ltd, Guntur District.	Dokiparru (V)	Captive, IPP 6.0	2001-April
9A	Jyothi Bio Energy Ltd, Prakasam District.	Gundlapally (V)	4.5 (3^{rd} party sale)	1999-November
9B	Jyothi Bio Energy Ltd, Prakasam District.	Gundlapally (V)	IPP 6.0	2003-November
10	Greenko Energies Pvt ltd, Guntur District.	Vadavalli (V) Satenapalli (M)	IPP 6.0	2002-August
S.No.	**Biomass power project**	**Location**	**Capacity (in mw)**	**Date of commissioning**
11	Sri Kalyani Agro Industries, West Godavari District.	Prathipadu (V) Pentapadu (M)	Captive,IP P 4.0	2002-December

12	Matrix Power Pvt Ltd, Guntur District.	Karampudi (V & M)	IPP 4.5	2001-August
13	My Home Power Ltd, Medak District.	IDA,Phase 1, Patancheru (V& M)	IPP 8.0	2002-February
14	Om Shakti Renergies Ltd, Chittor District.	Pannuru (V) Vijayapuram (M)	IPP 6.0	2004-January
15	Perpetul Energy Systems Ltd, Vijayanagaram Distrct.	Appayapeta (V) Seetanagaram (M)	IPP 6.0	2003-March
16	Ritwik Energy Systems Ltd, Chittor District.	Rachagunneru (V), Sri Kalahasti (M)	IPP 6.0	2002-September
17	Ritwik Power Projects Ltd, Khammam District.	Tekulapally (V) Penuballi Mandal	IPP 6.0	2002-December
18	Roshni Powertech Ltd, Krishna District.	Ayyanki (V), Moovya (M)	IPP 6.0	2001-August
19	Greenko Energies Pvt ltd, Kadapa District.	Chennuru (V & M),	IPP 6.0	2004-April
20	Satyamahrshi Power Corpn.Ltd, Guntur District.	Muttaiahpalen (V), Krosur (M)	IPP 6.0	2004-July
21	Shalivahana Green Energy Ltd, Adilabad District.	Rangampet (V). Mancherial (M)	IPP 6.0	2002 December
22	Shree Papers Ltd, East Godavari District	G.Rangampet (V), Samolkot (M)	Captive, IPP 4.0	2003-May
23	SLS Power Ltd, Nellore District	Nayalakulathota (V) Ashok Nagar (M)	IPP 6.0	2001-August
24	Sree Rayalaseema Green Energy, Kurnool District	Aswathapuram(V), Pandipadu (M)	3rd party sale 5.5	2002-April
25	Satyakala Power Projects Pvt Ltd, Krishna District.	Ganguru (V), Penamaluru (M)	IPP 4	2002-Jan
26	Saro Power & Infrastructure Ltd, Mahabubnagar Dist.	Magnuru (V&M)	IPP 6.0	2003-May
27	Suchand Powergen Pvt Ltd, Kurnool District.	Udumalapuram (V) Nandyal (M)	IPP 6.0	2002 November
28	Suryateja Power Projects Pvt Ltd, Mahboobnagar District	Beechupally (V) Itikayal (M)	IPP 6.0	2007-April

Contd….

S.No.	Biomass power project	Location	Capacity (in mw)	Date of commissioning
29	Singaraya Hills Green Power Genco P) Ltd Prakasam Dist.	Hansapur (V) Tripuranthakam (M)	IPP 6.0	2008-July
30	Veeraiah N C Power Projects Ltd, Krishna Dist.	Kurumaddali (V) Pamarru (M)	IPP 4.0	2002-November
31	Velagapudi Power Generetion Ltd, Guntur District	Naddampallam (V) Prathipadu (M)	IPP 4.0	2006-December
32	Varam Power Projects Ltd, Srikakulam Dist.	Chilakapalem (V)	IPP 6.0	2002-February
33	Vijaya Agro Products Pvt Ltd, Vijayawada	Enkipadu (V)	Captive 4.0	2002-January
34	Vishu Vidyut India Ltd, Visakapatnam	Narasingapally (V & M)	IPP 6.0	1999-June
Total Biomass Power installed Capacity			202.75 MW	

Source: Compiled from the monthly reports of Biomass Energy Developers Association

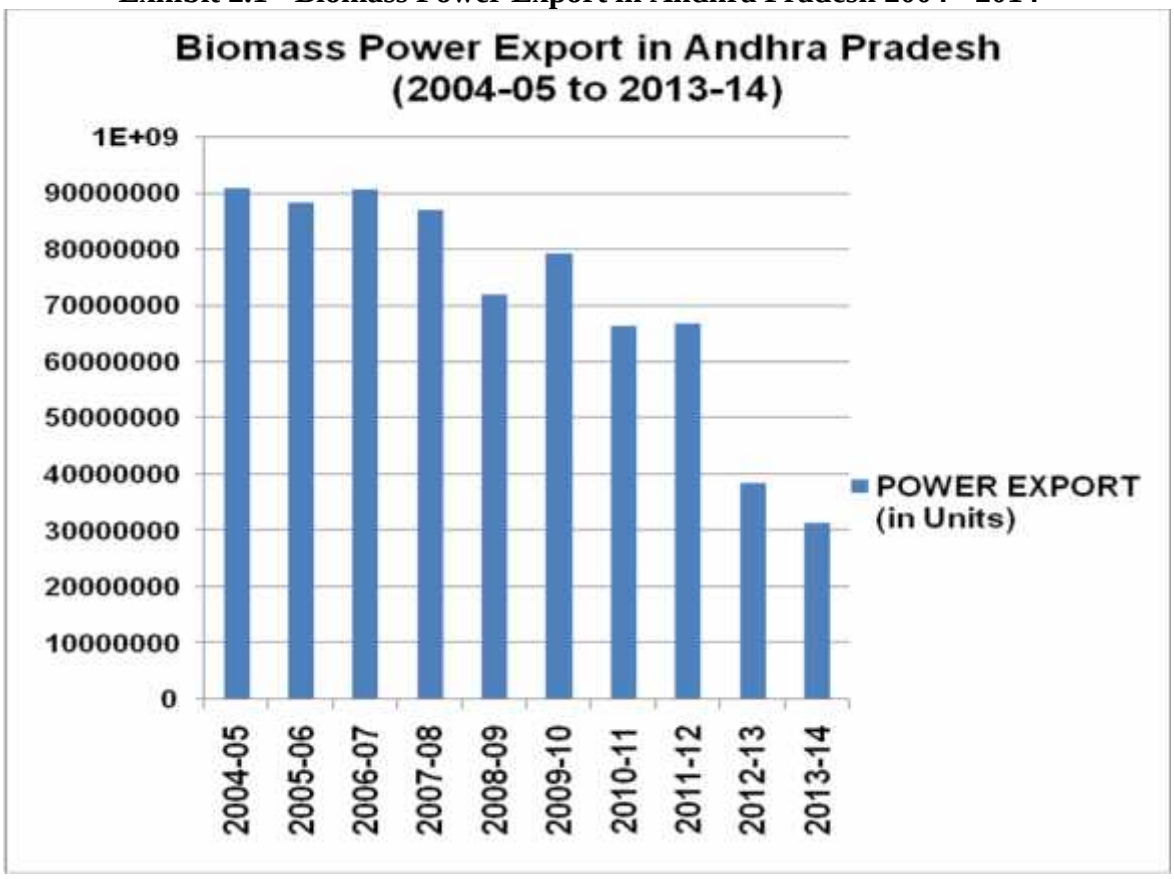
Table 2.2 - Generation of Electricity by Biomass Power Plants

Biomass Power Export Details in Andhra Pradesh 2004 – 2014	
YEAR	**POWER EXPORT (in Units)**
2004-05	908611156
2005-06	883035332
2006-07	906717518
2007-08	868627478
2008-09	719610579
2009-10	791420668
2010-11	662955876
2011-12	666725632
2012-13	383466435
2013-14	314313676

Source: Compiled from the monthly reports of Biomass Energy Developers Association

The generation of the biomass power for the period during 2004-05 to 2013-14 is presented in Table 2.2 and Exhibit 2.1. It is evident from the Table that the export of biomass power has gradually decreased from 908,611,156 units in 2004-05 to 314,313,676 units in 2013-14 because of reduction in the generation capacity which is of great concern to the industry. The main reason for the reduction in generation capacity can be attributed to the tariff policies of the government.

