Rural and rural energy development in India

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Abstract
Over 70% of the population in India lives in the rural areas of the country. The needs of this vast population, subsistence or otherwise (livelihood related), have been addressed by several programmes and initiatives guided by central or state policies. The policies or ensuing programmes have, however, been sectoral-planned and managed by specific ministries or departments. Energy too has been dealt with as a specific sectoral need of the people rather than an integral component of the overall rural development process. As a result, meeting the energy needs of the rural masses, whether for irrigating their fields or fueling their cook stoves, still remains a challenge for the country. On the other hand, initiatives in say, agriculture or health remain incomplete or wasteful without the appropriate energy inputs being ensured.

The paper examines these inter-sectoral linkages that need to be identified and studied from the perspective of planning for the needs of the people in a comprehensive and coherent manner. The paper begins with a critique of the approach to rural development in India. In line with this, a review of the development of the energy sector in the rural areas is undertaken and the issues therein are discussed. The inter-sectoral and sub-sectoral linkages that can be forged to deal with some of these issues in the development of rural areas, specifically in the energy sector, are elaborated with specific examples. The paper also brings forth the institutional arrangements required to establish and address these linkages.

Introduction
Over a quarter of the world’s poor are concentrated in India. With the sustained efforts of government interventions, the proportion of the population BPL (below the poverty line) has been brought down from 54.8% in 1973/74 to 35.9% in 1993/94 and further to 26% in 1999/2000. The rural poverty during
this period has also been brought down from 56.4% in 1973/74 to 37.27% in 1993/94 and to 27.09% in 1999/2000. Even so, the latest estimate by the Planning Commission (for 1999/2000) shows that more than 26% of the country’s population (260 million people) continue to live below the Poverty Line (BPL). Of this, 75% (about 193 million) live in the rural areas (<http://planning_commission.nic.in/search.htm> accessed on 29 September 2002).

Rural poverty also affects urban poverty through rural-urban migration. It also creates unfavourable impacts on the economic and political stability of the country. Therefore, any attempt to alleviate poverty should begin with the elimination of rural poverty.
However, despite this obvious relationship, the elimination of rural poverty has not received the desired impetus. Simple handout solutions, such as distribution of food, housing, and other necessities by the state is not a sustainable approach to securing people's well being in the long run. Instead, arrangements that provide the rural people equal access to resources and services and create a state of well-being that enables them to afford the resources and services are required. In this regard, energy is critical both as a resource and a necessary input for creating this state of well being in the rural areas.

A major challenge faced by the country today is how to promote successful energy transitions (to the use of cleaner technologies and fuels) in the rural areas. The challenge still exists despite the several decades of effort by the government to promote a "fuel switch" and energy conservation in the rural areas. Most critical to bringing about rural energy transitions, especially amongst the poor, is to increase the incomes of people enabling them to afford the transitions—in fuel or technology. However, there are very limited opportunities to generate direct employment or enhance incomes through energy-related interventions, especially when these are planned and implemented in a piecemeal manner. Also, the energy interventions need to be supplemented/complemented with other developmental initiatives that will bring about an overall improvement in the rural economy, thereby making energy transitions a reality. It becomes critical, therefore, to review how the overall rural development in the country has fared, and within that how development of energy products and services has taken place in order to draw some inferences for the future.

**Rural development in India: approach and lacunae**

Despite the numerous programmes and initiatives of the government, rural development in India has not impacted the local economy in a manner that has fostered growth and increased the incomes of the rural people. It continues to be centrally planned and target based. The programmes/projects are planned at the level of the respective ministry and the
participation of the relevant stakeholders or the community is negligible. A case in point is *Pradhan Mantri Gram Sadak Yojana*, a programme recently launched by the Ministry of Rural Development that seeks to connect all the villages, with a population of more than 500 persons each, by the end of the Tenth Five-Year Plan. This programme is expected to have a direct impact on the rural economy connecting a large section of the rural population and bringing them into the mainstream developmental processes. However, a closer look at the scheme of the Department of Rural Development to connect all the villages, with a population of above 1000 persons each, within the next three years seems over-ambitious (Ministry of Rural Development 2002, Annual Report, 2001/02, Government of India).

