# TECHNO-ECONOMIC FEASIBILITY STUDY OF SETTING UP A 10 MW BIOMASS BASED ELECTRIC POWER STATION IN A TALUKA IN MAHARASHTRA

***(Report prepared for ICICI under PACER program. May 1991)***

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## EXECUTIVE SUMMARY

India faces a tremendous shortage of electricity. It is estimated that there will be a shortfall of about 12,000 MW electricity in the eighth V-year plan. Rural areas always bear the major brunt of any such shortages. They are also characterized by unemployment and paucity of wealth. Generation of electricity from biomass has the potential of solving both the problems of shortage of electricity and unemployment in rural areas. The present project is an effort towards evaluating the feasibility of this concept.

Most of the present energy projects are focused on villages. But because of lack of necessary infrastructure, the energy production schemes in these villages do not contribute to long term solutions. Thus it is recommended that energy production should be o a taluka level. Hence a techno-economic feasibility study for setting up a 10 MW electricity generation plant running on biomass has been carried out for Phaltan taluka in western Maharashtra.

The study has four major components:

1. Biomass availability.
2. Power pant technology.
3. Economics of power production.
4. Institutional infrastructure of the plant.

## I. **Biomass Availability**

It has been estimated that the annual fuel requirement for a 10 MW (net) power plant will be about 83,000 metric tons (T) (dry). This fuel requirement can be met by two sources, namely agricultural residues and through large-scale energy plantations. In Phaltan taluka, it is estimated that about 1,00,000 T (dry) of agricultural residues majority of which is burnt in the fields are available every year for energy production. Thus, in principle these residues alone can provide the necessary fuel for the power plant. The cost of these residues is estimated to be Rs. 400/T (dry), including the transportation and handling costs.

However, because of non-availability of infrastructure for harvesting and transporting these residues to the plant site, they may not be available readily. Therefore, it is proposed to generate biomass fuels from large-scale energy plantations and use a mix of wood and residues in the plant.

Some of the tree species identified as suitable for such energy plantations under irrigated conditions are *L. leucocephala*, *Eucalyptus* hybrid, *P. juliflora* and *S. sesban*. A 5-year

rotation cycle is assumed for these plantations. Their yields are expected to be 10-15 T/ha-year on poor soils and 25-30 T/ha-year on good soils.

With these plantations, the growers are expected to earn a net profit of Rs. 7,000-12,000/ha-year at a biomass price of Rs. 650/Ton (dry). This remuneration is comparable to that obtained from conventional crops grown in Phaltan taluka.

Discussions with farmers reveal that they are willing to opt for energy plantations provided they are given a remunerative price and an assured market for the biomass. Besides, these are low-risk plantations and require much less labour, maintenance and other inputs as compared to crops, thereby making them an attractive proposition for the farmers.

The extent of such plantations required depends on the ratio of residues to wood which is used in the power plant. Residues, being cheaper than wood from energy plantations, will be the preferred fuel. However, because of the limitations of getting these residue easily, the biomass mix is proposed. As a worst-case scenario, it is estimated that only 50% of the annual fuel requirement will be met by these residues, and the remaining 50% will be met by wood from energy plantations.

This implies that a maximum of 42,000 T (dry) of wood will have to be generated every year. Assuming the yields to be in the range of 15-30 T (dry)/ha-year depending on the soil conditions, it is estimated that a maximum of 2,800 hectares will be required for these plantations. This is only 6% of the total irrigation land in Phaltan taluka. The water required to irrigate these plantations is only about 3.3% of the total canal flow-rate. Thus, it is established that infrastructural facilities like land and water are available within the taluka itself to sustain the energy plantations even for the worst-case scenario.

It is estimated that the entire process of collecting the biomass fuels and transporting tem to the power plant site will create employment opportunities for about 1000 persons. Besides this, planting of trees on 2800 hectares will increase the green cover of the taluka. This is bound to have a beneficial effect on the environment. The power plant will be equipped with very sophisticated pollution control equipments to ensure that the power plant does not degrade its surroundings.

Finally, the nature of interaction between the individual growers and the power plant has been proposed. The power plant can act as a central agency and co-ordinate the planting, monitoring and harvesting of the energy plantations.

## II. **Power Plant Technology**

The major technological aspects of generating electricity from biomass including the process know-how and the equipments required, have been thoroughly evaluated on selected power plants in the US. The conventional Rankine cycle with steam turbine is considered to be an appropriate choice for the power plant. The major power plant equipments involved in fuel handling and processing, combustion of different forms of biomass fuels, generation of electricity through a prime mover and effective pollution control have been found to be well developed. The details of the technology are given in Chapter III.

This technology is easily adaptable to Indian conditions. Initial steps for the transfer of this technology to India have been taken. A US group which is willing to collaborate with an Indian firm, either on a turnkey basis, or on a consultancy basis, has been identified.

Further, the Maharashtra State Electricity Board has also expressed its willingness to buy all the electricity from this plant. The terms and conditions are to be decided later.

This study has thus established the technical viability of setting up a 10 MW power plant based on biomass fuels.

