

Sustainable Bioenergy Solutions for Tomorrow (BEST) – Case India: Madhya Pradesh, Maharashtra and Tamil Nadu

WP 2 Radical improvement of bioenergy supply chains

Task 2.3: Challenges and opportunities in the utilization of Indian biomass resources

Subtask 2.3.4: The challenges of biomass use in India

Report on

**Development of Bioenergy Policies in India within the
Framework for National Energy Policies and Strategies**

&

**Overview of Bioenergy Policies and their Implementation in
Madhya Pradesh, Maharashtra and Tamil Nadu**

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Chapter 1

1. Development of bioenergy policies in India

1.1 Introduction

The Indian economy is the ninth largest economy in the world, driven by a real GDP growth of 8.7% in the last 5 years (7.5% over the last 10 years). This high order of sustained economic growth is placing enormous demand on its energy resources. The demand and supply imbalance in energy is pervasive across all sources requiring serious efforts by Government of India to augment energy supplies as India faces possible severe energy supply constraints (Energy Statistics 2013). A projection in the Twelfth Plan (2012-2017) document of the Planning Commission indicates that total domestic energy production of 669.6 million tons of oil equivalent (Mtoe) will be reached by 2016-17 and 844 Mtoe by 2021-22. This will meet around 71 per cent and 69 per cent of expected energy consumption, with the balance to be met from imports, projected to be about 267.8 Mtoe by 2016-17 and 375.6 Mtoe by 2021-22 (Energy Statistics 2013). The total installed capacity for electricity production of the country as on 31.12.2011 was 186655 MW (**Figure 1**) and the renewables was about 11% (**Figure 2**). Renewable power production comprised of 14104.62 MW from wind, 3120.83 MW from small hydro plants, 2787.63 MW from biomass power & biomass gasifiers and 149.16 MW from solar power & urban & industrial waste (National Electricity Plan 2011).

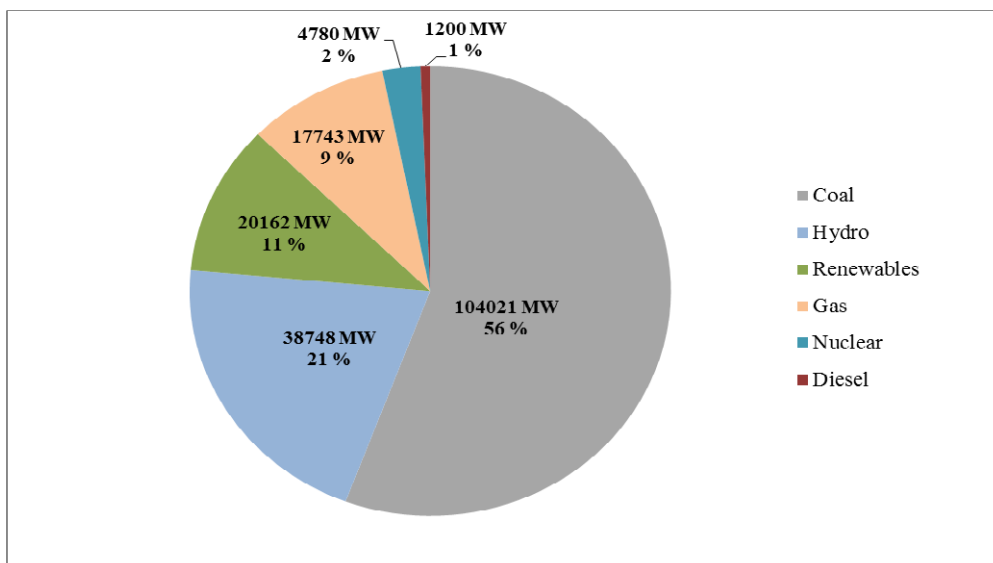


Figure 1. Total installed capacity for power production in India (as on 31.12.2011). *Source: National Electricity Plan, 2012 (Volume 1 Generation).*

Combustible renewables and waste constitute about one fourth of Indian energy use. This share includes traditional biomass sources such as firewood and dung, which are used by more than 800 million Indian households for cooking. India faces a significant challenge in providing access to adequate, affordable and clean sources of energy, especially cooking fuel to a large section of the population, most of who live in rural areas. As per the 2011 Census, almost 85% of rural households were dependent on traditional biomass fuels for their cooking energy requirements. National Sample Survey 2009-10 reveals the continued dependence on firewood in rural areas for cooking, with percentage of households depending on firewood remaining at 76.3% in 2009-10 – a

drop of only 2 percentage points since 1993-94. On the other hand, the incidence of dependence on firewood for cooking in urban areas has fallen from about 30% to 17.5% between 1993-94 and 2009-10 – a drop of more than 12 percentage points (National Electricity Plan 2011). This implies that the role of bioenergy will remain significant in rural areas for a foreseeable future and therefore, there is need for policies and action plans to develop modern bioenergy sector in the country to cater the needs of a very large population.

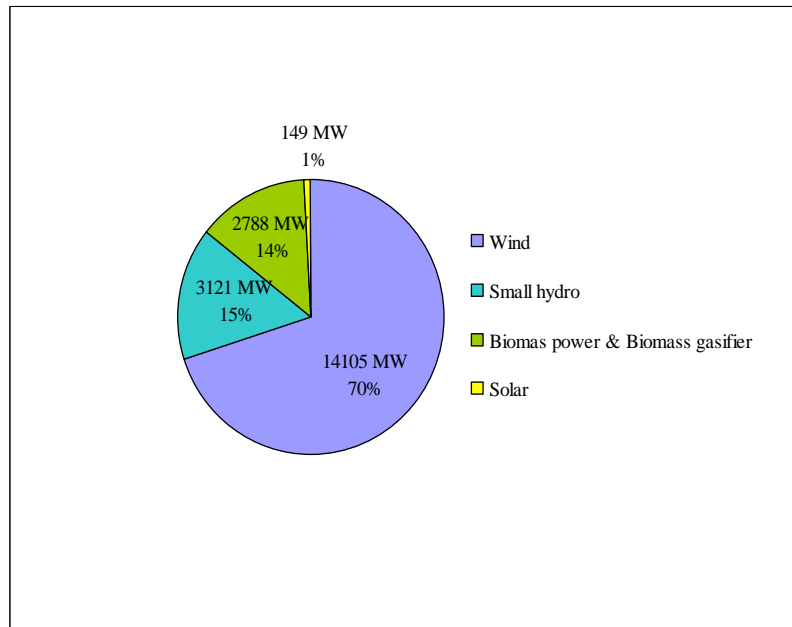


Figure 1. Total installed capacity for renewable power production in India (as on 30.06.2011). *Source: National Electricity Plan, 2012 (Volume 1 Generation).*

1. 2. Bioenergy related policies in India - progress

The Government of India (GoI) has been trying to develop the bioenergy sector in the country through formulating various policies and action plans since the last decade. At the beginning there was no specific policy for bioenergy and the GoI addressed the issue through broad renewable and non-conventional energy related policies and strategies. The Electricity Act 2003 directed the Central Government to develop power systems in the country based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy. After that, a number of specific policies and strategies have evolved related to bioenergy and other renewable energy sectors in India such as the National Biofuels Policy 2008. The following sections provide an overview of all those policies, plans, and strategies that are relevant for the bioenergy sector in the country.

1.2.1 The Electricity Act 2003 [No. 36 of 2003]

The Electricity Act 2003 came into being on 26 May 2003 in India. The Act consolidates the laws relating to generation, transmission, distribution, trading and use of electricity by taking measures that are conducive to development of electricity industry, promote competition, and protect interest of consumers and supply of electricity to all areas. The Act aims to rationalize electricity tariff, ensure transparent policies regarding subsidies, and promote efficient and environmentally benign

policies. The Act also paves the way for the constitution of the Central Electricity Authority, Regulatory Commissions and Appellate Tribunal. The Act directs that *Central Government shall, from time to time, prepare the national electricity policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy.* The Act also directs that the Authority (i.e. Central Regulatory Authority) shall prepare a National Electricity Plan in accordance with the National Electricity Policy and notify such plan once in five years.

Under The Act, each State (except Jammu and Kashmir) has been given the power to specify terms and conditions for the determination of tariffs for electricity produced within the State. In each State, the State Electricity Regulatory Commission will be formed to discharge, among others, the functions such as determining the tariff for generation, supply, transmission and wheeling of electricity; regulating electricity purchase, procurement, distribution, and pricing; and promoting cogeneration and generation of electricity from renewable sources of energy and also purchase of electricity from such sources [Section 82 (1) and Section 86 (1)]. In addition, the Section 4 of The Act specifies that the Central Government shall, after consultation with the State Governments, prepare and notify a national policy, permitting stand-alone systems (including those based on renewable sources of energy and non-conventional sources of energy) for rural areas.