The target-driven approach to rural development has also neglected the quality-related aspects. Rural development projects in India are supply driven and are based on formulae determined for the entire country. For example, the IRDP (Integrated Rural Development Programme) now a part of the SGSY (*Swarnjayanti Gram Swarozgar Yojana*) primarily attempts to build income-generating assets for the poor, backed by some training efforts. However, the retention of assets one year after the project has only been between 10–20%. Likewise, under the *Indira Awas Yojana programme*, Rs 20000 per unit is the ceiling for construction assistance in the plain areas, while for the hilly areas it is Rs 22000, which again seems unrealistic.

The need for coordination is most acute in rural development projects since it involves practically every department. Within the ministries, lack of inter-departmental coordination results in wastage of resources. For example, most of the housing schemes of the Ministry of Rural Development implemented by the Department of Rural Development (*Gramin Vikas Vibagh*) do not deal with water and sanitation aspects (except for the *Indira Awas Yojna programme*, in which a sanitary latrine is part of the dwelling unit constructed under the programme or the *Samagra Awas Yojana Programme*, which has been recently launched, in 1999/2000, and talks of an integrated provision of shelter,
sanitation, and drinking water) as integral components of rural housing. On the other hand, the Department of Drinking Water Supply (Peya Jal Poorti Vibagh), which is not concerned with rural housing programmes, deals with rural water supply, and sewage, drainage, and sanitation relating to rural areas. A multiplicity of schemes and programmes also leads to a diminished focus and lack of an overall direction. For instance, there are five schemes for rural housing under the Ministry of Rural Development and nearly all are credit-cum-subsidy schemes for shelter provision.

Similarly, there is also a multiplicity of ministries and departments dealing with a particular rural development need. For example, while the supply of water for drinking purposes is under the Ministry of Rural Development that of irrigation water is being dealt with by the Ministry of Power (energization of pump sets) and the Ministry of Water Resources (major irrigation works). Further the Ministry of Water Resources is also responsible for the development, conservation, and management of water as a national resource. The Ministry of Agriculture has been instrumental in providing credit to farmers, for the development of minor irrigation, through commercial banks, regional rural banks, co-operatives and NABARD (the National Bank for Agriculture and Rural Development). The Ministry of Rural Development also provides credit for the development of minor irrigation projects. At the state level too such compartmentalization can be seen. For example, in the state of Rajasthan, while the improved cook stove programme is under the purview of Panchayati Raj Vibagh the Department of Rural Development is managing the biogas programme.

Other renewable energy programmes in the state are under REDA (the Rajasthan Energy Development Agency). Such institutional arrangements overlook the fact that the people have and appreciate a common-solution approach to their energy needs.

Perhaps the most critical lacuna in the rural development sector in India has been the lack of a common vision. There are several stakeholders that play a major role in shaping policy and in effective implementation. These include the
rural poor, the district rural development agencies, the public works engineers, the local governments, the contractors, and the central ministries. The need for active participation by all the stakeholders in the planning, implementation, monitoring, and evaluation of the rural development process has been emphasized. However, no effort has been made to institutionalize this participation. At grass-roots level, there is a tendency to equate decentralization with participation. Not discounting that decentralization is a necessary pre-requisite for initiating effective participatory processes, it does not automatically lead to participation.

At grass-roots level, a 'single window' approach to planning and implementation has been attempted through the setting up of the DRDA (District Rural Development Agency) and the BDO (Block Development Office) at the district and block levels, respectively. However, the administration at these levels is so used to working in compartmentalized structures that an integrated and coordinated approach to planning and implementation becomes an unusable concept.

In this regard, the issue of social equity becomes important as programmes and projects seem to benefit outsiders or the affluent in the rural areas rather than the needy or the poor. In many cases, the poor and other vulnerable sections of the rural population are most likely to be left out of the development process due to the lack of a common voice or mechanism to express their opinion at the decision-making level. The current policy framework also does not envisage a role for women in the development process.

