Government of India
Ministry of Non-conventional Energy Sources
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Creating Energy Security in Villages through Biomass
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1.0 Introduction

1.1 There has been a significant surge in price of oil which has crossed $ 70 per barrel and is projected to increase further in real terms. International price of coal has also risen significantly. Higher levels of demand projected for the coming years are likely to be met mainly through imports, placing an even greater burden on the country's foreign exchange resources. An approach towards energy security would on the one hand need intensification of existing diplomatic and commercial initiatives and on the other diversification of the energy-mix. Diversification should lead to the accelerated harnessing of new and renewable energy resources that are capable of meeting a broad spectrum of requirements thus contributing to the overall national energy security.

1.2 Biomass is an important renewable energy source as it contributes around 30% of total primary energy consumed in the country. Bulk of our present rural energy consumption comes from non-commercial energy in the form of traditional biomass used at very low efficiencies. Penetration of petroleum products such as diesel, kerosene and LPG in the rural areas has been poor, and the supplies made are heavily subsidized. Despite rapid scale-up of installed capacity envisaged by 2031-32, alongwith higher penetration of petroleum products, traditional biomass would still continue to be used as primary fuel, with its share going up from the present 130 MTOE to about 160 MTOE. Assuming that the country achieves the projected installed capacity of power generation at the end of the 11th Plan, and by 2031-32, and also achieves the envisaged connection of all villages to the national grid, it does not follow that electricity will actually be delivered at these locations.

1.3 Continued use of traditional biomass would imply that the unmet demand will increase in size rather than decrease in rural areas. Efficient handling and management of biomass with all its complexities can substantially meet this unmet demand leading to a greater sense of security for the villages, rather than just security at the national level.

1.4 Inadequate growth in employment, its impact on poverty and the large rural-urban difference are matters of serious concern that are engaging the attention of our planners and policy makers. While we embark on a small number of very large projects, we should not forget to make arrangements for planning, executing and caring for a very large number of small, even tiny, projects. Subsidies being provided at present for supply of electricity and petroleum products to rural areas could be more gainfully diverted to support creation of capital assets required for such small projects. Of course in MW terms the impact may be negligible but in terms of population served and jobs created, exercising this option by the rural population will have far greater impact and political significance.

1.5 Such a win-win strategy would bring about a reduction in foreign exchange outgo; significantly add to the tree and biomass cover of the country; provide decentralized energy solutions for village panchayats; create new opportunities for employment and livelihoods; and, rejuvenate the rural economy. All this would be possible to be achieved in a decentralized manner, and in an environment friendly and sustainable manner.

2.0 Resource and Potential

2.1 Biomass is an indigenous resource which is abundantly already available, or can be grown. Energy plantations have to be an integral part of any strategy to use biomass for energy. An area of about 107 million hectares has been estimated to be degraded with 64 million hectares categorized as wasteland which includes degraded forests. The minimum wasteland area that might be available is about 35 million hectares. To this, if about 5 million hectares of land by the side of highways and rail tracks is added, the total land available for plantations becomes 40 million hectares. In addition, there would be significant potential from farm forestry with farmers raising tree plantations on bunds, etc.

2.2 Wastelands are a common land resource under control of Government or the Panchayats, and individuals cannot utilize such land for any productive purpose. Every village has some fallow, common or uncultivated non-grazing land and such wasteland, not currently in agriculture, can be allotted to the villagers or their co-operatives for agro-forestry and raising plantations of fast growing fuelwood species and non-edible oilseed bearing trees. If every panchayat is entrusted with undertaking plantations over contiguous wasteland through community participation and given the right to use the resources, a sustainable supply of biomass can be ensured for the energy production systems. Agro-forestry can also be promoted through contract farming whereby corporate bodies can organize groups of farmers to produce the required biomass under contract through development of wastelands.

2.3 Apart from plantations, surplus agricultural wastes and agro-industrial residues can be utilized for thermal or electrical energy generation. 120 -150 million tonnes of these resources are generated every year in the country. About half of the surplus residues are burnt in the fields causing serious air pollution. Electricity generation capacity can be installed and supported by this resource in the off-grid mode in villages through the gasification route.

3.0 Technology Options

3.1 Energy needs in villages can be met through solid biomass or bio-oils using technologies already known for some time but improved and developed further in recent years. Alternative routes for energy production could be selected from among biomass gasifiers, biogas plants or biofuel units, depending upon availability of various resources and other site conditions. Biomass gasification for electricity generation has been known for about six decades. However, modern technology has reached maturity only in the last few years. India is known as an acknowledged leader in conversion of solid biomass into clean gaseous fuel. Small-scale biomass gasifiers of upto 500-600 KW capacity are eminently suited for off-grid electricity supply in our rural areas. Biogas has been known as a source of a clean gaseous fuel through cow dung based anaerobic digesters for the last six decades. Through modern technology interventions, it is now possible to convert other biomass to biogas through a more efficient two-stage process. Furthermore, electricity

production from both biogas and producer gas is now possible through gas engines, in place of dual fuel engines earlier run with diesel.