1.2.2 National Electricity Policy 2005

1st National Electricity Policy of India, developed by the Ministry of Power, came into being on 12 February 2005 in compliance with the Section 3(1) of the Electricity Act 2003. The Policy was prepared after extensive consultation with the States, other stakeholders, the Central Electricity Authority and the Central Electricity Regulatory Commission. The Policy has set the goal of adding new generation capacity of more than 100 000 MW during the 10th (2002-2007) and 11th (2007-2012) Plan periods to have per capita availability of over 1000 units of electricity per year and to not only eliminate energy and peaking shortages but to also have a spinning reserve of 5% in the system. Among other objectives, The Policy aimed to provide all households in the country access to electricity within the next five years. It also provided a short-term (five-year) framework for the National Electricity Plan with a fifteen-year perspective. The Policy among others attempted to address the issues of rural electrification, generation of electricity, co-generation and non-conventional sources of electricity (including biomass, small hydro and wind), training and human resource development, protection of consumer interests, energy conservation and environment. Private sector participation in electricity generation, transmission, and distribution was also encouraged in The Policy to fulfill its objectives. The Policy statements regarding cogeneration and non-conventional energy sources are presented in the **Table 1**.

Table 1. Cogeneration and Non-Conventional Energy Sources under the National Electricity Policy 2005 (Section 5.12).

Section 5.12.1	Non-conventional sources of energy being the most environment friendly there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. Adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.
Section 5.12.2	The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the State Electricity Regulatory Commissions (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 SERCs. 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.
Section 5.12.3	Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.

Source: National Electricity Policy 2005

1.2.3 Electricity Tariff Policy 2006

The Electricity Tariff Policy 2006 was formulated by the Ministry of Power in compliance with *Section 3* of the Electricity Act 2003 and in continuation of the National Electricity Policy 2005. The Tariff Policy came into being on 6 January 2006. The objectives of the Tariff Policy were to: ensure availability of electricity to consumers at reasonable and competitive rates; ensure financial viability of the sector and attract investments; promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risks; and promote competition, efficiency in operations and improvement in quality of supply. Regarding non-conventional sources of energy generation including Co-generation, the Tariff Policy specified some norms under *Section 6.4*, which are presented in **Table 2**.

1.2.4 Rural Electrification Policy 2006

In compliance with *Sections 4 & 5* of the Electricity Act, 2003, the Central Government announced the Rural Electrification Policy on 23 August 2006. Under *Section 2.1*, the Policy aimed at providing access to electricity to all households by year 2009; ensure quality and reliable power supply at reasonable rates; and ensure minimum lifeline consumption of 1 unit per household per day as a merit good by year 2012. The Policy encouraged setting up off-grid solutions (where grid connectivity not possible) based on stand-alone systems for supply of electricity so that every household gets access to electricity. It was further stated that *non-conventional sources of energy* could be utilized even where grid connectivity exists provided it is found to be cost effective. The Policy recommended the State Governments to prepare and notify a Rural Electrification Plan to achieve the goal of providing access to all households. Within the Policy Provisions for Permitting Stand Alone Systems for Rural Areas (*Section 8.7*), the Policy has recognized the potential for local resource based decentralized generation that exists in large parts of rural India. According to the Policy statement “*in rural areas, biomass based fuels provides 81% of domestic energy. But to use it as modern commercial energy, improvement in efficiency and increasing convenience of using it, for example through gasification, is essential*”.

1.2.5 Integrated Energy Policy 2006 (Expert committee report)

Achieving an efficient configuration of the various forms of energy requires consistency in the policies governing each sector and consistency in the pricing of different types of energy. There is

Table 2. Provisions for Non-conventional sources of energy generation including Co-generation under the Electricity Tariff Policy 2006.

1.	<p>Pursuant to provisions of <i>Section 86(1)(e)</i> of the Electricity Act, 2003, 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.</p> <p>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.</p>
2.	<p>Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under <i>Section 63</i> of the Electricity Act, 2003 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.</p>
3.	<p>The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.</p>

Source: Electricity Tariff Policy 2006

also a need for clarity in the direction in which we wish to move in aspects like energy security, research and development, addressing environmental concerns, energy conservation, etc. To address these issues in an integrated manner, the Prime Minister had directed the Planning Commission to constitute an Expert Committee to undertake a comprehensive review and to make recommendation for policy on this basis. The Committee was constituted on 12 August 2004 it submitted final report to the Planning Commission on 9 August 2006. The Committee provided specific policy recommendations for promoting renewables in the country. **Table 3** presents the policy recommendation for promoting liquid and solid biofuels.

Table 3. Specific policy recommendations to promote liquid and solid biofuels in India under the Integrated Energy Policy 2006

Biodiesel	<ul style="list-style-type: none"> • Support <i>Jatropha</i>, <i>Karanj</i> and other similar species, with incentives • Since the end objective is to promote bio-diesel and significant research is still needed to establish viable germ plasms and genotypes for bio-fuel plantations, it is recommended that the parallel route based on industrial oils be pursued immediately through a reduction in import duty to 5% for high FFA vegetable oils for conversion to bio-diesel. • Transesterification facilities set up by importers of industrial oils may also be given TTRCs. • Encourage direct and local sale of bio-diesel where feasible. This can begin with the metro towns. • As a green fuel make bio-diesel free of excise and levies charged on fossil fuel-based diesel. • Bio-diesel and/or blends of biodiesel should be sold with full disclosure and priced differently from pure fossil fuel based diesel.
Ethanol	<ul style="list-style-type: none"> • Set import tariff on alcohol independent of use and at a level no greater than that for petroleum products. • Require that oil companies may blend up to 5% of ethanol with petrol but do not mandate oil companies to do so. • Price ethanol at its economic value vis-à-vis petrol but not, in any event, above its import parity price. • Companies in India such as Praj Industries and International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) have developed commercial varieties of sweet sorghum. To encourage alternate routes to ethanol, such production may be procured at the full trade parity price of petrol for 5-7 years instead of being purchased at its true economic value based on calorific content duly adjusted for improved efficiency. • As a green fuel, however, government may wish to waive all or part of the excise and levies charged on petrol to the extent that it contains ethanol. However, bulk of the benefit must be passed on to the consumer.

	<ul style="list-style-type: none"> • Petrol pumps must declare if they are selling blended petrol and price it differently. • Incentivize cellulosic ethanol with investment credits
Fuelwood plantation	Cooperatives should be encouraged and facilitated to grow tree plantations in villages. Cooperatives which are open to all members of the community should be given government land on a long-term lease. Women should be encouraged to set-up and manage such plantations so that the time they now spend in gathering fuel can be spent productively in a way that empowers them. They should also be provided finance. If organized and managed properly, such plantations are economically viable and successful as shown by the experience of National Tree Growers Cooperatives Foundation. Field based NGOs could also be involved in this activity. To encourage large-scale plantations, based on contract farming, the corporate sector could be incentivized to build wood based power plants with assured access to benefits announced under the liberal captive policy enunciated in the Electricity Act, 2003.
Electricity from wood gasification	This process can provide electricity based on gasification of wood and can be very useful especially in remote villages. The same set of policies indicated for micro hydel and wind power plants should be followed here.
Community biogas plants	Biogas plants have been promoted for families with 5 or more cattle head to obtain 2 to 3 cubic meter of gas per day. The estimated potential is 14 million plants. This leaves out the dung of all those who have fewer animals and also wastes the surplus gas that may be produced in warmer months. The real potential of biogas is thus in community level plants. To encourage private or community entrepreneurs to set these up, they need to be provided land and finance. Also to have the willing participation of all the cattle owners in the community requires an appropriate operating strategy. The essential policy required is the provision of land and finance.
Family size biogas plants	If fuel efficient cooking utensils and methods, with which 60% to 70% energy can be saved, are used than even a biogas plant with one or two cattle heads can provide the bulk of required energy for a family's cooking. This would avoid the institutional complexity of operating community level biogas plants. Trials with small biogas plants and energy efficient cooking should be carried out to examine their acceptability.

Source: Integrated Energy Policy 2006 (Expert committee report)

1.2.6 National Policy on Biofuels 2008

National Policy on Biofuels was announced by the Ministry of New and Renewable Energy in 2008 and it was approved by the Union Cabinet in December 2009. The Policy mandated a phase wise implementation of the programme of ethanol blending in petrol in various states. The blending level of bio-ethanol at 5 per cent with petrol was made mandatory from October 2008, leading to a target of 20 per cent blending of bio-ethanol by 2017. Some of the salient features of the Policy are presented in **Table 4**.

Table 4. Salient features of the National Policy on Biofuels 2008

Strategy and approach	The focus for development of biofuels in India will be to utilize waste and degraded forest and non-forest lands only for cultivation of shrubs and trees bearing non-edible oil seeds for production of bio-diesel. In India, bio-ethanol is produced mainly produced mainly from molasses, a by-product of the sugar industry. In future too, it would be ensured that the next generation of technologies is based on non-food feedstocks. Therefore, the issue of fuel vs. food security is not relevant in the Indian context.
	Cultivators, farmers, landless laborers etc. will be encouraged to undertake plantations that provide the feedstock for bio-diesel and bio-ethanol. Corporates will also be enabled to undertake plantations through contract farming by involving farmers, cooperatives and Self Help Groups etc. in consultation with <i>Panchayats</i> , where necessary. Such cultivation / plantation will be supported through a Minimum Support Price for the non-edible oil seeds used to produce bio-diesel.
	In view of the current direct and indirect subsidies to fossil fuels and distortions in energy pricing, a level playing field is necessary for accelerated development and utilization of biofuels to subserve the Policy objectives. Appropriate financial and fiscal measures will be considered from time to time to support the development and promotion of biofuels and their utilization in different sectors.