The poor performance at grass roots level is also due to the lack of required expertise, largely at the district level. The central government has sufficient expertise to help shape the projects broadly and also has the support of research and academic organizations (e.g. the National Institute of Rural Development). However, such support or expertise is not found at the district or block levels.
The lack of ownership of the project, both by the lower bureaucracy and the people, is another problematic issue. Rural development projects tend to be influenced by political interests, which also specify the target group, the sector of intervention, and the time period for realizing objectives. The implementing agencies, therefore, have little role to play and the feasibility of the project is only incidental.

**Rural energy development in India: a critique**

Recognizing the critical role that energy plays in the development of the rural areas, the GoI (Government of India) has taken several initiatives in the past to promote a fuel switch to the use of fossil-based fuels, such as kerosene, by introducing heavy subsidies and setting up extensive rural infrastructure (e.g. the public distribution system). Likewise, the government has also been active in improving the supply of bio-fuels and introducing new and renewable sources of energy, as alternative fuels, to meet the demands of the rural populace. The 1980s saw two significant efforts to address the rural energy problem. In 1981/82, the government launched the NPBD (National Project on Biogas Development) and in 1983, the NPIC (National Programme on Improved Chulhas). The NPBD is the largest rural energy programme in terms of investment and the NPIC is the largest in terms of the number of devices disseminated. Additionally, in 1982 the DNES (Department of Non-Conventional Energy Sources) was set up for research and development, demonstration, and dissemination of renewable and rural energy technologies. In 1987, IREDA (the Indian Renewable Energy Development Agency) was established under the DNES for developing, promoting, and financing commercially viable new and renewable energy alternatives in the country. In 1992, the DNES was upgraded into a full-fledged ministry, the MNES (Ministry for Non-Conventional Energy Sources).

Recognizing the extremely area-specific nature of the rural energy problem and the wide variations that exist in the socio-cultural environments in rural areas, an attempt towards decentralized area-based energy planning at the block level was made in the IREP (Integrated Rural Energy Programme) that was started as part of the Sixth Five-Year
Plan and, at the village level, in the Urjagram programme started during the Seventh Five-Year Plan.

The other major programme for energizing rural areas has been that of rural grid extension. The rural electrification programme of the government, which is the largest rural energy programme today, claims to have electrified more than 85% of the 580,000 villages in the country (CEA 1996). However, only 37% of the rural households have electricity connections (GoI 1997a).

Energization of agriculture pump sets has been the other major programme of the government in the rural areas, which was initiated in the early 1950s along with other policy measures such as the underpricing of power for irrigation. The objective was to give a boost to the agriculture economy in the country. However, in the absence of specific groundwater policies (that do not limit either the number of bore wells/pumps or the pump spacing) the problem of excessive extraction of groundwater has assumed alarming proportions. The number of energized pump sets has increased rapidly, it is estimated that there would be 8 million diesel pump sets and 14 million electric pump sets operating in the country in 2001/02 (Maggo 1998).

Other policies, such as electricity tariffs based on a flat rate per unit of installed horsepower have lead to both wastage of power and over-exploration of groundwater resources.

Accordingly, the shortfalls in rural energy development can be categorized under the following broad heads.

Policy
As of now there is no rural energy policy for the country, which perhaps is the most overarching factor contributing to the poor development of the energy sector. However, the policies that do exist in other sectors and greatly impact rural energy use also prove the case in point. The most glaring example in this regard is the subsidy extended for irrigation in the agriculture sector. The flat tariff rate has been a strong incentive for prolonged pumping and installation of oversized capacity pumps leading to wastage of both electricity and water. It has left the consumers with hardly any incentive to conserve power or improve efficiency. Likewise, the state electricity boards too have little resources left to improve the reliability and quality of supply.

Planning
In line with the overall rural development planning process in the country, the rural energy programmes are also planned at the central level (the ministry level) that fixes the targets for various states on an annual basis (Box 1). There is, therefore, no assessment of the felt need for the technologies or services at the local level. The rural energy programmes are also technology driven. The emphasis, therefore, is on disseminating technologies rather than a package of products and services. The planning of the programmes is also not in tune with their primary objectives. For example, the improved cookstove programme (the NPIC) was conceived as a demonstration programme. However, limited efforts were made to identify appropriate demonstration sites where the cookstove would address a felt need of the community.