Exhibit 2.1 - Biomass Power Export in Andhra Pradesh 2004 - 2014



2.3 OPERATIONAL ISSUES OF BIOMASS POWER PLANTS

The success of Biomass power plants depends primarily on the management of biomass fuel which in turn is influenced by various factors like availability of biomass material, price, etc. Availability of biomass material is highly seasonal in nature. It will have moisture (ranging from 15-50 per cent moisture content) as it is freshly collected from agricultural fields. For operating the plant smoothly the boiler parameters have to be

maintained steadily like temperature of 485^0 C and pressure of 65ATA and the biomass fuel mix needs to be monitored and controlled with 20 per cent moisture level only.

The biomass fuel is required to be procured in large quantities during the fuel available season and stored in the open fuel yard where there will be moisture losses, carpet losses and bio-degradable losses. Certain biomass fuels like woody waste, cotton / chilly stalks, palm oil bunches, etc., are to be processed into uniform sized chips to avoid boiler parameters fluctuations. The biomass fuel processing is a cumbersome activity involving several precautions to be taken, and the problem is further accentuated due to shortage of labour.

Fuel combinations of raw materials are another challenge to be faced to maintain proper fuel mix. To maintain the constant boiler and turbine parameters, various available fuels have to be mixed in correct proportions based on their moisture contents and Calorific values. The biomass fuel mix is based on its Gross calorific value and moisture levels to ensure the average required Station Heat Rate(SHR) of 4500 Kcal / kWh at boiler gate. If proper fuel combinations are not maintained, the Specific Fuel Consumption (SFC) will be higher (> 1.80 to 2.0 Kgs / kWh) which eventually shoots up the fuel cost for generating a unit power. If the operating SFC goes beyond 1.35 Kgs/ kWh, it reduces the tariff and there will be loss.

The biomass is supplied by unorganized supply net work. It will be difficult to maintain the continuity of supplies at defined / fixed agreed fuel price. Competition for biomass fuels like rice husk, woody waste and maize cobs is very stiff from other industries like brick industry, paper industry and solvent plants which also use them as raw materials. Moreover, the prices for these fuels keep changing very frequently and widely.

The industry has to incur unforeseen expenditure on raw materials, especially in the monsoon season. For example, the biomass fuel rice husk price was around Rs 400 / MT in 2002-03 which has gone up exponentially varying between Rs 2,500- 3000 / MT by the year 2010. Driven by the demand-supply situation, it is expected that the price would

touch Rs 3,000/MT especially during September to December months. This apart, woody biomass is used in huge quantities in Biomass Power Plants adding transportation and processing costs. The landing cost of the high moisture content (35-45 per cent) woody biomass varies between Rs.1800-2000 /MT. As woody biomass involves 15-18 per cent losses, it has to be dried up in the open fuel yard and stored for at least 3- 4 months.

Most biomass power plants have to maintain biomass inventory for about 60 days. As biomass stocks have to be bought in cash and huge inventories need to be maintained, this will add to the cost of the fuel besides entailing storage and moisture losses. Certain biomass fuels will have moderate Sulphur, oil, alkaline and Silica content which spoils the Super heater coils and economizer tubes of the biomass power plants very often. It requires regular shutdowns for cleaning and repairing of these tubes.

Quality and availability of boiler water is another problem. Normally in majority of the plants sufficient ground water / canal / river water is available only for months (June – February) and the rest of 3 months (March – May) there is generally shortage of Water and Salts (TDS) content will be very high. So, alternate arrangements have to be made to get the required quality and quantity of water during those 3 months also.

In general, the normal operating Plant Load Factor (PLFs) is 45-55 per cent only due to various problems like fuel shortage, high fuel rates , high moisture contents in certain fuels, frequent mechanical failures ,etc. if Biomass power plants are located and connected to the rural sub-stations where there are high grid fluctuations this will result in more production stoppages.

Operations of biomass power plants need highly skilled workers. So workers need to be trained, monitored and motivated closely to keep up the machinery and production levels high. Further, there are sometimes failures of ESP which results in agitations from nearby villagers. So, close monitoring is required to mitigate the fly ash and wet ash menace.

The Biomass power plants in Andhra Pradesh have entered into long term (20 years) Power Purchase Agreements (PPAs) with the government power transmission company viz., APTRANSCO. Third party sale of biomass power is not allowed, so there is no scope to absorb the additional increase in the fuel prices. Government price policies decide the survival of the Biomass power plants. Government policies which involve bureaucratic delays have never given solutions on time to the operators of biomass power plants. For example, tariff disputes were referred to the Appellate Tribunal, High court and Supreme court which is still pending as on today, i.e, even after 10 years. So, almost 16 biomass power plants became bankrupt and Non-Performing Assets (NPAs) and eventually closed down or sold out by the developers.

2.4 STATUTORY BODIES THAT REUGLATE BIOMASS POWER PLANTS

Biomass power projects are promoted in Andhra Pradesh by Ministry of New and Renewable Energy (MNRE) and Non-conventional Energy Development Corporation of Andhra Pradesh Limited (NEDCAP).The other statutory/legislative bodies that regulate tariff etc., are APTRANSCO, APSERC and Appellate Tribunal for Electricity (ATE). A brief description of the above statutory/legislative authorities is given below:

i. Ministry of New and Renewable Energy

The role of new and renewable energy has been assuming increasing significance in recent times with the growing concern for the country's energy security. Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s. The sudden increase in the price of oil, uncertainties associated with its supply and the adverse impact on the balance of payments position led to the establishment of the Commission for Additional Sources of Energy in the Department of Science & Technology in March 1981. The Commission was charged with the responsibility of formulating policies and their implementation, programmes for development of new and renewable energy apart from coordinating and intensifying R&D in the sector. In 1982, a new department, i.e., Department of Non-conventional Energy Sources (DNES), was created from the then Ministry of Energy. In

1992, DNES became the Ministry of Non-conventional Energy Sources. In October 2006, the Ministry was re-christened as the Ministry of New and Renewable Energy.

Ministry of New and Renewable Energy (MNRE) is the nodal ministry of Government of India for all matters relating to new and renewable energy. The broad aim of the Ministry is to develop and deploy new and renewable energy sources to supplement the energy requirement of India.

ii. Non-conventional Energy Development Corporation of Andhra Pradesh Limited (NEDCAP)

The genesis of Non-conventional Energy Development Corporation of Andhra Pradesh Limited [NEDCAP] took place in the year 1986 with the help of Government of Andhra Pradesh. The objectives of NEDCAP are to:

- Generate electricity through renewable sources like wind and solar on decentralized manner
- Conserve energy in rural areas
- Import and adopt viable technology and machinery in the areas of Non-conventional energy sources and ensure post installation service
- Impart training and to promote research and development in the field of Non-conventional energy sources

iii. APTRANSCO

The Government of Andhra Pradesh, considering the recommendations made by the High Level Committee, had embarked upon the AP Electricity Reforms Act in 1998. As a sequel, the APSEB was divided into Andhra Pradesh Power Generation Corporation (APGENCO) and Andhra Pradesh Transmission Corporation (APTRANSCO) on 01.02.1999. The State Government owns 100 per cent shares in both the Corporations.