	<p>Research, development and demonstration will be supported to cover all aspects from feedstock production and biofuels processing for various end-use applications. Thrust will also be given to development of second generation biofuels and other new feedstocks for production of bio-diesel and bio-ethanol.</p> <p>A major instrument of this Policy is that a Minimum Support Price (MSP) for oilseeds should be announced and implemented with a provision for its periodic revision so as to ensure a fair price to the farmers. The details about implementation of the MSP mechanism will be worked out carefully after consultations with concerned Government agencies, States and other stakeholders</p>
Distribution & Marketing of Biofuels	The responsibility of storage, distribution and marketing of biofuels would rest with oil marketing companies. This shall be carried out through their existing storage and distribution infrastructure and marketing networks, which may be suitably modified or upgraded to meet the requirements for biofuels.
Financing	Plantation of non-edible oil bearing plants, the setting up of oil expelling/extraction and processing units for production of bio-diesel and creation of any new infrastructure for storage and distribution would be declared as a priority sector for the purposes of lending by financial institutions and banks. Multi-lateral and bi-lateral funding would be sourced, where possible for biofuels development. Carbon financing opportunities would also be explored on account of avoidance of CO2 emissions through plantations and use of biofuels for various applications. Investments and joint ventures in the biofuels sector are proposed to be encouraged. Biofuels technologies and projects would be allowed 100% foreign equity through automatic approval route to attract Foreign Direct Investment (FDI), provided Biofuels is for domestic use only, and not for export. Plantations would not be open for FDI participation.
Financial and Fiscal Incentives	Financial incentives, including subsidies and grants, may be considered upon merit for new and second generation feedstocks; advanced technologies and conversion processes; and, production units based on new and second generation feedstocks. If it becomes necessary, a National Biofuel Fund could be considered for providing such financial incentives. As biofuels are derived from renewable biomass resources they will be eligible for various fiscal incentives and concessions available to the New and Renewable Energy Sector from the Central and State Governments. Bio-ethanol already enjoys concessional excise duty of 16% and bio-diesel is exempted from excise duty. No other Central taxes and duties are proposed to be levied on bio-diesel and bio-ethanol. Custom and excise duty concessions would be provided on plant and machinery for production of bio-diesel or bio-ethanol, as well as for engines run on biofuels for transport, stationary and other applications, if these are not manufactured indigenously.
Research & Development and Demonstration	Research and Development will focus on plantations, biofuels processing and production technologies, as well as on maximizing efficiencies of different end-use applications and utilization of by-products. High priority will be accorded to indigenous R&D and technology development based on local feedstocks and needs, which would be benchmarked with international efforts and patents would be registered, wherever possible.
Quality Standards	Development of test methods, procedures and protocols would be taken up on priority along with introduction of standards and certification for different biofuels and end use applications. The Bureau of Indian Standards (BIS) has already evolved a standard (IS-15607) for Bio-diesel (B 100), which is the Indian adaptation of the American Standard ASTM D-6751 and European Standard EN-14214. BIS has also published IS: 2796: 2008 which covers specification for motor gasoline blended with 5% ethanol and motor gasoline blended with 10% ethanol. BIS would review and update the existing standards, as well as develop new standards in a time-bound manner for devices and systems for various end-use applications for which standards have not yet been prepared, at par with international standards.
International cooperation	International scientific and technical cooperation in the area of biofuel production, conversion and utilization will be established in accordance with national priorities and socio-economic development strategies and goals. Modalities of such cooperation may include joint research and technology development, field studies, pilot scale plants and demonstration projects with active involvement of research institutions and industry on either side. Technology induction/ transfer would be facilitated, where necessary, with time-bound goals for indigenization and local manufacturing. Appropriate bilateral and multi-lateral cooperation programmes for sharing of technologies and funding would be developed, and participation in international partnerships, where necessary, will also be explored
Import and export of	Import of biofuels would only be permitted to the extent necessary, and will be decided by the National Biofuel Coordination Committee proposed under this Policy. Duties and taxes would be

biofuels	levied on the imports so as to ensure that indigenously produced biofuels are not costlier than the imported biofuels. Import of Free Fatty Acid (FFA) oils will not be permitted for production of biofuels. Export of biofuels would only be permitted after meeting the domestic requirements and would be decided by the National Biofuel Coordination Committee.
Role of States	The role and active participation of the States is crucial in the planning and implementation of biofuel programmes. The State Governments would be asked to designate an existing agency, or create a new agency suitably empowered and funded to act as nodal agency for development and promotion of biofuels in their States. State Governments would also be required to decide on land use for plantation of non-edible oilseed bearing plants or other feedstocks of biofuels, and on allotment of Government wasteland, degraded land for raising such plantations. Creation of necessary infrastructure would also have to be facilitated to support biofuel projects across the entire value chain.
Awareness and capacity building	Support will be provided for creation of awareness about the role and importance of biofuels in the domestic energy sector, as well as for wide dissemination of information about its potential and opportunities in upgrading the transportation infrastructure and supporting the rural economy. Significant thrust would be provided to capacity building and training and development of human resources. Universities, Polytechnics and Industrial Training Institutes will be encouraged to introduce suitable curricula to cater to the demand for trained manpower at all levels in different segments of the biofuel sector. Efforts will also be directed at enhancing and expanding consultancy capabilities to meet the diverse requirements of this sector

Source: National Policy on Biofuels 2008

1.2.7 Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009

The Regulations, prepared by the Central Electricity Regulatory Commission came into being on 16 September 2009. The Commission has specified that tariff for renewable energy technologies shall be *single part tariff* consisting of the following fixed cost components: (1) Return on equity (2) Interest on loan capital (3) Depreciation (4) Interest on working capital (5) Operation and maintenance expenses (O&M). However, renewable energy technologies having fuel cost component, like biomass power projects and non-fossil fuel based cogeneration, single part tariff with two components, fixed cost component and fuel cost component, shall be determined. The generic tariff shall be determined on levelled basis for the Tariff Period. However, for renewable energy technologies having single part tariff with two components, tariff shall be determined on levelled basis considering the year of commissioning of the project for fixed cost component while the fuel cost component shall be specified on year of operation basis. The financial principles and technology specific parameters for biomass based power projects are presented in **Table 5** and **Table 6**, respectively.

Table 5. Financial principles renewable energy (including biomass-based power projects) (FY 2009-10)

Capital cost	Shall be inclusive of all capital work including plant and machinery, civil work, erection and commissioning, financing and interest during construction, and evacuation infrastructure up to inter-connection point. Provided that for project specific tariff determination, the generating company shall submit the break-up of capital cost items along with its petition in the manner specified under <i>Regulation 8</i> .
Debt Equity Ratio	70 : 30
Loan tenure	10 years
Interest rate	For the purpose of computation of tariff, the normative interest rate shall be considered as average long term prime lending rate (LTPLR) of State Bank of India (SBI) prevalent during the previous year plus 150 basis points.
Depreciation	Depreciation per annum shall be based on 'Differential Depreciation Approach' over loan tenure and period beyond loan tenure over useful life computed on 'Straight Line Method'. The depreciation

	rate for the first 10 years of the Tariff Period shall be 7% per annum and the remaining depreciation shall be spread over the remaining useful life of the project from 11th year onwards.
Return on Equity	The normative Return on Equity shall be: a) Pre-tax 19% per annum for the first 10 years. b) Pre-tax 24% per annum 11th years onwards.
Interest on Working Capital	For biomass power and non-fossil fuel based cogeneration: a) Fuel costs for four months equivalent to normative PLF; b) O&M expense for one month; c) Receivables equivalent to 2 (Two) months of fixed and variable charges for sale of electricity calculated on the target PLF; d) Maintenance spare @ 15% of operation and maintenance expenses. Interest on Working Capital shall be at interest rate equivalent to average State Bank of India short term PLR during the previous year plus 100 basis points.
O&M expenses	Shall comprise repair and maintenance (R&M), establishment including employee expenses, and administrative and general expenses. Normative O&M expenses allowed during first year of the Control Period (i.e. FY 2009-10) under these Regulations shall be escalated at the rate of 5.72% per annum over the Tariff Period.
Rebate	(1) For payment of bills of the generating company through letter of credit, a rebate of 2% shall be allowed. (2) Where payments are made other than through letter of credit within a period of one month of presentation of bills by the generating company, a rebate of 1% shall be allowed.
Late payment surcharge	In case the payment of any bill for charges payable under these regulations is delayed beyond a period of 60 days from the date of billing, a late payment surcharge at the rate of 1.25% per month shall be levied by the generating company.
Sharing of CDM Benefits	100% of the gross proceeds on account of CDM benefit to be retained by the project developer in the first year after the date of commercial operation of the generating station; b) In the second year, the share of the beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, where after the proceeds shall be shared in equal proportion, by the generating company and the beneficiaries.
Subsidy or incentive by Central / State Government	The Commission shall take into consideration any incentive or subsidy offered by the Central or State Government, including accelerated depreciation benefit if availed by the generating company, for the renewable energy power plants while determining the tariff under these Regulations.
Taxes and Duties	Tariff determined under these regulations shall be exclusive of taxes and duties as may be levied by the appropriate Government