Box 1. Rural energy planning: the target game
The fixation with targets in rural energy development is best illustrated from a personal field experience. While studying the improved cook-stove programme in rural Rajasthan, the research investigators found that unable to install the targeted number of improved cook stoves, a self employed worker had to forgo a portion of his
salary. Hence, the level of motivation to mobilize the community and aspects such as quality control, setting up repair and maintenance facilities, or user training were not the least of concerns of this worker.

As in case of nearly all-rural development projects in the country, the rural energy programmes too are removed from financial appraisal and are considered areas of essential spending. A primary focus on the achievement of physical and financial targets reinforces this approach. As a result, the essential steps of the feasibility assessment including data collection, study of similar experiences in other countries, and internalization of different costs-social and environmental-are not factored in. Even if these steps are carried out, they are implemented at the design stage and there is no scope to do the same at the field level.

**Financial aspects**
The ‘product subsidy’ (on energy efficiency) that aimed at benefiting the poor has achieved partial success. Most of the poor persons in the rural areas remain untouched by these programmes. The social reality that the poor are largely in a vulnerable position and, hence, are unable to voice their opinions is often overlooked while planning and implementing programmes. Further, the subsidy on product design-energy efficient, or renewable-has also stifled innovation as in the case of solar photovoltaic products. There is, therefore, no existing ‘range’ of energy products to cater to the wide variety of needs of the rural people. Lack of clarity in approach as reflected in both commercialization-based and subsidy-driven promotion of the RETs (renewable energy technologies) has also lead to ambiguity and lack of direction.

Perhaps the most critical barrier in the development of rural energy markets has been the absence of local credit lending mechanisms. Though there has been a massive spread of micro-credit across the rural areas, there has been no attempt to tap these areas effectively for promotion of rural energy products and services or the effort has been to create exclusive groups for financing. A similar approach has also
been seen in the efforts to involve communities in rural development projects, including energy programmes. A host of user groups or committees are formed at the village/block levels, which at times are exclusive of the panchayat. Such large numbers of groups have a short life. Further, creating parallel decision-making structures is also not very conducive to the development of the village.

Implementation
In pursuit of targets, the extension workers at grass roots level hardly concentrate on elements of program sustenance such as motivation, quality control, maintenance and repair, capacity building, institutional strengthening, and community mobilization. The block-level officials (including the extension workers) are overburdened and, therefore, lack the necessary motivation to organize and involve communities. In any case, these elements or ‘processes’ are not accounted for in the annual performance of the state/district. The state nodal agencies or block level functionaries, therefore, have no incentive to invest their time on such aspects.

Research and development
There has been limited support for product development in case of technology-based programmes such as biogas and photovoltaics. There has also been no follow up to improve products or programmes based on the numerous evaluations. Since there is little flow of information/feedback between the laboratory and the field, the options for rural masses remains very limited.

Similar weaknesses in rural energy programmes based on the integrated decentralized approach (such as the IREP and Urjagram) have also been recognized at the policy level. The Ninth Five-Year Plan document states, ‘The programs that are socially oriented like biogas, improved chulhas, and the IREP could not make the expected impact in changing the lifestyle of the people mainly because of the weak institutional set-up, lack of a suitable mechanism to maintain and put the non-functional systems back into operation, lack of locally
available trained and skilled manpower where such systems were installed, etc’. (GoI 1997b).  

There are also some specific problems related to the type of energy delivery service. For instance, the poor rate of household electrification is both on account of the inability of households to afford electricity connections as well as the low demand on account of the poor reliability and quality of the existing supply. On the other hand, the state electricity boards have little incentive to extend or improve the grid on account of the low demand and the heavy subsidies. The net result is that at least 70-80 million rural households still depend on kerosene lamps for meeting their lighting requirements. At the planning level, rural electrification has been equated with village electrification schemes on the demand side, which have more or less focused on household lighting. On the supply side, rural electrification has been understood as grid electrification and if grid extension was not viable, the emphasis has been on electrifying villages through renewables. Such a lop-sided approach to energizing rural areas has led to low levels of penetration and delivery of poor quality services.