The Power Grid in the state is maintained by APTRANSCO. It allows transmission of power from other generating companies and distribution after payment of charges. The main business of APTRANSCO is purchase of electrical energy and sale of energy to the distribution companies and bulk supply to other agencies and to coordinate with the generators and trading of power etc. Finalization of power purchase agreements with new generating projects for purchase of power and all other works are connected with the transmission and bulk supply of electrical energy in the State of Andhra Pradesh. Apart from APTRANSCO, Power Grid Corporation of India Ltd. (PGCIL) looks after the linkages with the regional grid and inter regional power transfer.

APTRANSCO was further unbundled, delinking the function of distribution and retail supply of power. For this purpose, the state of Andhra Pradesh was carved into four geographical contiguous distribution zones (East, South, Central and North) and the distribution and retail supply undertaking and business was segregated into and vested respectively with the four distribution companies (DISCOMs).

iv. Andhra Pradesh State Electricity Regulatory Commission (APSERC)

Earlier the State Government had control over fixing the tariff. The enactment of the Electricity Regulatory Commission Act (ERC), 1998 led to the setting up of the Central Electricity Regulatory Commission and State Electricity Regulatory Commissions, which took over the state's power of deciding the tariff. The Government of Andhra Pradesh passed AP State Electricity Regulatory Commission, restructuring the electricity industry and provided avenues for more private sector participation. Following this, the Andhra Pradesh Electricity Regulatory Commission (ERC) was set up as an independent and autonomous body to set the tariff and create an environment for dynamic and equitable growth of the electricity sector in the state.

v. Appellate Tribunal for Electricity (ATE)

Appellate Tribunal for Electricity is a statutory body constituted for the purpose of hearing cases against the orders of the Regulatory Commissions and the Adjudicating

Officer. By virtue of Section 110 of the Electricity Act, 2003 (Central Act 36 of 2003), an Appellate Tribunal for Electricity having jurisdiction throughout India has been set up to hear appeals or original petitions against the orders of the Adjudicating Officer or the Central Regulatory Commission or State Regulatory Commission or joint Commission constituted respectively under Section 76(i) or 82 or 83 of the Act. The Tribunal is conferred with original jurisdiction to hear petitions under Section 121 of the Act and issue directions to all Commissions for the performance of their statutory functions. This Tribunal has been established by the Ministry of Power, Govt. of India w.e.f. 7th April, 2004. This Tribunal ordinarily sits at Delhi.

2.5 IMPACT OF GOVERNMENT POLICIES ON BIOMASS POWER PLANTS

For promotion of generating electricity from renewable resources, the Government of India (GOI) formulated policies during the year 1993-94 for giving incentives for Biomass power plants. The incentives included capital/interest subsidy for setting up of Biomass power plants. Further the policy gave a framework for fixation of tariff payable for power generated from Biomass power plants with effect from 01-04-1994 with a provision for escalation year-on-year.

The Government of India has set up a Ministry of Non-conventional Energy Sources (MNES) exclusively for implementation and monitoring the aforesaid policy framework. In addition, Indian Renewable Energy Development Agency (IREDA) was also set up to provide financial assistance on softer terms to the Biomass power plants. The Government of India also directed the State Governments to prepare their own policy frameworks including the tariff payable for promotion of power generation by Biomass power plants

Uniform incentives to power plants based on renewable sources of energy

Accordingly, the Government of Andhra Pradesh formulated a framework for providing subsidies and fixation of tariff, vide GO.Ms.No. 93 dated 18-11-1997. The incentives are

presented in Table 2.3 and the guidelines for fixation of tariff rates are presented in Table 2.4.

Table 2.3 - Source-wise renewable energy Incentives given to power plants

Sl. No.	Description	Incentives
1	Price for Power	Rs. 2.25/- per unit
2	Escalation	5 per cent per annum with 1997-98 as base year and to be revised on 1st April of every year up to the year 2000 AD.
3	Wheeling Charges	2 per cent
4	Third Party Sales	Allowed at a Tariff not lower than HT Tariff of APSEB.
5	Banking a) Captive Consumption b) Third Party Sales	Allowed up to 12 months. Allowed throughout the year on 2 per cent banking charges. Allowed on 2 per cent Banking charges from August to March

Source: MNRES Guidelines

Table 2.4 - Ministry of Non-conventional Energy Sources - Guidelines for fixation of Biomass Tariff

Sl. No.	YEAR	Tariff to be paid to Biomass Developers
1	1994-1995	Rs. 2.25
2	1995-1996	Rs. 2.36
3	1996-1997	Rs. 2.47
4	1997-1998	Rs. 2.60
5	1998-1999	Rs. 2.73
6	1999-2000	Rs. 2.86
7	2000-2001	Rs. 3.01
8	2001- 2002	Rs. 3.16
9	2002-2003	Rs. 3.32
10	2003-2004	Rs. 3.48

Source: Compiled from Ministry of New and Renewable Energy's Guidelines

Andhra Pradesh Electricity Regulatory Commission (APERC) was constituted on 03-04-1999 by Government of Andhra Pradesh as per A. P. Electricity Reform Act, 1998. The

APERC passed order on 20.06.2001 that all generators of non-conventional energy shall supply power to APTRANSCO only effective from the billing month of August 2001.

Some developers of Biomass power plants challenged the orders of APERC in the Hon'ble High Court of Andhra Pradesh regarding sale of electricity exclusively to APTRANSCO and prohibiting the third party sale. Stay orders were issued by Hon'ble High Court of Andhra Pradesh on the above issue.

Review of Biomass Tariff from 01-04-2004

The tariff payable to Biomass power generators was reviewed by the APERC in its order dated 20-06-2001 in OP.No. 1075 / 2000, after considering the following issues:

I. Whether the tariffs and incentives should be uniform for all the categories of NCE projects as provided earlier in MNES guidelines, GOAP orders and APERC's order in OP.No 1075/ 2000 dated 20-06-2001 or should they be different for different categories of NCE projects.
II. Whether the tariff should be a single part tariff or a two part tariff.
III. Whether the tariff should be project specific or uniform for all projects falling in a category.
IV. Whether there should be a cap on tariff when a project exceeds the expected minimum performance.
V. Social and environmental considerations.
VI. Control period.

The fixed cost portion of the tariff has common components like interest on loans, interest on working capital, depreciation and return on equity (ROE). But the variable cost portion varies widely on account of the raw material/fuel used. Each category of NCE projects is distinct from another in raw material consumption. Similarly the operating cost and the availability of raw material for each category vary widely. Even the free sources of energy like water and wind are not uniformly available across the State. The availability varies mainly depending on the location of the project. All these

have wide ranging influence on the tariff. Hence, the APERC considers that it may not be appropriate to fix uniform tariffs / incentives for different categories of the NCE projects.

The APERC was keen on fixing the tariff for Biomass power plants broadly in line with the following principles:

a) Transparency and interaction with the public, utility and developers.
b) Balancing the interest of all stakeholders
c) Consistency in principles and their application

The purchase price is subject to review on completion of 10 years from the date of commissioning of the Biomass power plant.