3.2 Comparative cost of electricity generation at about 30% capacity utilization works out to about Rs. 4.40 per unit for biomass gasifiers, with no subsidy, and Rs. 2.20 per unit with 90% subsidy. Cost of generation would be lower for higher capacity utilization. Costs of electricity generation for the biogas and biofuel options are higher, though biogas is an attractive option for cooking energy and biofuel for motive power, with value addition being provided in the form of fertilizers from the slurry from biogas plants and oil cake from the expellers. To improve overall viability, and to ensure availability of power on demand, the distributed generation facilities could be synchronized with the grid, wherever it is available.

3.3 The technology for small-scale atmospheric pressure gasification has been developed indigenously and there are 13 manufacturers of gasifiers and six manufacturers of gas engines. The production capacity of gasifiers and engines could be suitability augmented in the small/medium scale sector depending upon the demand. Indigenous capability also exists for on-site construction of biogas plants and installation of biofuel extraction/refining units. Edible oil extraction units in rural areas are at present under utilized or not in use. They can be revitalized and upgraded for non-edible oilseeds. In a nutshell, we now have the indigenous capability and capacity to handle the technology issues related to decentralized energy generation based on biomass confidently and competently.

4.0 Village Energy Security through Biomass

4.1 About 80% of the villages in India are deemed to have been electrified, based on earlier definitions of rural electrification. About 1,25,000 villages still remain to be electrified though their number is likely to be higher going by the latest definition which requires atleast 10% of the total number of households in a village to be electrified. There is a large un-served rural population as only 44% of rural households have access to electricity. Hamlets that are located away from the main inhabited village are most often not connected thus depriving large segments of the population of a revenue village.

4.2 Even in the villages already electrified, the electricity supply position remains highly unsatisfactory. The households that have grid electricity are not satisfied with the low voltage level and power cuts of upto 20 hours a day occurring for 20 days or more in a month. The supply is generally unreliable, erratic and of poor quality which has led to widespread mistrust for grid electricity. Even those households that can afford do not opt for connections in view of high tariffs despite long power cuts and voltage fluctuations. There is thus an unmet demand which can be met by setting up a mini power plant with a localized mini grid based on locally available resources. It can be credibly argued that in such a scenario, a mini grid based on biomass could benefit the villages by providing lighting to all the households, besides meeting the requirements in agriculture, services such as drinking water, street lights, shops etc.

4.3 Surveys in several States have indicated that continuous power cuts are a common occurrence and grid electricity is not available when required for domestic loads, community facilities such as street lights, drinking water or for irrigation. In electrified villages, people often have to resort to diesel generators to meet such requirements or for commercial and cottage/small industry loads. Even when all the villages including those already deemed to be electrified and those to be electrified are connected to the grid, there would still remain a demand-supply gap of grid electricity in the form of unmet demand from households that may have grid electricity but are not satisfied; from as yet unconnected households; or, from other productive loads that could lead to income generation. Such an unmet demand is only likely to grow in future to support the projected rapid economic growth. In such a scenario, it will be necessary to deploy distributed renewable energy systems alongside grid electricity to meet the full demand for electricity in rural areas.

4.4 It is now possible to bring energy security to the villages through modern biomass conversion technologies that are capable of meeting the total energy requirements including cooking, electricity, thermal energy and motive power. Village-level, or Panchayat-level, renewable energy systems could comprise a mix of biogas plants, biomass gasifiers and biofuel-pumpsets, depending upon local resource availability and site conditions. The capacity of the energy production units could range from 10 kW to 100 kW for individual villages or go up to about 1 MW for cluster of villages served by a local grid. Assured energy availability through decentralized biomass energy systems will help to augment irrigation facilities and establish cold chains, which will give a major fillip to agricultural production and food processing. Dispersal of industrial activity from urban centres to rural areas will become possible through development of small-scale village industries.

4.5 Energy production is to be backed up by plantations of fast growing fuelwood and oil bearing trees which can be raised in wastelands and farmlands in and around the villages. The capital cost of the energy production unit and other infrastructure would have to be met through carefully targeted subsidies, with subsequent running cost to be met by the communities through appropriate user charges. Implementation can be achieved through the involvement of panchayats and local communities and association of energy service providers, with ownership resting with the community.

4.6 A programme on providing decentralized biomass energy could be taken up in about 200,000 villages comprising unelectrified villages and villages connected to the grid but having unmet demand. Majority of these villages would be remote and would lie in tribal and/or forest fringe areas. Extension to or strengthening of the conventional grid in the unelectrified or de-electrified villages would be infeasible and uneconomical, and transmission of power over the long distances to reach such villages would involve heavy losses.

4.7 A beginning could be made in 1,73,000 forest fringe villages, many of which are tribal. The National Afforestation Programme (NAP) is being implemented through the decentralized mechanism of the Forest Development Agency (FDA) and the Joint Forestry Management Committees (JFMCs). About 84,000 JFMCs have already been constituted in the States, and have been jointly working with the respective State Forest Departments. Where possible, JFMCs could be involved in the implementation of these projects.