Source: Central Electricity Regulatory Commission Regulations, 2009

Table 6. Technology specific parameters for biomass-based power projects (FY 2009-10)

Technology aspect	Rankine cycle technology application using water cooled condenser
Capital cost	Rs.45000000/MW (FY 2009-10) and after shall be linked to indexation formula
Plant Load Factor	During stabilization-60%; after stabilization in the 1 st year-70%; 2 nd year onwards-80%. stabilization period shall not be more than 6 months from the date of commissioning of the project
Auxiliary power consumption	10 %
Station Heat Rate	3800 kCal / kWh
O&M expenses	Rs. 2025000/MW during FY 2009-10. 5.72% escalation from the 2 nd year onwards
Fuel mix	Different types of non-fossil fuels available within the vicinity of biomass power project such as crop residues, agro-industrial residues, forest residues etc. and other biomass fuels
Use of fossil fuel	Not more than 15%
Monitoring mechanism for the use of fossil fuel	Project developer shall furnish a monthly fuel usage statement and monthly fuel procurement statement duly certified by Chartered Accountant to the beneficiary (with a copy to appropriate agency appointed by the Commission for the purpose of monitoring the fossil and non-fossil fuel consumption) for each month, along with the monthly energy bill.
Calorific Value ((kCal/kg))	Madhya Pradesh: 3612; Maharashtra: 3611; Tamil Nadu: 3300 For other states, a specific value has been determined

Fuel cost (Rs./MT) for FY 2009-10	Madhya Pradesh: 1299; Maharashtra: 1801; Tamil Nadu: 1823. For other states, a specific price has been determined. Price should be linked to an index formula for the subsequent periods. Otherwise, a normative escalation factor of 5%/year shall be applicable.
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Source: Central Electricity Regulatory Commission Regulations, 2009

1.2.8 Renewable Energy Certificate Mechanism, 2010

In 2008, India's National Action Policy on Climate Change (NAPCC) formulated a renewable portfolio standard 'Renewable Purchase Obligation (RPO)', to produce 15% of the country's electricity from renewable energy sources by 2020. It was envisaged that strong policy measures and proactive regulatory framework and innovative financing instruments would be required, if the desired level of penetration of renewable energy is to be achieved. One such policy instrument prescribed in NAPCC is Renewable Energy Certificate (REC) Mechanism which would enable large number of stakeholders to purchase renewable energy in a cost effective manner. To this direction, the Central Electricity Regulatory Commission notified the Regulations for Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation on 14 January 2010 by introducing the modalities of REC in the Indian Electricity Sector. Some of the salient features of the REC mechanism are presented in **Table 7**.

Table 7. Salient features of the Renewable Energy Certificate Mechanism 2010

Renewable energy generation	RE generators will have two options – either to sell the renewable energy at preferential tariff fixed by the concerned Electricity Regulatory Commission or to sell the electricity component and environmental attributes separately. If sold separately, the environmental attributes can be exchanged in the form of Renewable Energy Certificates (REC).
Types of certificates	There shall be two categories of certificates: solar certificates (for generation of electricity based on solar energy), and non-solar certificates (for generation of electricity based on other renewable energy sources). The Certificate once issued shall remain valid for three hundred and sixty five days from the date of issuance of such certificate.
Minimum requirement	REC will be issued to the RE generators for 1 MWh of electricity injected into the grid from renewable energy sources.
REC exchange	The REC will be exchanged only in the Power Exchanges approved by CERC within the band of a minimum and a maximum price to be determined by CERC. CERC has already notified the price band.
REC purchase	The distribution companies, Open Access consumer, Captive Power Plants will have the option of purchasing the REC to meet their Renewable Purchase Obligations (RPO). Voluntary Purchasers like NGOs, the corporate sector, individual purchasers etc. may also purchase REC in order to meet their Corporate Social Responsibility or to support the environment.
Compliance	There will be compliance auditors to ensure compliance of the requirements of REC by the participants of the scheme.

Source: Renewable Energy Certificate Mechanism 2010

1.2.9 Scheme for Implementation of Grid interactive Biomass Power and Bagasse Cogeneration Projects during 2010-11 and remaining period of the 11th Five Year Plan, 2010

The Scheme was announced by the Biomass Power Division under the Ministry of New & Renewable Energy (MNRE) on 28 April 2010. The objectives of the Scheme are:

- (a) To promote setting up of biomass power projects with minimum steam pressure configuration of 60 bar and above for surplus power generation (grid interfaced on commercial basis).
- (b) To promote cogeneration projects for surplus power generation from bagasse in private/cooperative/public sector sugar mills with minimum steam pressure configuration of 40 bar and above (Grid interfaced on commercial basis).

(c) To promote bagasse cogeneration projects for surplus power generation in cooperative/public sector sugar mills with minimum stream pressure of 60 bar and above, taken up through BOOT/BOLT model by IPPs/State Government Undertakings or State Government Joint Venture Company (Grid interfaced on commercial basis).

This scheme modifies earlier schemes relating to grid interactive renewable power generation projects based on biomass combustion and bagasse cogeneration and will be applicable from 1st April, 2010 and will continue up to the end of 11th Plan period i.e. 31 March, 2012. Main features of the Scheme are presented in **Table 8**.

Table 8. Main features Scheme for Implementation of Grid interactive Biomass Power and Bagasse Cogeneration Projects during 2010-11 and remaining period of the 11th Five Year Plan.

Types of biomass	<ul style="list-style-type: none"> For biomass power project: biomass will include Agro-based Industrial Residue, wood produced in Energy Plantations or recovered from wild bushes / weeds, wood waste produced in industrial operations; Crop / Agro Residues. For bagasse cogeneration projects: bagasse during crushing season
Upfront subsidy/part subsidy	<p>For under implementation biomass power and bagasse cogeneration projects in private / cooperative / public sector sugar mills and bagasse cogeneration project in cooperative sugar mill through BOOT/BOLT model – ‘back ended subsidy’ in accordance with the provisions of scheme.</p> <p>For under implementation bagasse cogeneration projects in cooperative /public sector sugar mills, boiler up gradation in existing cooperative sugar mill and BOOT/BOLT model through State Govt. undertaking / State Govt. Joint Venture Company, (<i>Urja Ankur Trust</i>) in cooperative / public sector sugar mills - 50% of eligible subsidy will be released to the financial institution after financial closure and placement of order for major equipment and inspection of the project by designated agency. Balance 50% will be released after successful commissioning of the project as per DPR norms, and performance testing of the project which would inter-alia imply operation of the project for three months including at least 72 hours continuous operation at minimum 80% of rated capacity.</p>
Back ended subsidy	For Biomass power & bagasse cogeneration projects in private sector sugar mills, IPP based BOOT / BOLT model in Coop./public sector mills – Sanctioned subsidy amount shall be released in a single installment on successful commissioning of the project and performance testing of the project which would inter-alia imply operation of the project for three months including at least 72 hours continuous operation at minimum 80% of rated capacity.
Incentives to state nodal agencies	The State Nodal Agencies would be given an incentive/service charge @ 0.25% of subsidy in order to facilitate developers in setting up Biomass Power & Bagasse Cogeneration projects. This would be released after release of full subsidy amount.

Source: MNRE, 2010

1.2.10. Strategic Plan for New and Renewable Energy Sector for the Period 2011-17, 2011

The Ministry for New and Renewable Energy (MNRE) placed the Strategic Plan for New and Renewable Energy Sector for the Period 2011-17 in 2011 in order to quantify the aspirations in terms of SMART (Specific, Measurable, Achievable, Realistic, Time-bound) targets for different renewable resources/ application areas. Targets for an additional year 2016-17 were included so that the Strategy would become co-terminus with the 12th 5-year plan period of 2012-17. The targets for biomass-based energy production along with other renewables for the period 2011-2017 are presented in **Table 9**. The Strategy also set targets for year-wise deployment of various decentralized systems for off-grid applications for 2011-17. The targets for bioenergy related deployment are presented in **Table 10**. The Strategy has also prepared sector-specific

implementation plans for the realization of the renewable energy potentials in the country. Specific plans related to the bioenergy are presented in **Table 11**.