Methodology of Tariff Determination

APERC decided to fix the tariff on "cost-plus" basis so that each element of fixed and variable cost is properly compensated. The key issue involved in determination of tariff in case of projects is whether to consider single part tariff or two part tariff. The APERC recognizes the fact that two part tariff will be difficult to implement in view of the large number of the plants of low capacity. But at the same time, the APERC considered that beyond the threshold level of generation, the developers should get only variable cost (if any) and incentives and not the fixed charges. The APERC would also like to determine the tariff for all the projects of one category based on the year of commissioning of each project.

Operating Parameters

APERC fixed the tariff taking into account both variable cost and fixed cost to the Biomass developers who entered into long-term power purchase agreement with APTRANSCO based on certain operating parameters as detailed below. To make the plant operations more efficient and to keep in line with the guidelines provided in the

prescribed parameters, the biomass developers should have thorough knowledge of all the operating parameters.

Variable Cost – Operating Parameters:

The variable cost operating parameters are : {a} Specific Fuel Consumption (SFC);{b} Gross Calorific Value (GCV); {c} Station Heat Rate (SHR); {d} Fuel Price ; {e} Auxiliary Consumption.

{**a**} **Specific Fuel Consumption (SFC):** Specific Fuel Consumption is the quantity of biomass fuel required to be consumed to generate one unit of power. It is measured in Kilograms per kWh. SFC is derived by a formula: SHR / GCV. In rainy / moistened conditions the SFC will be 1.85 -2.0 Kgs / kWh and in the dry season the SFC will be 1.45 -1.60 Kgs / kWh. So, the yearly average SFC in most of the biomass power plants is 1.75 Kgs/ kWh. whereas State Electricity Regulatory Commission (APERC & TSERC) is considering only 1.35 kg of biomass to generate 1 kWh of power for calculating the Variable Cost in the tariff. Eventually the biomass developer has to daily incur a loss of 0.40 Kgs biomass cost on every unit of power generated from biomass power plants. It is suggested that the State ERCs considers at least the minimum SFC of 1.60 Kgs/ kWh against their present decision of 1.35 Kgs / kWh for all the biomass power plants.

{b} Gross Calorific Value : It is the heat produced by combusting a specific quantity and volume of fuel in an oxygen-bomb calorimeter under specific conditions which is known as the gross calorific value. Fuel should be compared based on the net calorific value. The calories or thermal units contained in one unit of substance and released when the substance is burned is known as the calorific value. The word “Gross” here signifies that the water formed and liberated during combustion in the liquid phase. The Gross Calorific Value (GCV) supposes that the water of combustion is entirely condensed. The heat contained in this water is recovered. This heat is called latent heat of condensation. So in addition to the normal amount of heat liberated on burning, latent heat is also added. Thus there is increase in the amount of heat available in the gross calorific value.

The Net Calorific Value (NCV) supposes that the products of combustion contain the water of combustion to the vapor state. The heat contained in this water is not recovered. Instead of condensing the steam, if we are allowing it to let it go, there will be no latent heat of condensation. So, on comparing it to the gross calorific value, its amount of heat will be less. This is called Net Calorific Value.
NCV = GCV – Latent heat of condensation.

The moisture content present in the biomass fuel and gross calorific values are inversely proportional in nature. Higher is the moisture content, lower is the gross calorific value. Most of the biomass fuels are collected from fields which will have moisture levels ranging from 15-50per cent. When the fuel is dried in the open fuel yard, the inherent moisture will be evaporated. Otherwise with so much of fuel, if the biomass fuel is stored in closed sheds, either it will be decomposed or burnt off due to the development of self ignition within the heaps. Thus there will be moisture loss or decomposition loss in the high moistened material.

APERC considered the GCV on fired basis which means what the biomass fuel is being fed to the boiler furnace as 3100 kg/ kWh. But most of the biomass fuels at the time of purchase will have a GCV of 2700-2800, as the moisture levels are high. The moisture content in the fuel, increase the fuel weight in as purchased condition .So, it is noted that 1MT of fuel in an as-fired condition would require 1.372 MTs fuel to be purchased.

{c} Station Heat Rate (SHR): It is the product of GCV and SFC(GCV *SFC).The state APERC considered the required station heat rate parameter to generate 1 kWh of power as 4200 Kcal/ kWh. Care shall be taken in the procurement, drying and mixing the biomass fuel to get the demarcated SFC of 1.354 Kgs/ kWh and GCV of 3100 Kgs / kWh. If the biomass contains lot of moisture and feed it to the boiler, the SFC will be high and eventually the SHR will go beyond the limit of 4200, which results in the increase in the Fuel cost. Ideally the GCV of the biomass shall always be at 3100 even at the time of procurement or while feeding. The concept of right and effective biomass fuel

combination will keep these three parameters: SFC, GCV and SHR at desired limits and result in the lowest / ideal fuel cost.

{d} Fuel Price : The biomass fuel cost has been increasing very fast for the last 10 years. The rice husk price in the season (December-August) : Rs.2200- 2500 /MT and in the off-season (September – November): Rs.2800-3300 /MT. The woody biomass price : Rs.1600-1800 /MT. The Palm oil bunches: Rs.850-1200/MT. The Maize cobs : Rs.2200-2500 /MT. Saw dust / Coconut fibre : Rs.1000/MT. The Cotton / Chlli stalk : Rs.850-1000 /MT. Based on the fuel combination weighted averages, ERC decided the present 2014-15 Biomass fuel price as Rs.2834/ MT with yearly escalation of 6per cent. The procurement department shall keep this guideline and restrict the average fuel price. Moisture, storage and inventory losses will mount up the fuel cost.

{e} Auxiliary consumption: The existing operating power plant machinery like various motors, chippers, saw mills, lighting equipment, fans, air conditioned equipment consume certain portion of power out of the total power generated by the power plant . This parameter is fixed by ERC as 12 per cent. The power exported to the buyer is: Power generated Minus Auxiliary consumption. If the auxiliary consumption is more than 12 per cent, the quantum of power exported will be less to that extent and leads to less revenue. So, the regular checking, maintenance of the plant and machinery is highly essential. Austerity measures are to be brought in, to cut down the auxiliary consumption.

The variable cost portion of the tariff is decided by the management of these above four parameters.

Variable Cost = SHR * Fuel cost / GCV*(1-Auxiliary Consumption)10.

Fixed Cost - Operating Parameters:

The parameters considered for calculating the fixed charges are, (i) Project Cost; (ii) Plant Load Factor (PLF); (iii) Auxiliary Consumption ; (iv) O&M Expenditure and

Escalation ; (v) Debt Equity Ratio; (vi) Depreciation; (vii) Interest on Term Loan; (viii) Return on Equity; (ix) Interest on Working Capital; (x) Incentive.

i. Project Cost: Project cost is the original cost at the construction period. It is fixed as Rs.4.0 Crores / MW.

ii. Plant Load Factor: Plant Load Factor (PLF) of the biomass power plant depends on factors like age of the plant and growing uncertainties in the nature and quality of available biomass fuels. Factors influencing PLF are detailed below:

- When agricultural residue is used in the boilers, the phenomenon of super heater corrosion sets in. This leads to monthly stoppage of the power plant due to choking of super heater coils. It further reduces PLF.

- Due to the seasonal nature of the biomass fuel and its low bulk density, most of the biomass is stored in the open area. This leads to increase in moisture to an extent of 35-50per cent in the biomass fuels during the rainy season. Under such a circumstances, the boiler cannot achieve its full load which will further reduce the turbine load.