## III. **Economics and Proposed Policy Measures**

A preliminary exercise has been carried out to estimate the cost of generating electricity from biomass, both from brand-new plants as well as from reconditioned plants. A brand-new 10 MW plant is expected to cost ~ Rs. 35 crores, whereas a reconditioned plant would cost ~ Rs. 15 crores. Two scenarios have been considered, depending on the amount of residues available to the plant.

In the first scenario, it is expected that most of the fuel requirements will be met by the biomass residue priced at Rs. 400/T. The electricity cost is then estimated to lie between Rs. 1.16-1.42/kWh for reconditioned plants, and Rs. 1.90-2.32/kWh for brand-new plants. This scenario is expected to be valid for the first few plants.

The second, or the worst-case scenario is expected to be valid for subsequent plants. In this scenario, the residues are expected to meet only 50% of the annual fuel requirement. The remaining 50% will be met by wood from energy plantations priced at Rs. 650/T (dry). In this case, the cost of electricity is expected to be Rs. 1.30-1.56/kWh for reconditioned plants, and Rs. 2.02-2.46/kWh for brand-new plants. Details of both scenario are given in Chapter IV.

In order to attract private investors to the field of power generation, certain policy measures to be adopted by the Government have been proposed. These include complete tax write-offs on money invested in the power sector and a more rational electricity tariff structure, especially for the agricultural users. Setting up of such plants to cater to the electricity needs of the industrial centers of the MIDC in each taluka has also been proposed.

## IV. **Proposed Institutional Infrastructures**

It is proposed that the institutional infrastructure of the power plant be made up of a consortium of energy plantation farmers, financiers and power plant manufacturers. It will essentially be a join-stock company with shares owned by members of the proposed consortium. Previous experience has shown that the co-operative system is beset with mismanagement and corruption, and hence, a joint-stock company is preferable. The total project cost will be of the order of Rs. 35 crores for a brand-new 10 MW power plant, and ~ Rs. 15 crores for a reconditioned plant.

## V. **Recommendations**

It is recommended that steps should be taken to set up the first such plant in Phaltan taluka. It is also recommended that members of this consortium be identified and a bankable proposal

be prepared and presented to financial institutions. Finally, it is recommended that there should be only one such power plant per taluka in order to conserve the biomass resources.

## ACHIEVEMENTS OF THE PROJECT

1. A complete techno-economic feasibility study for setting up a 10 MW power plant running on biomass in western Maharashtra has been completed.

2. A methodology has been developed by which this study can be extended to other parts of the country.

## APPENDIX XIV

### WORKSHOP ON POWER GENERATION FROM BIOMASS

Organized by

**Nimbkar Agricultural Research Institute (NARI), Phaltan**

**Mahratta Chamber of Commerce and Industries, PUNE**

February 15, 1991

### LIST OF INVITEES

| | | |
|---|---|---|
| 1. | Mr. Mohan Dharia | Deputy Chairman, Planning Commission, New Delhi |
| 2. | Mr. B. B. Vohra | Former Chairman, Advisory Board on Energy, New Delhi |
| 3. | Dr. J. Gururaja | Advisor, Department of Non-conventional Energy Sources (DNES), Ministry of Energy, Government of India, New Delhi |
| 4. | Mr. R. L. Suri | Secretary General, National Council of Power Utilities (NCPU), New Delhi |
| 5. | Dr. R. K. Pachauri | Director, Tata Energy Research Institute, New Delhi |
| 6. | Mr. P. Abraham | Chairman, Maharashtra State Electricity Board (MSEB), Bombay |
| 7. | Mr. M. V. Dhekne | Technical Director, MSEB, Bombay. |
| 8. | Mr. V. G. Rajadhyaksha | Director, Consindia Pvt. Ltd., Bombay and Former Chairman, Hindustan Lever Ltd., Bombay |
| 9. | Mr. Swaminathan S. Aiyer | Resident Editor, Times of India, New Delhi. |
| 10. | Dr. S. P. Sukhatme | Professor, Department of Mechanical Engineering, IIT Bombay. |
| 11. | Mr. S. G. Kale | Secretary, Planning Department, Government of Maharashtra, Bombay. |
| 12. | Mr. P. H. Vaidya | Asst. General Manager, PACER Secretariat, ICICI, Bombay. |

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| 13. | Dr. N. A. Kalyani | Chairman and Managing Director, Bharat Forge Ltd., Pune |
| 14. | Mr. R. D. Aga | Chairman and Managing Director, Thermax Ltd., Pune |
| 15. | Mr. S. L. Kirloskar | Chairman, Kirloskar group, Pune. |
| 16. | Shri Appasaheb Pawar | Managing Trustee, Baramati Agricultural Development Trust, Baramati |
| 17. | Mr. B. D. Pawar | Director of Marketing, Government of Maharashtra, Pune. |
| 18. | Dr. N. Rath | Former Director, Gokhale Institute of Economics, Pune |
| 19. | Dr. K. S. Rao | Director, Gujarat Energy Development Agency, Baroda, Gujarat. |
| 20. | Mr. Suresh Ranade | Managing Director, MITCON, Pune. |
| 21. | Mr. H. K. Firodia | Chairman and Managing Director, Kinetic Engineering Ltd., Pune. |
| 22. | Mr. V. S. Laghate | Corporate Development Manager, Century Enka Ltd., Pune. |
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