5.0 Impact on Livelihoods and Quality of Life

5.1 Although the impact of such a decentralized programme in MW terms might be marginal, it would otherwise be significant in terms of population served and jobs created, which are the cornerstones of the current policy of the Government. This programme can make an important contribution to the "Bharat Nirman Yojana" through wage employment, self employment and creation of livelihoods; improving quality of life through provision of modern energy services; and, might impact rural-urban migration apart from contributing to all round socio-economic development of the rural areas.

5.2 Jobs can be created in plantation establishment and management; collection, preparation and trading of biomass, on the one hand, and in bio-oil production and power generation, on the other. Lowest investment is required in creation of jobs through plantations. Large agro-forestry projects being taken up by the private sector through contract farming are creating new avenues for employment in plantations. Atleast one full-time job can be created per hectare of plantations. Jobs would also get created in handling of biomass, bio-oil production and power generation. In addition, new jobs would get created and higher incomes would result from existing livelihoods through availability of energy in rural areas.

6.0 Test Projects on Village Energy Security

6.1 As a consequence of MNES and the Forestry Division of MOEF working in concert, test projects which have the potential to progressively bring "energy security" to all villages have been started. The Ministry of Panchayati Raj has also been involved with regard to the modalities of implementation through panchayats.

6.2 24 test projects have been taken up so far in three States, viz., Madhya Pradesh, Rajasthan and West Bengal. In Madhya Pradesh, the projects are being implemented by the Forest Department in 11 villages covering eight districts, namely, Seoni, Mandla, Hoshangabad, Dhar, Chhindwara, Jhabua, Betul and Harda. In West Bengal, the projects are also being implemented by the Forest Department in seven villages covering four districts, namely, Bankura, Jalpaiguri, Paschim Medinipur and Purulia. In Rajasthan, the projects are being implemented by the Zila Parishads of the respective districts in six villages covering six districts, namely, Sawai Madhopur, Bikaner, Jalore, Jhalawar, Baran and Jodhpur. In all these projects, which are in progress, electricity will be provided through biomass gasifiers and the cooking energy needs will be met through improved cookstoves and cattle dung based biogas plants. Plantations of fast growing species are being taken up; Village Energy Committees have been set up; and, a Village Energy Fund has been created in all the villages, as per the Guidelines.

7.0 Test Project in Kasai Village

7.1 The country's first test project on Village Energy Security through Biomass was dedicated on October 29, 2005 in Kasai, a remote forest fringe village in Betul District of Madhya Pradesh. Kasai is an adivasi village situated in the Satpura ranges. It has 55 households that belong to the Korku tribe. The main crop of the village is Kutki (food grain) and villagers also collect minor produce of Harad, Chironji and Amla from the nearby forest for their livelihood. The village is endowed with abundant biomass resources in the form of wood (forests and farm land), crop residues, cattle dung and oil seeds. The energy

demand for this village is mainly for cooking, electricity for domestic and community use, water pumping and commercial activity like shops, running of Atta chakki and milk chilling plant.

7.2 The project aims at meeting the total energy requirements through locally available biomass material The energy production unit comprises of two 10 KW biomass gasifiers and engine-gensets, which will provide electricity for various requirements in the village. To start with, lights for each household, school, engine room and streets have been provided. A flour mill has been energized and a water pump and milk chilling unit are also proposed. Few households have started to use music systems and televisions. Plantations of fast growing species have been completed in 10 hectares of land around the village to ensure sustained supply of wood for the gasifiers. An expeller unit will also be installed to produce bio-oil from the oilseeds of the Jatropha plantation, which will be used for running pumpsets. Improved chulhas have been constructed in every house to conserve firewood, and biogas plants are being built to provide cooking energy to the households.

7.3 The project is being managed by the Village Energy Committee which has been constituted by the Gram Sabha as the Sub-Committee of the Gram Panchayat. The VEC comprises of 11 members including 5 women members. The VEC is responsible for all aspects relating to operation and maintenance of the project, fixing and collection of user charges. Two accounts have been opened by the VEC, viz., Capital Account for depositing the grant for capital assets and the Revenue Account for maintenance of the project. The accounts are being operated jointly by President VEC, Range Officer and a representative of the NGO. A Village Energy Fund has been created with initial contributions from each household. User charges of Rs. 120 per month from each household will also be deposited in this fund to meet the expenditure on operation and maintenance. Three local youth have been trained for operation and maintenance of the systems.

7.4 The tribal folk of Kasai village who had been living in total darkness for ages are delighted with this intervention. With the advent of electricity for the first time in their village, they have already celebrated Diwali. The project has provided a ray of hope to them for development of their village, income generation and improvement in their quality of life.

7.5 Among the other test projects taken up so far, 11 projects are being implemented in eight districts of Madhya Pradesh. Apart from Kasai, another three projects are likely to be completed next month. These projects are being implemented by the Forest Department of the State.