- The calorific value of the fuels used change continuously, rendering combustion controllers ineffective.

- The presence of certain sodium salts in the fuels used, which have low melting point, causes deposition of ash to take place in the super heater area leading to erosion, corrosion, heat transfer and combustion problems.

- Because the plant is run on mixed fuels (with continuously varying calorific value and proportions) maintaining ideal air fuel ratio at all times is impossible.

- The fibrous nature of some of the biomass fuels (woody biomass and all farm residues) and because of low bulk density, they are not free flowing and tend to jam when stored in a bunker. Therefore, controlled feeding of these fuels to the furnace is not possible.

- The above problems lead to constant fluctuations in temperature and pressure of flue gas across the boiler, which ultimately leads to inefficiency and failures.

- Evacuation issues beyond the plant's control and related to the condition / operation of the grid by the licensee.

Keeping the above issues in mind APERC fixed the PLF norm as 80 per cent for all biomass power plants.

i. Auxiliary Consumption: It is the power used by the power plant for operating its own machines during the power generation. It is fixed as 10per cent.

ii. O & M Expenditure and Escalation: O&M expenditure is fixed as 5.5 per cent of the capital cost for the first year which is escalated by 6.69 per cent every year. Accordingly, the expenditure that could be allowed for the 11th year of operation comes to Rs 42 Lakhs per MW. The same works out to 10.5per cent of the original capital cost of Rs.4 Cr per MW and 37per cent of the depreciated capital cost of Rs 1.13 Crores per MW at the beginning of the 11th year.

iii. Debt and Equity Ratio: Debt is the funding from the financial institution as 70per cent and Equity is the investment by the developer as 30per cent.

iv. Depreciation: The parameter is fixed as depreciation rates i.e., 7.84per cent for the first 8 years; 7.28per cent for the 9th year and the balance 20per cent of the

project cost spread evenly over remaining 11 years of Biomass Power Projects. By this regime, 70 per cent of the value is depreciated in the first nine years and 20per cent during the succeeding 11 years leaving a residual value of 10per cent at the end of the 20th year.

v. Interest on Term Loan: In general, as per the bank loan conditions, it is a practice that the Term loan shall be cleared within the first ten years period of operation. The interest on term loan during 1st ten years of operation is considered as 12per cent. If some other project developers have taken incremental loans over and above their initial borrowing and consequently they have been unable to fully amortize their debt, then it is possible that this additional debt could be attributable to inefficient management/operation of the power plant. Consequently, interest on outstanding long term debt beyond the 10th year will not be considered.

vi. Return on Equity: ROE is considered as 16per cent throughout 20 years period of operation while allowing for a pass through of the Income Tax / MAT.

vii. Interest on Working Capital: The working capital comprises (a) Fuel cost for one month computed at threshold PLF (b) O&M expenses for one month (c) Receivables from Transco for 2 months at threshold PLF (d) Maintenance spares at 1per cent of the project cost. The interest on working capital is fixed as 12per cent.

viii. Incentive: To further promote and encourage Biomass project developers, an incentive of Rs 0.50 per unit for all generation above 80per cent PLF would be paid by the DISCOM concerned.

Thus in 2004-05, the initial MNES guidelines based biomass power tariff of Rs.3.48 /unit was revised down by APERC Order O.P.No: 1075/2000 dated 20.03.2004 to Rs.2.80 / unit of exported power (VC: Rs.1.27 + FC: Rs.1.53) which devastated the entire Biomass

power industry. The APERC Specific Fuel Consumption (SFC) was only1.16 Kgs/ kWh whereas the actual operating SFC was 1.75 Kgs/ kWh. Accordingly as against the APERC variable cost of Rs.1.27 / unit power in 2004-05, the biomass developers were incurring Rs.2.00 / unit. So there was a straight Rs.0.73 Paisa loss / unit power on Variable cost. If any of the biomass power plant was generating 35,00,000 units of power in a given month, the operation loss was Rs.26.00 Lakhs / month.

Thus so many biomass developers faced financial crunch during 2004-2006 and eventually either the biomass power plants became Non-Performing Assets by not paying term loan with interest to the financial institutions or closed / sold out as the severity of financial problem increased further. Since there was no other go for the Biomass Energy Developers Association (BEDA) approached the High court and Supreme Court on the tariff dispute case with APTRANSCO, which is still pending as of 2014. The stringent government policy on Tariff fixation coupled with ban on third party sale of power by biomass developers, pushed the flourishing 2004 period of biomass industry into doldrums.

The Biomass Energy Developers Association filed a writ petition no: 16621of 2004 in High court against the APERC Order:O.P.No: 1075 /2000 as without jurisdiction, contrary to law, arbitrary irrational, unreasonable and violative of the principles of natural justice and consequently to set aside the order dated 20.03.2004.

The High court ordered that, pending further orders, it s open to the Transmission Corporation to implement the revised tariff. However, in addition to the rates payable under the revised tariff the petitioners shall be paid 50 per cent of the differential amount between the old and revised tariff (Rs.3.48 – Rs.2.80 = Rs.0.68 paisa x 50 per cent = 0.34 paisa) for the actual power supplied by the biomass developers with effect from 20.09.2004.The additional amounts so paid shall be subject to further orders in the writ petition. It is also made clear that 50 per cent of the differential amount shall be worked out as per the rates applicable to the respective categories of Non-Conventional Energy

power projects. Thus the biomass developers were paid by APTRANSCO a tariff of Rs.2.80+ Rs.0.34 paisa= Rs3.14 / unit power exported from 20.09.2004.

2.6 ADVERSE IMPACT ON BIOMASS POWER INDUSTRY IN AP

Up to March 2004, the biomass developers were paid the tariff of Rs.3.48 /unit as per MNEs guidelines. From 1.04.2004 onwards APERC announced the two way Tariff (Variable Cost + Fixed Cost) by introducing certain operating parameters for fixing the tariff. These parameters were highly theoretical and very new to the biomass developers. Based on the newly introduced parameters from 01.04.2004, the biomass power Tariff was reduced from Rs.3.48/unit to Rs.2.80 /unit (Variable cost: Rs.1.27 + Fixed Cost: Rs.1.53).

During 2004, the biomass developers were vey new to the biomass power plant operation and could not operate their power plants in line with the operating parameters fixed by APERC. The Specific Fuel Consumption parameter concept was not properly understood and followed in biomass plant operation in the initial years of operation by the developers. APERC SFC guideline was 1.16 Kgs/ kWh, where as the actual SFC in the field was 1.75 Kgs/ kWh. Eventually the actual Variable cost of the biomass power generation was as high as Rs.2.00 / unit whereas the APERC fixed it as Rs.1.27 / unit.

Due to the introduction of Fixed cost theory into biomass power tariff, APERC brought 80 per cent PLF and not allowed the biomass developers to get the full tariff for the power exported beyond 80 per cent PLF**.** As per APERC tariff order, full variable cost + fixed cost will be paid up to 80 per cent PLF power export and for the power export beyond 80 per cent, only VC will be paid with an incentive of Rs.0.25 paisa in place of FC.**(d)** With the restriction not to sell the biomass power to third party that is other than APTRANSCO, the biomass power developers could not operate their power plants at continuous losses and were in total confusion.