The critical issues in rural energy development: planning and implementation

Efficacy of the 'fuel-switch' policies
There is a wide gap between the yardstick of success as put in place by energy planners and grass roots realities. For instance, the energization of villages is taken to be a measure of the success of the rural electrification programme in India. The concerned authorities take pride in announcing the electrification of 87% of the Indian villages. However, the fact is that electrification is not the panacea for energy scarcity in the rural areas of developing countries. Even as the numbers quoted by the authorities are impressive,


5 According to the draft Tenth Five-Year Plan for 2002-07 of the Planning Commission, Government of India.
the actual numbers of households that are electrified is
dismally low (about 37%). The reasons for not taking
household connections are several. One of the prime factors
is the unwillingness to pay for the monthly bills in the face
of an erratic power supply of low voltage. The flat rate
charged irrespective of levels of consumption is another
reason.

Similarly, the data on a ‘fuel switch’ to say the use of LPG
(liquified petroleum gas) is counter to the field reality.
The penetration of LPG in the rural areas is extremely low.
Moreover, the households with LPG have not completely
switched over to the use of LPG and continue to do the bulk
of their cooking with biomass (i.e. wood, animal dung, and
crop residues). Field experiences have shown that in most
households, an LPG cylinder lasts for 2-3 months typically.
Many households do not get their cylinders refilled as they
are not convinced about paying this recurring cost when wood
is freely and easily available (in resource rich areas).
Further, with the impending increase in LPG prices, there are
also cases of people selling their connections. It is also
commonly seen that families where in the head of the
household is educated (or in service) are typically the ones
that use LPG for nearly all of their cooking needs. This was
seen in a recent study carried out by TERI in the villages
located in the fringes of the Ranthambhore National Park,
district Sawai Madhopur, Rajasthan. Here, it was the Brahmin
families (Head of household in service) who were using LPG to
meet all their cooking needs. This socio-economic reality has
to be understood and kept in mind while planning for energy
transitions in the rural areas.

Existence of a ‘gender bias’
The rural energy problem has a distinct gender dimension
because men and women do not bear the burden of the worsening
ecological scenario equally. Women play a key role in
biomass-based rural energy systems found across the country.
They are the primary collectors and users of traditional
biomass resources and are responsible for performing
household duties involving energy use. Consequently, women
are most acutely affected by environmental degradation and biomass shortages.

On average in India, women expend about two to six hours and walk four to eight kilometers in order to collect about 10 kg of fuel wood for their families every day (Batliwala 1995). Case studies in villages in Gujarat showed that in situations of extreme scarcity, women increasingly rely on animal dung, roots, twigs, shrubs, grasses, and weeds for fuel. These inferior fuels take longer to collect, due to the greater quantity needed for daily cooking, given their lower calorific value; do not provide continuous heat; need to be constantly tended; and also increase cooking time (Nagabrahman and Sambrani 1983). The latter results in increased exposure of women to smoke-filled kitchens. Studies in India and Nepal of women exposed to biomass smoke – but who did not smoke themselves – found that their death rate from chronic respiratory diseases was similar to that of male heavy smokers (World Bank, undated). The health and social cost of fuel insufficiency and device inefficiency is therefore high, and has the greatest impact on women and children.

However, when rural energy programmes are planned and implemented, the tendency is to approach the men of the household. The classical way of defining a farmer is that the farmer is a man. Such stereotypical attitudes are the main barriers to implementing successful programmes. At the programme level, the insensitivity to women’s problems is also seen in the implementation processes. Gender bias is observed in the working and staffing of agencies involved in implementing rural energy programmes. The extension agents

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are mostly men and, as a result, the women hesitate to interact with them. Further, most of the extension workers contact the head of the household, who is a male, even if the information is of relevance to women, who are the users (Moghe 1993).\footnote{Moghe, Kiran. 1993. Commercial marketing for the Indian NPIC - National Programme on Improved Chulhas. Boiling Point, 30.} Meetings held for prospective owners of improved stoves are also attended mostly by men who are not the prospective users. Women extension workers, on the other hand, can help in gaining access to women users compared to their male counterparts (Malhotra, Dutta, and Ramana 1998).\footnote{Malhotra, P., Dutta, S., P Ramana, V., 1998. Participatory rural energy planning: a handbook. Tata Energy Research Institute, New Delhi.}