Table 9. Year-wise targets for grid interactive renewable energy power (MW) and total fund requirement (Rs. in millions) for the period 2011-17

Technologies/Year	Biomass /agri waste	Bagasse cogeneration	Urban & industrial energy	Small hydro power	Solar	Wind	Total targets
Cumulative (anticipated up to 31.03.11)	1025	1616	84	3040	35	13900	19683
2011-12	100	250	20	350	300	2400	3420
2012-13	80	300	25	300	800	2200	3705
2013-14	80	300	35	300	400	2200	3315
2014-15	80	250	45	300	400	2200	3275
2015-16	80	250	55	350	1000	2200	3935
2016-17	80	250	60	360	1100	2200	4050
Total Target for the 6-year period	500	1600	240	1960	4000	13400	21700
Cumulative Total Target	1525	3216	324	5000	4035	27300	41383
Total fund requirement (Rs. in million)	350	2500	360	1065	8368	2800	15443

Source: MNRE 2011

Table 10. Year-wise targets for off-grid Bioenergy related application and total fund requirement for the period 2011-17

Year/Applications	Family biogas plants million no.)	Biomass gasifier- rural (No. of villages covered)	Industrial WTE/Bio power -Weq	Industrial WTE/Bio power - MWeq	Improved cookstoves (million numbers)
Cumulative anticipated up to 31.03.11)	4.5	150	330	330	No data available
2011-12	0.15	100	50	50	0.2
2012-13	0.15	120	60	60	0.4
2013-14	0.20	130	70	70	0.6
2014-15	0.20	140	80	80	0.8
2015-16	0.20	160	90	90	0.10
2016-17	0.20	200	100	100	0.12
Total Target for the 6-year period	1.10	850	450	450	0.42
Cumulative Total Target	5.60	1000	780	780	0.42
Total fund requirement (Rs. in million)	17600	420	900	6750	3150

Source: MNRE 2011

Table 11. Implementation Plan for the bioenergy sector for the period 2011-2017

Sector	Action plan	Proposed time Plan
Biogas	Following cluster-saturation approach instead of scattered one for installation of the plants and involving entrepreneurs/ Renewable Energy Service Companies in the operation & maintenance of the plants. Strengthen project-monitoring system (to form part of overall M&V framework). Persuade lagging States to take this up (e.g. UP, Bihar, Haryana).	Ongoing activity
Energy from agricultural / crop residues	Promoting establishment of sustainable fuel linkage systems including biomass collection, densifying, processing and storage facilities.	Ongoing activity
	Encouraging long-term fuel supply agreement and captive energy plantations	Pilots by 2012

	Setting up of such pilot plants	2011
	Setting up of Pilot project for pine needles	2011
	Support R&D project for Rice straw boilers	2011
	Getting tariff declared for small biomass gasification plants	2011
	Regular interactions with all stakeholders to periodically address policy / regulatory matters for the projects.	Ongoing activity
Biomass gasifiers	Focus on areas having surplus biomass wastes (esp. rice husk, pine needles) for rural electrification/ meeting unmet electricity demand.	2011
	Development of entrepreneurs, training of technicians	Ongoing activity
	Promotion of Gasifiers for meeting captive energy needs of industry, esp. rice mills.	Ongoing activity
	To encourage Energy Servicing Companies (ESCOs), Co-operative, NGOs, Local bodies etc. availing the subsidy and balance as bank loan, equity etc.	Ongoing activity
Bioenergy in industry	Awareness creation in target industries –Seminars/ Workshops	2011/12
Urban wastes to energy	Sensitizing Urban local Bodies about the advantages, potential and prospects	Ongoing activity
Biomass cookstoves	Promoting demonstration projects	2011
	Interaction with other Ministries for support policies	2011/12
	Evolving new business models	2011
	Review/updation of test protocols and standards	2011

Source: MNRE 2011

1.2.11 National Electricity Plan, 2012 (Volume 1 Generation)

In compliance with the *Section 3 (4)* of the Electricity Act 2003 and in accordance with the National Electricity Policy 2005, the Central electricity Authority under the Ministry of Power prepared the 1st National Electricity Plan for India in July 2007. The Plan is short-term framework of five years while giving a 15 year perspective. The 2nd Plan was prepared in January 2012 and here the 2nd Plan is being discussed. The 2nd Plan has two volumes – Volume 1: Generation and Volume 2: Transmission. Draft version of the Volume 2: Transmission has also been prepared and is available for public comments. The main perspectives of the 2nd Plan (Volume 1: Generation) are as follows:

- Short-term and long term demand forecast for different regions
- Suggesting areas/locations for capacity additions in generation and transmission keeping in view the economics of generation and transmission, losses in the system, load centre requirements, grid stability, security of supply, quality of power including voltage profile, etc; and environmental considerations including rehabilitation and resettlement
- Integrating such possible locations with transmission system and development of national grid including type of transmission systems and requirement of redundancies
- Suggesting different technologies available for efficient generation, transmission and distribution.
- Recommending Fuel choices based on economy, energy security and environmental considerations.

The Plan estimated the additional capacity generation required during the terminal years of the 12th Plan (Year 2016-2017 of 2012-2017) and the 13th Plan (Year 2021-2022 of 2017-2022). It was against the estimated peak load demand for energy at 199540 MW for the Year 2016-2017 and 283470 MW for the Year 2021-2022. In the additional capacity generation exercise, hydro, gas and nuclear based capacity was given the foremost priority due to their inherent advantages towards a Low Carbon growth Strategy. However, renewable capacity was also accorded importance in the

planning for additional capacity generation for those two terminal years of the 12th and 13th 5-year Plans. The **Table 12** presents the total capacity addition requirements for the 12th and 13th 5-year Planning periods.

Table 12. Capacity addition (MW) in the terminal years during the 12th and 13th Plan periods according to three scenarios (EPS Projections).

Type	Scenario 1: Low Renewables, Low Gas* (MW)		Scenario 2: Low Renewables, High Gas (MW)		Scenario 3: High Renewables, High Gas (MW)	
	2016-2017	2021-2022	2016-2017	2021-2022	2016-2017	2021-2022
Thermal						
Coal	66600	49200	54600	38000	51400	34000
Gas	1086	0	13086	13000	1086	13000
Nuclear	2800	18000	2800	18000	2800	18000
Hydro	9204	12000	9204	12000	9204	12000
Renewables						
Wind	11000	11000	11000	11000	15000	20000
Solar	4000	16000	4000	16000	10000	20000
Other RES**	3500	3500	3500	3500	5000	5000

* Low Renewables, No Gas Scenario in 2021-2022; **Other RES includes small-hydro, biomass, etc.

Under its Low Carbon Growth Strategy for the 12th and 13th 5-year Plan periods, the National Electricity Plan 2011 has proposed promoting hydro power, renewable energy including solar power, new gas based projects with a mix of indigenous gas and imported re-gasified LNG, retirement of old and inefficient coal based generating units, implementation of national enhanced efficiency renovation and modernization program, adoption of clean coal technology, nuclear power generation, reduction of transmission & distribution losses, implementation of Bureau of Energy Efficiency programmes, and utilization of coal bed methane.

1.3 Analysis of the opportunities and challenges related to implementation of the bioenergy related policies in India

The above presentation of various policies and strategies related to bioenergy and other renewables show that bioenergy policies are evolving in the country and at present policies are quite mature. There is a clear guideline related to tariff calculations for biomass power projects and it is helpful for the biomass power project investors/developers. GoI has also launched various incentive programmes for promoting the biomass power sector in the country and the MNRE has defined targets for both grid interactive and off-grid biomass power production up to 2016-2017. According to the MNRE targets, biomass power should generate about 1525 MW by the end of 2016-2017. This target is much lower compared to the MNRE targets for solar and wind for the same period, which are 4035 MW and 27300 MW, respectively. It reflects that addition of only 500 MW of biomass power has been targeted during the period 2011-2012 and 2016-2017 (**Figure 3**). National Electricity Plan 2012 estimated that about 5000 MW of renewable power (biomass and small hydro, etc.) will be added by 2016-2017 according to its Scenario 3: High Renewables, High Gas (**Figure 4** and **Figure 5**). This additional 5000 MW also includes bagasse-based cogeneration and therefore, the share of biomass power (agri and forestry) would be much lower. This low target for biomass power generation in the country could be due to various challenges that the sector has been facing in various States in the country (see Chapter 2).

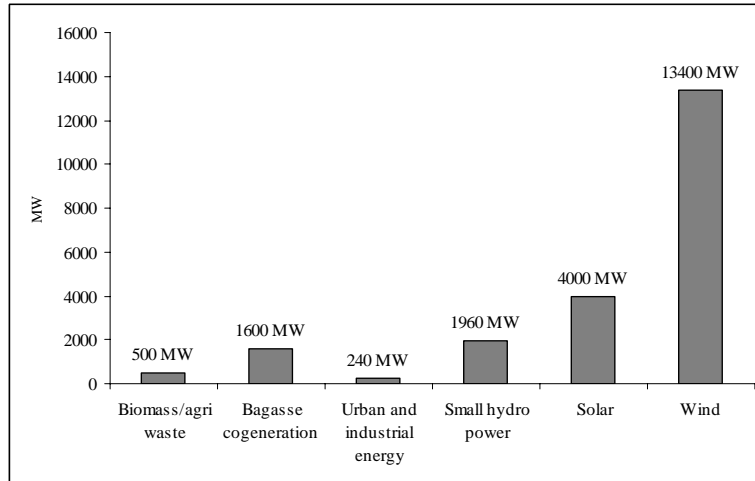


Figure 3. Total targets for grid interactive renewable energy power (MW) during 2011-2012 and 2016 – 2017. *Source: MNRE 2011.*