Almost each biomass power plant, which could not implement the operating parameters, incurred an operation loss of Rs.20-25 Lakhs each month and thus the biomass power plant developers faced severe financial problems. The biomass developers, with deep financial crunch, stopped operating power plants. Few plants became NPA and some of the developers sold out their biomass power plants. Simultaneously the Biomass Energy Developers Association (BEDA) approached APERC, Appellate Tribunal for Electricity, High Court and Supreme Court in 2005-06 and filed cases against the APERC order in 2004.

i. Fixation of Fixed Cost from 1st year to 20th year of operation

The details of the fixed cost for the period from 1st to 20th years of the operations of biomass power plants as determined by the APERC are presented in Table 2.5.

Table 2.5 - Fixation of Fixed Cost from 1st year to 20th year of operation

YEAR OF OPERATION SINCE COMMENCEMENT OF UNIT	FIXED COST (Rs./ unit)
1st	1.77
2nd	1.74
3rd	1.72
4th	1.69
5th	1.67
6th	1.67
7th	1.65
8th	1.64
9th	1.59
10th	1.23
11th	1.25
12th	1.31
13th	1.37
14th	1.43
15th	1.49

16th	1.56
17th	1.64
18th	1.71
19th	1.8
20th	1.89

Source: Compiled from various APERC Orders.

Incentive on generation beyond threshold PLF of 80 per cent is payable by APDISCOMs at the rate of Rs. 0.35 Paisa / kWh.

ii. Fixation of Variable Cost:

The details of the variable cost for the period from 2004 – 05 to 2013 – 14 as determined by the APERC are presented in Table 2.6.

Table 2.6 - Variable Cost tariff for the period of 10 years from 2004-05 to 2013-14

Financial Year	Variable Cost (Rs. / Unit)
2004-05	**1.97**
2005-06	**2.09**
2006-07	**2.21**
2007-08	**2.35**
2008-09	**2.49**
2009-10	**3.03**
2010-11	**3.18**
2011-12	**3.34**
2012-13	**3.51**
2013-14	**3.68**

Source: Compiled from the orders of APERC

While determining the variable cost tariff as mentioned above, the APERC did not revisit the various parameters towards fixation of variable cost except in respect of cost of fuel, which changes with time. Further, what needs to be noted is that the order dated 31-

03-2009 mentioned *supra* was made, inter-alia, also subject to the final order of the Hon'ble Supreme Court of India in Appeal before it against the order of the Hon'ble APTEL dated 02-06- 2006.

Subsequently, by judgment dated 08-07-201 in C.A Nos. 2926 / 2006 &.batch, the Hon'ble Supreme Court set aside the impugned judgment of Hon'ble APTEL dated 02-06-2006 and remanded the matter to the APERC directing, *inter-alia*, that the Commission shall hear the non-conventional energy generators afresh and fix/ determine the tariff for purchase of electricity.

In pursuance thereof, the APERC heard the parties afresh and passed three different orders which were communicated under cover of a letter dated 12-09-2011. On the appeal filed against the same before the Hon'ble APTEL. The Hon'ble APTEL had passed judgment dated 20-12-2012 in Appeal No.166 of 2011 and batch, inter-alia, determining the various parameters for the determination of tariff and directing the APERC n to pass final order for the tariff accordingly.

Pursuant to the order dated 20-12-2012 and order dated 30-04-2013 of the Hon'ble APTEL, the APERC determined the tariff vide its order dated 22-06-2013, for the Biomass power plants. While the tariff for Biomass consisted of fixed cost (for 1st year of operation to10th year of operation) and variable cost (for FY 2004-05 to 2008-09). Now the task before the APERC is to give consequential effect to the order dated 31-03-2009 to the extent applicable based on the operating parameters (relevant to variable cost and to the extent applicable) determined in Hon'ble APTEL order *d*ated 20-12-2012 and order dated 30-04-2013. Other Terms and conditions of the order dated 31.03.2009 remain unmodified. For that purpose the relevant operating norms are as extracted hereunder:

2. 7 GENERAL MANAGEMENT PRACTICES BEING FOLLOWED BY THE BIOMASS POWER PLANTS IN ANDHRA PRADESH

i. Biomass Fuel Management

Biomass Fuel is the key input for operating the biomass power plant at profitable levels. The suggestions are [a] Calendarization / Yearly Biomass Fuel Procurement Plan [b] Supply chain [c] Required Quantity availability [d] Type & Quality of the fuel [e] Competition &Price [f] Storage [g] Processing [h] Fuel Mix / Combinations & Feeding [j] Monitoring Biomass fuel usage and accounting fuel losses.

[a] Calendarization / Yearly Biomass Fuel Procurement Plan: The biomass is procured {i} directly from farmers as agricultural crop residues like: Cotton / Chilli / Maize stalk, Pulse husk, Maize cobs, woody waste. {ii} directly from industries as waste like : Rice Husk from rice mills, Maize cobs from seed separating mills, Groundnut shell, Castor kernel from oil factory, Palm oil bunches from oil mills, saw dust from saw mills. {iii} through rising and cutting the own energy plantations from barren / waste lands. The availability of biomass fuel is highly seasonal in nature, soon after the harvest of the main crop like agricultural fields or taking the main produce at factories / industries. So, the yearly biomass fuel requirement plan based on its consumption, power production targets (daily /monthly/ yearly) the detailed procurement plan has to be worked out.

For the purpose of yearly biomass fuel procurement the biomass developers keep in mind the average fuel procurement price plan which is in line with the Power Purchase Agreement price fixed by APERC, the seasonal availability of various fuels, availability of funds for biomass material procurement.

[b] Supply chain: The suppliers of biomass fuel market are highly unorganized and there are no professional suppliers in biomass fuel markets. The material is supplied either by farmers directly or part-time / full-time agents. The suppliers will operate their biomass fuel business with insufficient funds and mostly depend on the power plant funding. Once the material is brought to biomass plant, the supplier expects cash payment for entire

material supplied. This needs the biomass developers to maintain sufficient cash balances so as to meet the purchase requirements.

[c] Required Quantity: Keeping the stiff competition in mind from other biomass power plants in the same / nearby area or from the similar industries which consume the biomass, the daily requirement of fuel has to be worked out.

Proper computerized bridge has to be installed inside the factory premises to weigh the quantity of material to be procured from various sources. Care is to be taken to check the healthiness / correctness of the weigh bridge at a frequency by the management to avoid the possible cheating / misappropriation by weigh bridge operators. Control measures have to be followed like on-line weigh-bridge monitoring and the practice of printing the photographs of the material carrying trucks before and after unloading depicting clearly the vehicle number on the weigh bridge slip. The fuel yard supervisor has to check thoroughly the admixture of sand / soil in the biomass fuel while unloading the truck at fuel yard. The guideline is that: the six tyres truck will carry only 10 MTs and ten tyres truck will carry only 17 MTs of material. If the truck is showing more weight than the above standards, then the in-charge manager shall stop the truck and verify the quality of fuel. He has to check all the weigh-bridge slips along with the invoice and payment vouchers to nip off the possible weigh-bridge manipulations by the operators.

Apart from the biomass which can be collected from various sources in the market through the supply chain, each biomass power plant developer shall also plan to hire / own the barren / waste lands to raise their own energy plantations. The quick and profusely grown hybrid energy plantations / clones have to be planted, cut, processed and brought to the power plant site. This will ease out the biomass fuel market competition to a great extent.

[d] Type & Quality of the fuel: All the agricultural waste materials shall be procured at the best possible low level of moisture. To maintain the boiler parameters steadily in the rainy / moistened season, the high GCV coal will be added to the biomass fuel. In any given year, the government will allow for 6 MW Biomass power plants to use only 8000

MTs of coal which is 10per cent of total biomass fuel quantity and accordingly the coal permits will be issued to biomass power plants.