Lack of an intra-sectoral approach
There is little coordination while planning the targets of the several rural energy programmes even under a single ministry. The targets of programmes like the NPIC and the NPBD, for example, are determined independent of each other such that, for a given region, the combined target of biogas plants and improved cook stoves could be far in excess of the potential demand. Thus, organizational resources are wasted in pushing both (Ramana 1998).\footnote{Ramana PV. 1998. As if institutions matter: an assessment of renewable energy technologies in rural India. Enschede: University of Twente. 257 pp.}

Lack of a holistic approach: linking energy to productive use and income generation
Past experiences indicate that government efforts at rural electrification based on RETs usually target only the provision of minimum energy for lighting and cooking as they are limited by the availability of financial resources. They do not focus on linking the provision of electricity services with productive use and income generation. In addition, these programmes support the initial capital investment only. Requirements such as those for replacing the battery, operation and maintenance, and development of a market support infrastructure etc\footnote{Market support infrastructure in this context refers to user awareness on the usage of electricity, supply and service of appliances, availability of trained and capable technicians, etc.} get neglected. As a result, these
initiatives are short-lived, do not provide reliable services to the community and, hence, do not contribute towards the economic development of the region. In other words, inadequate institutional infrastructure and capacity for integrated planning, implementation, co-ordination, and follow-up, adversely affect the sustainability, replicability, and widespread use of RETs for rural electrification markets.

Rural energy use: social equity, economic, and quality-of-life issues

In India, rural development and rural energy development have so far remained exclusive of one another. A ‘sectoral’ approach to development continues to define the policy and programmatic approach to determining poverty alleviation solutions. Within the special forte of rural energy, a sub-sectoral approach can be seen even after four decades of planning and policy making and numerous studies and research results highlighting the lacunae and weaknesses of such an approach. This sector-specific approach to rural energy development has led to a rural-urban divide in terms of the availability of energy resources and services, giving rise to social equity issues. Taking one specific sector, say the household sector, vast disparities can be seen in the type and quantum of energy used (Figure 1).

Source NSSO (1997).¹³

Such disparities have meant a denial of opportunities and choices to the people living in the rural areas exacerbating the cycle of poverty. The impacts of such a disparity in the energy mix become all the more difficult for the rural masses to cope with in the event of other limited means—infrastructure, credit, information, etc. Although no direct correlation between deforestation and rural energy use has been established—the demand for agricultural land and the industrial and commercial requirements are considered the principal causes—there is evidence that where the land is already degraded, fuelwood extraction could exacerbate the process (TERI 1996).14 Fuelwood is the primary energy source for cooking, used by rural households (78%) (TERI 1999).15 In actual volumes as well, fuelwood ranks first, at 252.1 million tonnes; followed by dung-cakes, at 106.9 million tonnes; and agricultural residue, at 99.2 million tonnes (the figures refer to annual consumption) (TERI 1992).16 With domestic households as well as rural industries using increasing quantities of fuelwood, this situation can only worsen in the future. Further, given the pressures of a high population growth rate, the forest and public lands in the country are in various stages of degradation severely affecting their carrying capacity. Out of India’s population of one billion, 360 million live in or around forest areas, exerting tremendous pressure on the limited forest resources. Of these 360 million, more than 68 million are tribal/indigenous people, a large percentage of who constitute the most disadvantaged section of society (based on per capita income, literacy rate, nutritional and health status, and lack of access to social and technical services) (<www.forestsandcommunities.org>, accessed on 3 December 2001). It is this section of the population, which is most severely affected since they are dependent on the natural (forest) resources for their subsistence and livelihood needs.