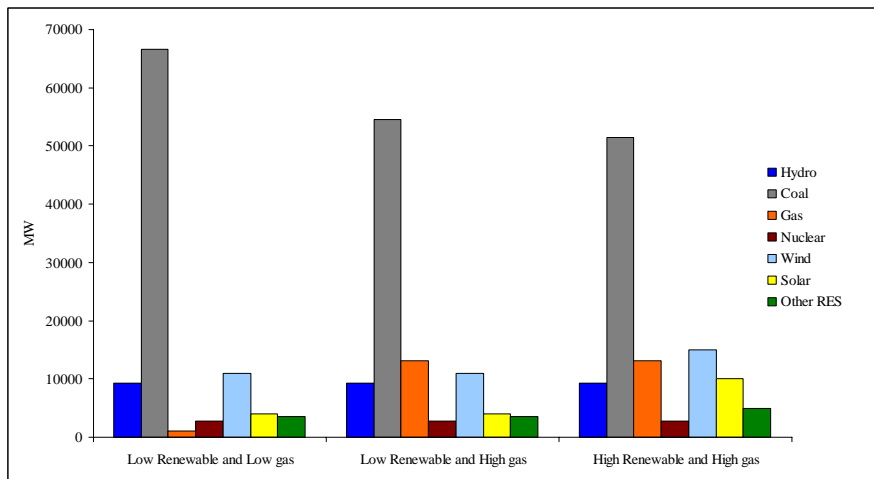


Figure 4. Total capacity addition (MW) by the end of 2016-2017 according to three scenarios (EPS Projections). *Source: National Electricity Plan, 2012.*

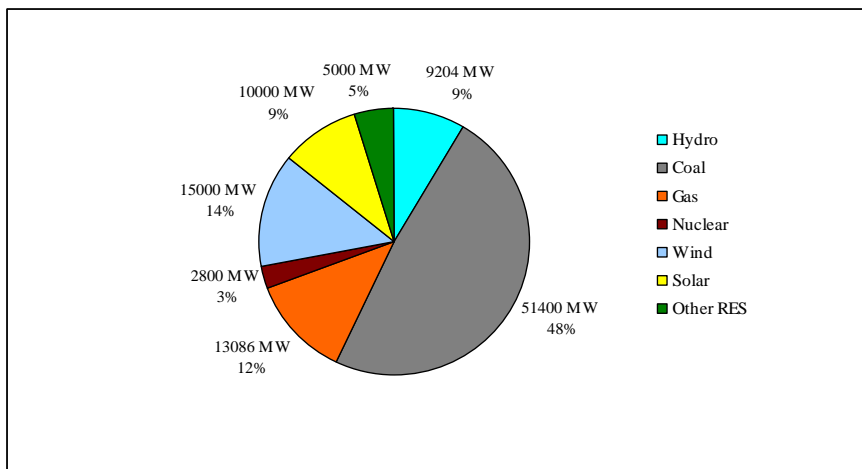


Figure 5. Total capacity addition (MW) by the end of 2016-2017 according to the Scenario 3: High Renewables, High Gas (EPS Projections). *Source: National Electricity Plan, 2012.*

Chapter 2

2. Overview of bioenergy policies and their implementation in Madhya Pradesh, Maharashtra and Tamil Nadu

2.1 Bioenergy policy in Madhya Pradesh

Madhya Pradesh is the second largest State in India. Agriculture is the mainstay of the State's economy and 75% of the people are rural. According to the Forest Survey of India (2009) report, about 48% of the State's area is under agriculture (ca. 15 million ha) and 28% is under forest (ca. 9 million ha). The State's total installed electricity generation capacity was about 5 GW as on 31.3.2012 and the share of renewables was 10% (**Table 13**).

Table 13 . Installed generating capacity of electricity (GW) in Madhya Pradesh as on 31.03. 2012

State	Hydro	Thermal	Nuclear	New and Renewables**	Total	Growth rate (2010-11 to 2011-12)
Madhya Pradesh	1.70	2.81	0.00	0.48	4.99	4.39%

Source: Energy Statistics 2013

**Renewable Energy Sources includes small hydro projects, wind power, biomass power biomass gasifier, urban & industrial waste and solar power

In recent years, the State has taken initiatives to increase energy production from renewables including bioenergy. According to the Energy Statistics of 2013, total renewable energy generation potential in the State is 3166 MW (excluding solar), while the total installed grid-connected capacity as on 31.03.2012 was 477 MW (including solar). Biomass-based power generation played a very small role among the renewables (**Table 14**).

Table 14. Renewable energy potential (MW) and installed capacity of grid interactive renewable power in Madhya Pradesh as on 31.03.2012

Type	Wind power	Small hydro power	Biomass power	Solar power	Cogeneration bagasse	Waste to energy	Total	Growth rate (2010-11 to 2011-12)
Potential	920	804	1364	NA	0	78	3166	
Installed	376.40	86.16	8.5	2.10	0	3.90	477.06	30.39%

Source: Energy Statistics 2013

Government Madhya Pradesh (GoMP), with the aim of promoting setting up of renewable energy-based power plants, has issued policies for various energy sources to encourage investors/developers. The first renewable energy related policy was issued by the GoMP in the year 2006 for promoting power generation through new and renewable energy sources in the State. In policy-2006, provisions were made for establishing biomass-based power projects in Madhya Pradesh as well as giving incentives for the same. In the year 2011, GoMP announced its first dedicated policy for biomass-based energy production in the State for promoting the sector and creating an enabling environment for investors and developers. The policy is known as **Madhya Pradesh Biomass based Electricity (Power) Project Implementation Policy, 2011**. According to the **Policy**, maximum capacity for any biomass-based power project should not be more than 15

MW and biomass-based power plants shall not be established within 2 km from the periphery of reserve/protected forests (**Table 15**). The Policy has also proposed a number of incentives for the developers to set up biomass-based power projects in the State. Madhya Pradesh Electricity Regulatory Commission is responsible for issuing orders and notifications time to time for determining tariff for biomass-based power production (**Table 16**) through inviting stakeholders in the process and following the guidelines prescribed under the *Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009*.

Table 15. Madhya Pradesh Biomass based Electricity (Power) Project Implementation Policy 2011

Name of the policy	Year of announcement	Policy features	Measures for implementation	Current status
Madhya Pradesh Biomass based Electricity (Power) Project Implementation Policy 2011	12 October 2011 (Amended on 21st February 2013)**	<ul style="list-style-type: none"> • Maximum capacity for any project shall not exceed 15 MW • Allotment of a new project will be made for a particular site on the basis of maximum free energy/MW offered to the GoMP by the developer • Developers can use maximum 15% conventional fuel (other than firewood) if the availability of biomass reduced for energy production on a continuous basis • Developers have to follow the guidelines by the Ministry of New and Renewable Energy, govt. of India and GoMP. • Developers though have freedom for captive use energy generated are restricted from selling energy outside the state. • To protect forests, biomass-based power plants shall not be established within 2 km from the periphery of reserve/protected forests • New biomass-based power plants shall not be permitted in a block or region where the 	<ul style="list-style-type: none"> • To ensure commitments, developers have to deposit a 'Performance guaranty' which is equivalent to 1% of the total project costs (the money will be released if the project achieves the stated milestones otherwise it will be forfeited as penalty) • When the developers sell electricity to GoMP they have to follow the existing tariff declared by the GoMP. They can sell to third parties on a mutual agreed rate. <p>Proposed incentives</p> <ul style="list-style-type: none"> • Electricity duty and Cess exemption for a period of 10 years from the date of commissioning the project • Wheeling facility will be provided to the developers by the M.P. Power transmission Company • 4% subsidy will be provided by the GoMP over the wheeling charges for a period of 10 years • Third party sale (in accordance with the Electricity Act 2003) • Status of industry and eligible to receive incentives under Industrial Promotion Policy of the GoMP • Land allotment (2 acres/MW) for power plant establishment • 50% exemption on stamp duty of purchase of private land for the power plant installation by the developer • Allotment of non-forest wasteland (if available) for biomass production (maximum 100 acres/MW) for maximum 5 MW 	Total installed capacity 57 MW according to the latest statistics by the New & Renewable Energy Department (GoMP) as on 28.02.2014. Total plants -14

		forest cover is more than a specified limit.	capacity <ul style="list-style-type: none"> • CDM benefits (carbon credits) • Exemption of entry tax on equipment purchased for the power project • Other incentives by the M.P. Regulatory electricity Commission 	
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**Amendments are not included

Table 16. Time line for Orders and Regulations related to tariff determination for biomass-based power projects in Madhya Pradesh

Name of the order/regulation/notification	Year of publishing	Responsible authority	Provisions
Revised Tariff Order	3 May 2013	Appellate Tribunal for Electricity, Bhopal	Revised tariff order and changes in Capital Cost, Return on Equity, Gross Calorific Value, and Price of fuel from the Order on 2 March 2012.
Notification Amendment in the Policy for implementation of Biomass based Power Projects in Madhya Pradesh -2011	21 February 2013	The Office of the Commissioner, Ministry for the New and Renewable Energy, GoMP Bhopal	Inviting proposals from private developers to set up biomass-based power plants in the State of capacity up to 15 MW
Order on the Petition for review the generalized tariff order of 2 March 2012	1 June 2012	M.P. Electricity Regulatory Commission (MPERC), Bhopal	Tariff Order of 2 March 2012 will remain valid although the error in the calculation of variable charges should be corrected. Similarly, difficulty in obtaining finance for these projects also needs to be addressed. It was decided that the variable tariff for the period from the date of issue of this tariff order to 31 st March, 2013 would be Rs. 2.45/kWh.
Tariff Order for procurement of power from Biomass based Power Projects	2 March 2012	MPERC	The control period will start from the date of issue of this order and will end on 31.03.2014
Tariff order for procurement of power from Biomass Based Power Plants	7 August 2007	MPERC	The tariff order had control period up to 31.3.2012

2.2. Bioenergy policies in Maharashtra

The State of Maharashtra is in the western part of India with a long coast line along the Arabian Sea. About 57% of the area (ca. 17 million ha) in the State is under agriculture, while 16% (ca. 5 million ha) is forest land (Forest Survey of India 2009). Total installed power generation capacity was about 20 GW in the State in March 2012, of which share of renewables was about 18% (**Table 17**). According to the Energy Statistics 2013, the State has about 1900 MW power generation potential from biomass (excluding bagasse-based cogeneration) and total installed capacity was about 190 MW by March 2012 (**Table 18**).