The government fixed the normative parameter of Gross Calorific Value (GCV) as 3100 Kcal/ kWh only. The developer is supposed to feed the biomass fuel to the boiler with GCV 3100 only. If high moistened material is procured, there will be evaporation losses from the material on storing it in the open fuel yard. Eventually the fuel consumption (SFC) will be higher per unit of power generated. Random fuel samples have to be collected from the truck, storage point while feeding the material. These samples moisture contents have to be analyzed with the help of Bomb calorimeter in the chemical laboratory at R.O. Plant. Season-wise allowable moisture levels have to be fixed like in the summer: 10-15per cent and rainy / winter season: 15-25per cent. If the material has more moisture than the above fixed levels, accordingly the quantity of the material has to be adjusted / deducted and payment has to be made to the supplier based on the moisture analysis slip given by the chemist / analyst. Care has to be exercised to balance the moisture levels in the biomass fuels at the time of procurement itself.

As already stated, certain biomass fuels will have moderate sulphur, oil, alkaline which have low melting point which causes deposition of ash to take place in the super heater coil area leading to corrosion, erosion, heat transfer and other combustion problems and also spoils the super heater coils and economizer tubes very often. Whenever fuels like Begalgram husk, Rice husk or Palm oil bunches are fed continuously, cleaning and repairing of the super heater coils and economizer tubes have to be planned.

[e] Competition & Price: Availability of the biomass material is seasonal and insufficient which influences the price of agricultural residues. In addition, the power crisis in the state for the last 10 years has led to the establishment of captive power units by the paper mills, solvent extraction and other industrial units, who have obtained licenses with coal but are poaching on the agricultural residues as the coal prices have gone up substantially. These units which are not part of non-conventional energy producers are competing in Biomass power plants for the same raw material resulting in higher prices.

The biomass fuel is supplied by unorganized supply net work. It will be difficult to maintain the continuity of supplies at defined / fixed agreed fuel price. Competition for biomass fuels like Rice Husk, woody waste and maize cobs is very stiff from brick industry, paper industry and solvent plants. Hence the prices for these fuels will keep changing very frequently and widely especially in the monsoon season.

(f) Storage: The biomass fuel has to be stored and heaped systematically in the designated / demarcated fuel yard. The entire fuel yard is to be divided into A,B,C,D yards and one specific fuel has to be stored at one particular place. The arrivals dates with fuel quantities have to be noted while unloading at the storage point. This will enable to follow the First- In-First-Out (FIFO) method while consuming the fuel. This method helps in reducing the storage losses. The fuel cannot be stored in the closed sheds due to the inherent moisture content to avoid the self ignition and decomposition. Fire fighting system / extinguishers are to be provided to handle the fire accidents.

The biomass fuel shall be procured in huge quantities during the fuel available seasons like cotton /chilli stalk and woody biomass. In general 60 days requirement of biomass fuel is to be procured well in advance and stored in the open fuel yard. While storing there will be moisture losses, carpet losses and bio-degradable losses and interest on inventories. So, all types of biomass fuel storage losses have to be accounted for once in a year. Normal biomass industry standard of all losses will be 8-10 per cent.

(g) Processing: After the harvesting of mango and cashew crop, farmers remove the older orchard plantations. The main trunks will be sent to timber industry and the side branches to power plants. After the last picking in cotton and chilli crops, their stubbles / stalks / left over plant parts will be collected from the fields by the farmers and sold to the power plants during February and May every year. At Palm oil extraction factories which start from the month of May onwards, empty palm oil bunches are generally sold to Biomass power plants. These fuels need to be piled properly, chipped and dried up in the open fuel yard by the power plants. In this process raw materials like woody waste, cotton / chilly stalks, palm oil bunches, etc., are brought in the shape of uniform sized

chips to avoid boiler parameters fluctuations. Log saws, Saw mills and chippers (Drum chipper / Wood chipper / Rotor grinders) are used to chip the woody biomass and cotton / chilli stalks and palm oil bunches. Ideally 7-10 days requirement of these biomass fuels have to chipped and dried up and then only it shall be fed to the boiler to bring down the Specific Fuel Consumption (SFC). Thus, the biomass fuel processing is a very cumbersome activity which involves additional labour costs.

(h) Fuel Mix / combinations & Feeding: To maintain the constant boiler and turbine parameters, various available fuels have to be mixed properly based on their moisture contents and Gross Calorific values (GCV). The biomass fuel mix is based on its Gross calorific value and moisture levels to ensure the average required Station Heat Rate(SHR) of 4200 Kcal / kWh at boiler gate. If proper fuel combinations are not maintained, the Specific Fuel Consumption (SFC) will go up as high as (>1.80 to 2.0 Kgs / kWh) which eventually shoots up the fuel cost for generating an unit power. If the operating SFC goes beyond 1.35 Kgs/ kWh, there will be loss in operations.

In the beginning of any month, based on the fuels available at fuel yard and outside in the market, the fuel combination has to be finalized with clarity on SFC and Fuel cost to be operated for that particular month. Accordingly the fuel has to be mixed and fed to the boiler. On daily basis the fuel combinations scenario has to be reviewed and ensure that SFC and fuel cost are maintained as per the month plan.

(i)Consumption of raw material

Generally, if a biomass power plant with a capacity of 6MW at 80 per cent PLF produces 3,82,68,680 units of power, it consumes about 72,700 MTs of raw material at 1.90 Specific Fuel Consumption with an average fuel cost of Rs.1700 / per Metric Ton amounting to a total expenditure of Rs.12,35,90,000 / per year.

(j)Monitoring Biomass Fuel usage and accounting fuel losses: The biomass fuel plays a major role in deciding the profitability of the biomass power plant. So, special attention is to be given to plan the biomass fuel procurement based on monsoon vagaries and market competition. Right quality material is to be procured and stored properly in the

open fuel yard. It shall be processed, mixed to get the required the station heat rate (SHR) at boiler.

During the rainy period as the Specific Fuel Consumption will be the highest in between 1.85 - 2.0 Kgs / kWh, it is suggested to operate the power plant at low / minimum possible load or plan shut down for completing all the yearly maintenance / specific repairs. It will be better to store the biomass fuel in the four sides open sheds during the high moistened wet/ rainy period from June to August, and feed it with a combination of high calorific value coal to avoid fluctuations in boiler. It is very difficult to procure the biomass fuels from September to November, so sufficient buffer stock of 25,000 MTs biomass fuel shall be planned well in advance and stored.

In the dry period December to May, the power plant can be operated at its full capacity as all the factors will be favoring like: [i] the SFC will be the lowest (1.45-1.60 kgs/ kWh) due to the availability of dry fuel, [ii] the high calorific value Rice Husk supplies will be in plenty as the main kharif paddy crop harvest coincides, [iii] all the operating parameters can be maintained well.

ii. Operations Management:

Biomass power plants can never be operated at a stretch for 365 days in a year. It requires monthly 1-2 days and yearly 20-30 days shut down for repairs and maintenance. The operative days will be only 310 days in a year.

[a] Boiler water: Normally in majority of the plants sufficient ground water / canal / river water is available only for 9 months and the rest of 3 months particularly in March, April and May there will be water shortage (or) Salts (TDS) content will be very high. So, alternate arrangements have to be made to get the required quality and quantity of water during those 3 months also by engaging water tankers.

[b] Fuel: In general the normal operating PLFs (Plant Load Factor) will be 45-55per cent only due to various problems like fuel shortage, high fuel rates, high moisture and

sulphur / sand contents in certain fuel. So, fuel has to be managed and mixed properly to get the required Station heat rate and finally ensure the plant operations at optimum 80per cent PLF.