At the local level, receding forests add to the drudgery of women who have to travel longer distances in search of fuel, or, in extreme situations, are forced to switch to inferior fuels such as roots, weeds, and leaves. An estimated 84% of the rural women aged 10-59 years are affected by fuelwood scarcity in India (UN 1995).\textsuperscript{17} The time spent on fuelwood collection is enormous. In a study carried out by TERI in Munjasar village of the Jodhpur district, an arid region of Rajasthan, on an average, a women or child was spending 833 hours per year on fuel collection by head load. This is equivalent to spending 104 person days on just fuel collection (TERI 1997).\textsuperscript{18} The health impacts of over-dependence on biomass are substantial and affect women and children most severely. The burden of carrying large head loads of wood over long distances is known to cause ailments such as muscular pains, backache, and pregnancy-related problems. It is estimated that up to 444 000 premature deaths in children under 5 years, 34 000 cases of chronic respiratory disease in women under 45 years, and 800 cases of lung cancer are attributed to IAP (indoor air pollution) due to use of the solid fuels by households in India\textsuperscript{19}.

There are also economic implications of such an energy-use pattern. For instance, local communities are known to buy food since their requirements are no longer being met from the household due to a decrease in soil productivity, as a result of diversion of animal dung from manure to fuel coupled with the absence of irrigation water (TERI 1997)\textsuperscript{20}. The use of agricultural residue and dung as energy sources, instead of fertilizers, reduces the soil nutrient level. It has been estimated that out of the total nitrogen content of


\textsuperscript{19}Energy and Health for the Poor. Indoor Air Pollution Issue No. 7. The World Bank, July 2002.

\textsuperscript{20}TERI. 1997. Micro level coping strategies by rural women for managing biomass resources. Submitted to The John D and Catherine T MacArthur Foundation Chicago, USA.
the dung production of 1.35 mt (million tonnes) annually, 0.4 mt are lost annually through the burning of dung as fuel (Ravindranath and Hall 1995). The consumption of crop residue as a fuel results in significant loss of soil nutrient value. The water retention value of the soil is also reduced increasing the need for irrigation.

The rural energy crisis, therefore, is primarily manifest in natural resource, health, time, and technology impacts. These translate into a variety of more general human health and livelihood issues, such as a decrease in food production; poor nutrition (lack of fuel to cook foods and switching to less nutritious, but easier to cook foods); lack of education (for the girl child); decrease in the household income (because women’s time is not available for income-generation activities); and, ultimately, distress migration (complete biomass and livelihood system breakdown leads to male out-migration in search of employment).

**Rural and rural energy development: lack of an inter-sectoral approach**

Often, the problem-solving approach in India’s planning efforts has been sectoral. A classical example is the treatment of water and energy problems in isolation. Highly subsidized power supply policies for agriculture have major implications for the power sector and the water resources (Box 2). Since farmers have to pay little for the power they use to draw water, there is a tendency to exploit it. On the other hand, the chronic shortage of power and the irregular supplies have had farmers withdraw maximum water during the limited time that power is available using oversized and inefficient pump sets. Lack of access to reliable water supplies perpetuates the poverty cycle, in which the farmers are forced to sell their limited assets and migrate. This is primarily because the availability of groundwater is

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22 Crop residues not only maintain the organic content and humus of the soil, but also provide surface protection. Reduction in crop residues thus makes the soil vulnerable to erosion and drought.
relatively independent of rains, and assured means of groundwater availability have a direct positive impact in terms of reducing poverty. Further, since groundwater can be accessed at the time and in the amount a farmer requires, farmers with groundwater access can avoid the political, caste, and other dynamics that often limit water access to the poor in large irrigation systems (<www.usaid.gov/in> accessed on 13 August 2002).

At the institutional level, while aspects related to water are of concern to the irrigation department or the agriculture department, the provision of electricity is the responsibility of the electricity department. Pricing of electricity and water is also not conducive to efficient water use.

Box 2. Power subsidies: loss of developmental opportunities
In Andhra Pradesh, power subsidies to the farm sector amount to 2% of the gross domestic product and 12% of the total fiscal outlays, comparable to the state’s expenditure for education and more that double its expenditure for health. Similar figures for Uttar Pradesh indicate that accumulated power sector subsidies of 3.7 billion dollars represent a lost opportunity to build 340 000 primary health centres or lay 250 000 kilometers of tarred roads or build 1.13 million primary schools.