Already in 2008 the State prepared a policy called *New policy for power generation from non-conventional sources of energy -2008* in order to encourage private sector participation in developing the biomass power projects in the State. Since there are about 202 registered sugar mills in Maharashtra, the Govt. of Maharashtra has encouraged through the Policy on both bagasse-based

cogeneration and biomass-based power production in the State. As per the statistics available on the Maharashtra Energy Development Agency website as on 28.02.2014, total installed capacity for biomass power is 190 MW and bagasse cogeneration power is 671 MW. Out of total targets of 3500 MW for renewable power generation in the Policy, 1000 MW for bagasse-based cogeneration projects and 400 MW for (agriculture waste) biomass-based power projects have been determined (**Table 19**). To attract private investors/developers, the Policy has also made several provisions such as subsidy, exemption on electricity duty for the 1st 10 years, etc. Maharashtra Electricity Regulatory Commission has been issuing orders and notifications time to time for determining tariff for biomass-based power production (**Table 20**) following the guidelines prescribed under the *Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009*.

Table 17 . Installed generating capacity of electricity (GW) in Maharashtra as on 31.03. 2012

State	Hydro	Thermal	Nuclear	New and Renewables**	Total	Growth rate (2010-11 to 2011-12)
Maharashtra	3.33	13.39	0.00	3.63	20.35	18.36%

Source: Energy Statistics 2013

**Renewable Energy Sources includes small hydro projects, wind power, biomass power biomass gasifier, urban & industrial waste and solar power

Table 18. Renewable energy potential (MW) and installed capacity of grid interactive renewable power in Maharashtra as on 31.03.2012

Type	Wind power	Small hydro power	Biomass power	Solar power	Cogeneration bagasse	Waste to energy	Total	Growth rate (2010-11 to 2011-12)
Potential	5439	733	1887	NA	1250	287	9596	
Installed	2733.30	281.33	190**	20.00	671**	5.72	3644.05	21.28%

Source: Energy Statistics 2013

** Maharashtra Energy Development Agency

Table 19. New policy for power generation from non-conventional sources of energy -2008 in Maharashtra

Name of the policy	Year of announcement	Policy target and features	Measures for implementation	Current status
New policy for power generation from non-conventional sources of energy - 2008	14 October 2008	<ul style="list-style-type: none"> Out of total targets of 3500 MW, 1000 MW of Cogeneration projects / Electricity Generation projects based on Bagasse, 400 MW of (agriculture waste) Biomass based Electricity Generation projects Promoters / Developers / Investors wish to avail the benefits allowed under this policy, it is obligatory for them to sell the 50% of electricity generated from the Projects commissioned under this policy to Maharashtra State 	<p>The Govt. of Maharashtra will provide the following benefits to the developers of 1000 MW of Cogeneration projects based on bagasse and 400 MW of (agriculture waste) biomass-based power projects:</p> <ul style="list-style-type: none"> Evacuation arrangement Expenditure of Evacuation System (through Green Energy Fund) Refund from Green Energy Fund for Evacuation Arrangement Expenditure: Subsidy 	Installed biomass power – 190 MW, bagasse-based cogeneration on 671 MW as on 28.2.2014. Total plants-18 for biomass

		Distribution Company /Ltd. (MSEDCL) at the rate fixed up by MERC under a long term Power purchase /agreement. It shall be obligatory to sell the remaining 50% electricity within the state of Maharashtra only	<ul style="list-style-type: none"> Electricity duty (Electricity Duty will not be levied for first 10 years from the date of commissioning. This benefit will also be applicable for third party sale) Capital Subsidy (only for bagasse-based projects) 	power. Around 10 have shout down.
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Table 20. Time line for Orders and Regulations related to tariff calculation for biomass-based power projects in Maharashtra

Name of the order/ regulation/notification	Year of publishing	Responsible authority	Provisions
Generic RE Tariff Order (<i>Suo Motu</i>) FY 2013-2014	22 March 2013	Maharashtra Electricity Regulatory Commission (MERC)	This order will be applicable for the RE projects during FY 2013-14. Tariff for biomass-based power generation projects was determined (Rs. 5.66/kwh for projects in FY 2013-14, Rs. 5.71/kwh for projects prior to FY 2013-14)
Generic RE Tariff Order (<i>Suo Motu</i>) FY 2012-2013	30 March 2012	MERC	This Tariff Order shall be applicable for New RE Projects to be commissioned during FY 2012-13. Tariff for biomass-based power generation projects was determined (Rs. 5.41/kwh for existing and new projects in FY 2012-13)
Generic RE Tariff Order (<i>Suo Motu</i>) FY 2010-11	14 July 2010	MERC	This order will be applicable for the RE projects during FY 2010-11. Tariff for biomass-based power generation projects was determined (Rs. 4.98/kwh)
Terms And Conditions For Determination Of RE Tariff) Regulations, 2010	7 June 2010	MERC	New Biomass power project(s) to be commissioned subsequent to notification of these Regulations and using new plant and machinery based on Rankine cycle technology and using biomass fuel sources, provided use of fossil fuel is restricted as stipulated under Clause 42.1 of these Regulations.

2.3. Bioenergy policies in Tamil Nadu:

The State of Tamil Nadu is located southernmost part of the country with a total land area of 13 million ha, out of which about 40% is under agricultural production and 16% is under forests (Forest Survey of India, 2009). According to the Energy Statistics 2013, total installed renewable energy generation capacity in the State is 7.34 GW, which is 52% of the total installed electricity generation capacity of the State (**Table 21**).

Table 21 . Installed generating capacity of electricity (GW) in Tamil Nadu as on 31.03. 2012

State	Hydro	Thermal	Nuclear	New and Renewables	Total	Growth rate (2010-11 to 2011-12)
Tamil Nadu	2.12	4.66	0.00	7.34	14.12	12.11%

Source: Energy Statistics 2013

**Renewable Energy Sources includes small hydro projects, wind power, biomass power biomass gasifier, urban & industrial waste and solar power

The State of Tamil Nadu has good potential for harnessing non-conventional energy sources. The Energy Statistics 2013 shows that the potential for biomass power is 1070 MW and for bagasse-

based cogeneration is 450 MW; altogether they are about 20% of the total potential for renewables-based power production (**Table 22**). According to the Tamil Nadu Energy Development Agency, total installed capacity for biomass-based power production was 167 MW as on 30.10.2011. There is no bioenergy policy in Tamil Nadu. However, the Govt. of Tamil Nadu has issued orders and notification to revise tariffs in bioenergy production in the state (**Table 23**).

Table 22. Renewable energy potential (MW) and installed capacity of grid interactive renewable power (MW) in Tamil Nadu as on 31.03.2012

Type	Wind power	Small hydro power	Biomass power	Solar Power	Cogeneration bagasse	Waste to energy	Total	Growth rate (2010-11 to 2011-12)
Potential	5374	660	1070	NA	450	151	7705	
Installed	6987.58	123.05	167**	15.05	365***	5.65	7644.03	17.92%

Source: Energy Statistics 2013

** Tamil Nadu Energy Development Agency

***Author's own calculation

Table 23. Time line for Orders and Regulations related to tariff calculation for biomass-based power projects in Tamil Nadu

Name of the order/regulation/notification	Year of publishing	Responsible authority	Provisions
Comprehensive Tariff Order for Biomass based Power Plants.	31.07.2012	Tamil Nadu Electricity Regulatory Commission (TNERC)	With regard to tariff determination, the relevant portions of regulation 4 of the Power Procurement from <i>New and Renewable Sources of Energy Regulation, 2008</i> . The Commission adopted Cost-Plus Two Part Tariff approach although it has recognized that it is not best method. However, this method could take care of price escalation in fuel cost.
Renewable Purchase Obligations Regulations	2010	TNERC	In order to promote the New and Renewable source of energy, the Commission has prescribed minimum percentage of electrical energy which each obligated entity shall purchase from new and renewable sources generators.
Comprehensive Tariff Order for Biomass based Power Plants	27.04.2009	TNERC	The Order covered tariff rates for power procurement by the distribution licensee from Biomass based generators. The validity of the Order was extended up to 31.07.2012
Power Procurement from New and Renewable Sources of Energy Regulations 2008	08.02.2008	TNERC	Tariff determined by the Commission shall be applicable for a period of twenty years and the control period may ordinarily be two years
Power purchase and allied issues in respect of Non-Conventional Energy Sources based Generating Plants and Non-Conventional Energy Sources based Co-Generation Plants	15.5.2006	TNERC	The Order stipulates tariff rates for power procurement by the distribution licensee from Wind Energy Generators (WEGs), Biomass based generators and Bagasse based co-generators. This was the first Order issued by the Commission on NCES based power plants.