[c] Grid Fluctuations: Biomass power plants are located and connected to the rural sub-stations where there are high grid fluctuations which results into more stops and starts.

[d] External environment stake holders: There will be sometimes failures of ESP which results in agitations from nearby villagers. So, close monitoring is required to mitigate the fly ash and wet ash menace. Further the biomass developers have to strictly adhere to all the rules and regulations prescribed by various regulatory authorities. For strict enforcement of these rules and regulations government agencies like Pollution Control Board, Boiler inspector, Labour officer, sales tax department, forest department, APTRANSCO, etc. will visit the plant and verify records maintained. The biomass developers have to attend any queries raised by them.

iii. Maintenance Management

During the normal operating period there will be breakdowns some times and due to the aging of the plant, some parts may be worn out which needs replacement. The detailed knowledge of the equipment maintenance, regular checkups and timely (Daily/Monthly/ Quarterly & Yearly) maintenance is required which is follows.

The objective of maintenance management is to ensure that the systems are working at their optimum efficiency. It can be done by (i) early identification and locating the problem (ii) taking any preventive steps to avoid any break-down (iii) timely inspection, appropriate replacement policies for machines and their components will improve the reliability of the machines.

The untimely / poor / no maintenance will result in (i) breakdown of one equipment hinders the entire production process (ii) If it breaks, repairing it is very expensive.(iii)

malfunctioning of the equipment will affect the efficiency (iv) workers become idle during breakdown time , results into the increase of Unit cost power generation.(v) sometimes the machine failures can lead to accidents.

The basic maintenance decisions are: (1) Whether to centralize / decentralize, i.e., who has to plan and monitor the repair- either the local plant team or head office. Big issues like change of turbine / boiler any total equipment will be planned by head office. Other regular / routine will be planned by local team. (2) Who are organizers of the maintenance? : Contract agent or In-house technical team (3) Based on the funds and time availability, the decision of repair or the replacement of the equipment is implemented. (4) on some occasions we shall also take the decision of an individual or group replacement of the equipment, like whether to repair / replace only turbine or with coupling / the generator also.

There are three types of maintenances: [a] Preventive / Predictive [b] Remedial/Break-down/ Corrective maintenance. [c] Opportunity Maintenance.

[a] Preventive / Predictive Maintenance: since “prevention is better than cure” biomass power plants give utmost preference to preventive/predictive maintenance.. The deterioration of the equipment is the result of over time usage, wear & tear, improper usage, overloading and the aging of the equipment. The indications which direct the plant to go for the Preventive / Predictive maintenance are: (i) reduction in production rate (ii) reduction in efficiency (iii) reduction in the operational life a machine (iv) increase in noise, vibration, temperatures, corrosion, leaks, consumption of fuel and electricity during operation of the equipment which can be understood by reading the daily log sheets very closely. The preventive maintenance can be time bound like: Periodic Preventive maintenance can be by organizing at regular intervals–daily, weekly, fortnightly, quarterly and annually maintenances It can also be organized at irregular method of maintenance like-routine inspection reveals necessity for tasks like overhauls, cleaning and repairs. Before the beginning of each shift the technical staff shall go through the maintenance check list, inspect machines thoroughly and adjust in incase of

any error in the machine. The costs of preventive maintenance will be for spares parts, costs of instruments used in condition monitoring, etc.

[b] Remedial / Break-down / Corrective Maintenance: Break-down occurs when the components of the machine are worn out, lubrication is insufficient, cooling system fails, voltage fluctuations, electricity surge, use of improper or sub-standard material, poor or mishandling of the equipment, etc. The remedial maintenance is organized to get the equipment back into operation as quick as possible, to minimize production losses, to minimize the investment in spare parts and standby machines and when the equipment is broken or under repair.

[c] Opportunity Maintenance: It is done when the equipment is at idle due to other equipment repairs. It is purely unscheduled and not based on any condition but it is to make use of other equipment repair opportunity time. It may bring benefits like reduction in stoppage due to scheduled preventive maintenance activities. The developer shall be careful in maintaining health of the equipment to avoid more costs on repairs. Whenever there is a need for major / scheduled maintenance, it shall be ensured to procure all the required spares well in advance along with the right / strong repairing technical team to keep the repair expenses as per the plan. The regular training programmes are organized for the in-house technical team on the improvements / updates of the equipment repairs.

iv. Human Resource Management:

Highly technically qualified engineers may not show interest to join the power plants as they are basically located at interior places / villages. Mostly people with diploma / ITI trained / with 2-3 years operational knowledge and the local graduates may be interested to join in biomass power plants. So they shall be trained, monitored and motivated to keep up the machinery well. Department wise man power requirement has to be assessed, the right persons have to be recruited and deployed for the right posts.

(a) Qualitative assessment of employees: The department heads / supervisors shall closely assess the technical knowledge level of each of their team members. They shall

be guided on the job / spot and organized review meetings to make them understand the technical and operational details each equipment / function along with the Preventive / predictive maintenance. The technical team members or operators are made responsible to follow religiously / strictly the scheduled checks for maintenance of each equipment. Incentive schemes are to be announced for the team members who are doing systematically 100 per cent the maintenance schedules, increasing the life of the equipment, operating the equipment at full efficiency and adding skills / studying courses to upgrade their knowledge.

(b) Quantitative Assessment of Employees: In every department specific standards are to be designed for each equipment / function operation. As against the standard parameters of the equipment the employee performance has to be gauged and the savings of each employee in the operation of his equipment calculated.

During the performance appraisals time, based on qualitative and quantitative assessment, special rewards / promotions are also to be given to the team members. Yearly performance incentives, bonus and promotions or special rewards are to be announced to the team members to keep the morale / motivation levels of the employees high. The employee health and safety has to be taken care of by the developer by providing them the health insurance schemes, uniform and protective equipments like shoes / helmets to all the factory employees. Recreation and family get together with all the employees create high sense of belonging.

It is always better to retain and promote the employees instead of bringing / recruiting outsiders into the company as and when there are vacancies. By such internal / in-house promotions, team spirit and responsibility of each employee can be improved. It is the prime responsibility of the developer to create good working atmosphere at each Biomass power plant.

iv. Administration & Financial Management:

The management has to bring strong reporting systems in the operation of the biomass power plant. They are Management Information System (MIS), Daily log books at Control room to monitor various equipment. The daily fuel procurement vouchers shall be supported with Photos taken at weigh-bridge, moisture analysis reports and fuel yard supervisor certification of material unloading at fuel yard. Daily consumable registers are to be maintained by the store-in-charge. The daily production data like Power generation, export and auxiliary consumption with the detailed parameters performance like SFC, fuel average cost, total fuel cost, administrative expenses and finance charges have to be monitored and recorded.

In the beginning of the financial year a detailed parameters plan / objectives like Power Export target, SFC, Average Fuel cost, unit cost are to be defined. The yearly calendarization of biomass fuel procurement, consumption and closing stocks chart has to be finalized based on the power export target for that particular year. The monthly / yearly cash flow chart has to be prepared for the operations. Accordingly budgets are to be provided for monthly fuel procurement, administrative expenses, and routine / planned maintenances expenses, etc.

A detailed daily review shall be organized on the performance of all the operating parameters like SFC, Average fuel cost, implementation of Fuel combination plan. Daily man power deployment for various processing activities at power plant and consumption of the consumables is monitored very closely. Accordingly the funds are to be provided to the power plants on daily basis.

*****