2.4 Comparative pictures of the elements for biomass power tariff determination in Madhya Pradesh, Maharashtra, and Tamil Nadu

A comparative analysis of the technology specific and financial parameters for determining tariff by the respective State Electricity Regulatory Commissions in the three States has been presented in **Table 24**.

Table 24. A comparative picture of technology specific and financial parameters for determining tariff for biomass power projects (cogeneration excluded) in Madhya Pradesh, Maharashtra and Tamil Nadu

Items	Madhya Pradesh (Rs.)	Maharashtra (Rs.)	Tamil Nadu (Rs.)
Life of plant and machinery	20 years	20 years	20 years
Capital cost/MW	Rs.44500000 /MW for 2012-13, Rs. 46300000/MW for 2013-14	Rs.47100000/MW for 2013-14	Rs.44500000/MW for 2011-12
Debt – Equity ratio	70:30	70:30	70:30
Fixed cost components of the single part tariff structure			
Return on Equity	20 % (pre-tax)/ year	19 % (pre-tax)/year for the 1 st 10 years, 24 % (pre-tax)/year from 11 th year onwards	19.85 % (pre-tax)/year
Interest rate for the loan	12 % per annum.	12.87 % for FY 2013-14	12.25 % per annum
Depreciation	7 % per annum for the first 10 years and 2 % per annum thereafter	7 % per annum for the first 10 years and 2% annum thereafter	4.5 % per annum
Interest on working capital	13 % for 2013-14	13.37% for 2013-14	12.50 % for 2013-14
Operation & Maintenance (O&M) Charges	4% with escalation of 5.72 % from 2nd year	Rs. 2530000/MW for 2013-14 with escalation of 5.72 %/pa	4.50 % with escalation of 5 % from 2 nd year
Term of loan	10 years	10 years	10 years
Components of working capital	Fuel stock - 4 months, O&M - 1 month and Receivables – 2 months	Fuel stock - 4 months, O&M - 1 month and Receivables – 2 months, Maintenance spare @ 15% of operation and maintenance expenses	Fuel stock - 1 month, O&M - 1 month and Receivables – 1 month
Plant Load Factor (PLF)	80%	During stabilization-60%, after stabilization in the 1 st year-70%, 2 nd year onwards-80%	80 %
Auxiliary consumption	10 %	10 %	10 %
Station Heat Rate (SHR)	3800 Kcal/ Kwhr	3800 Kcal/Kwhr	3840 Kcal/Kwhr
Gross calorific value (GCV) of the fuel	3600 Kcal/Kg	3611 Kcal/Kg	3200 Kcal/Kg
Biomass fuel cost	Rs. 2653/MT during 2013-14	Rs. 3160/MT during 2013-14	Rs. 2277/MT during 2013-14
Fossil fuel consumption to be restricted	15%	15%	15%
Tariff for 2013 – 2014	Rs. 5.64/kWh	Rs. 5.41/kWh	Rs. 5.75/kWh

2.5 Analysis of the opportunities and challenges related to implementation of the bioenergy related policies in the three states

All the three States have made necessary legal and political framework for promoting biomass power projects and are also encouraging private investors/developers to set up such projects. At present, 8.5 MW, 190 MW and 167 MW biomass power plants are installed in Madhya Pradesh, Maharashtra and Tamil Nadu, respectively. Energy Statistics 2013 shows that potential capacity for biomass power installation as 1364 MW for Madhya Pradesh, 1887 MW for Maharashtra, and 1070 MW for Tamil Nadu. Therefore, there are still a large un-tapped potential exists in all the three States. However, the existing biomass power plans in these States have been facing various challenges due to rise in biomass fuel costs (**Figure 6**) and also other technical and financial reasons (see **Table 25**). They all affect the rate of tariff as determined by the State Electricity Regulatory Commissions. A low tariff without taking into account the market realities could makes many biomass power projects unviable. Many biomass power plants have been shut down due to these constraints in these States and also in other parts of India. Banks and other financial institutions consider biomass power projects are at high risk and therefore developers of such projects face problems in obtaining loans at a competitive interest rate. Therefore, there is an urgent need to organize the supply chain for biomass fuels, establish dedicated plantations for energy crops with improved varieties, harvest agricultural residues for biomass power projects in a sustainable way, improve R&D for technical aspects for such projects. With these interventions and supportive policies, biomass power projects could be more sustainable not only in the three States but also in the country as a whole.

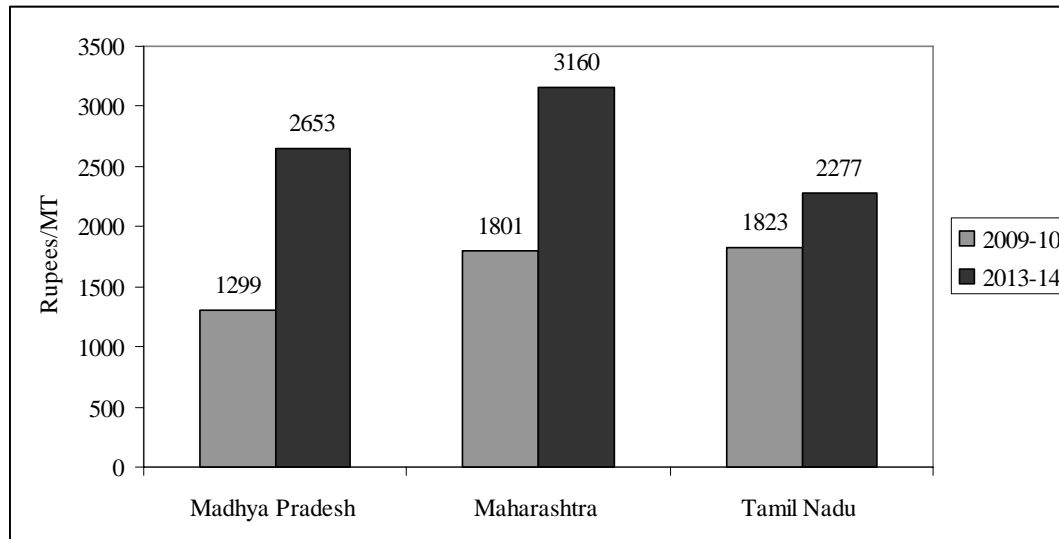


Figure 6. Price of biomass fuel in the three States during 2009-10 and 2013-14 as determined by the State Electricity Regulatory Commissions

Table 25. Main challenges related to biomass power projects (cogeneration excluded) in Madhya Pradesh, Maharashtra and Tamil Nadu

Madhya Pradesh	Maharashtra	Tamil Nadu
<ul style="list-style-type: none"> • The cost of equipment etc. has increased substantially over the past 5 years and the capital cost has increased to beyond Rs. 55000000/MW. This is much higher than the Rs. 42500000 /MW determined by the MPERC • The procurement of biomass fuel is in a highly unorganized sector and the prices are influenced by various local factors and therefore vary in wide range. There is no established mechanism to estimate the reasonable price of biomass • Price of fuels has gone up considerably and it ranges between Rs. 3000/MT and 4500/MT. Therefore, the MPERC determined rate Rs. 2653/MT during 2013-14 is too low • GCV is between 2500 kCal/kg to 2800 kCal/kg due to various types fuels used in biomass power production. This value is much lower than the MPERC determined value of 3600 kCal/kg 	<ul style="list-style-type: none"> • Increase in the capital cost for biomass projects. It ranges between Rs. 60000000 – 65000000 /MW, which is much higher than the MERC determined cost of Rs.47100000/MW for 2013-14 • Increase in O&M expenses due to inflation • GCV, SHR, and Auxiliary power consumption percentage should be revised. Actual gross calorific value is between 3000 kCal/kg and 3200 kCal/kg, whereas MERC determined it as 3611 Kcal/Kg. Actual SHR for biomass power projects is around 4500 kCal / kWh instead of 3800 kCal / kWh as determined by MERC • Price of biomass fuels varies between Rs. 3200/MT and Rs. 4000/MT. However, MERC determined rate is Rs. 3160/MT during 2013-14 • MERC determined tariff is lower and it needs revision due to the above difficulties in biomass power projects 	<ul style="list-style-type: none"> • Additional maintenance and running expenditure compared to fossil fuel-based power plants. Cost of spare parts and materials have all gone up due to inflation and therefore, O&M expenses have also increased • Cost of fuel has gone up rapidly due to increase in diesel price and consequently increases in transport cost. Fuel availability is also affected by flood and drought. Actual price biomass fuels is around Rs. 2500/MT and TNERC determined price is Rs. 2277/MT during 2013-14 • PLR Rate of interest for term loan is between 12.5 and 14% and banks are not interested in giving loans at this rate as they consider biomass projects are high risk. Current rate of interest on term loan and loan on working capital is between 15.5 and 17% • Boiler efficiency is a problem due to various types of biomass fuels are used • Labor cost has gone up by 50% • Various types of fuels used in biomass power generation have different characteristics such as moisture content and gross calorific value. Therefore, the normative SHR prescribed by the TNERC is too low • GCV is lower than what has been determined by TNERC due to various of types of fuels used in biomass power generation