There is, therefore, a need to expand the domain of energy (power) planning to include water wells, the exploitation and recharge of aquifers, and the management of the watershed, as a whole.
Another example that can be given in this regard is related to perhaps the most pertinent challenge being faced by the country, i.e., food security. A solution of the food problems in countries like India is not possible without solving the energy problem—of insufficiency and efficiency. A major challenge faced by our country is that of food security. According to the draft Ninth Five-Year Plan, the food grain consumption is likely to increase from 194.7 million tonnes in 1996/97 to 298.4 million tonnes in 2011/12. In order to meet this demand, the food grain production is projected to increase from 198.53 million tonnes to 304 million tonnes during the same period (Maggo 1998). This expected substantial increase in food grain production cannot be achieved by increasing the area under agriculture, as reflected in past trends. The net sown area in the agriculture sector has more or less remained the same since the terminal year of the Fourth Five-Year Plan, due to the pressure on land from other sectors of the economy. As a result of this, there will be an increase in the gross sown area or the intensity of cropping, in order to achieve the desired agricultural output. The intensity of irrigation will also need to be increased on a commensurate basis. The percentage of gross area under irrigation is projected to increase to 49.4% (Maggo 1998). This will call for a matching increase in the input of energy in the agriculture sector. There is hence a need to give impetus to developing integrated food and energy systems. One such example could be that of an agro-silvo-pastoral combination producing food, energy, and forest products.

However, the critical questions that need to be addressed in this context are the following.

- Have rural energy programmes supported or detracted from equity-oriented development programmes, such as land reform, and the provision of rural infrastructure and services?
- Is there a built-in bias in favour of urban systems at the expense of rural systems?

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• Are agricultural extension services giving sufficient attention to resource-conserving methods capable of increasing yields without significant extra energy inputs?
• Can existing ‘high output agricultural systems’ be modified to include the production of rural energy as well?
• Is enough being done to promote agro forestry?
• Can forestry, agriculture, water supply, and energy not be better linked by using a watershed management concept?

• Is experimentation with bio-energy and other technology for integrated food and energy systems being carried out in the context of the entire socio-environmental systems, within which the potential users really live and work?

In this context, programmes on rural electrification are also more likely to succeed when the overall conditions are right for rural income growth, i.e. when incentives are present for the development of agriculture and agro-industries. Likewise, such programmes are more likely to succeed when electrification is based on, or accompanied by, complementary social and economic infrastructure development such as rural water supplies, health programmes, primary and secondary education, and regional and feeder roads. Rural electrification clearly contributes to, but is not a substitute for, other rural development interventions.

Similarly, rural people have never regarded forestry or tree planting as an activity separate from their other productive activities. The management of trees and shrubs forms an integral part of their land-use strategy. However, since most rural development projects have tended to be organized on a sector basis, e.g. agriculture, forestry, or animal husbandry, with each sector ignoring the contribution of the others within the same land-use system, the people’s real land-use strategies have rarely been reflected in the rural development initiatives. In this context, while fuel wood shortage would be seen as a forestry problem, declining soil fertility would be the concern of the agricultural sector. Rural people make no such divisions. Thus the technical and sectoral approach taken in dealing with the ‘fuel wood
crisis’ has failed to recognize the inter-related nature of rural development problems (<www.forestsandcommunities.org> accessed on 4 December 2001).

**Alternative pathways**

Rural energy programmes continue to be planned and implemented in isolation from programmes on rural sanitation, health, literacy, housing, infrastructure development, etc. There is a realization at the policy level of the need for integrating programmes for the development of non-conventional energy sources into other development programmes of the central and state governments (GoI 1997b). However, in the absence of an overarching and comprehensive rural energy policy, the planning and implementation processes lack the necessary direction to achieve the overall objective of sustainable development of the rural areas. The following measures, therefore, need to be urgently addressed.

**At the policy level**

There is a need for an overarching rural energy policy encompassing a holistic approach to tackling the problems of the rural masses in meeting their energy-based requirements. In doing so, one needs to have a multi-sectoral approach wherein energy is seen as an essential input, which drives the process of social and economic development. The policy needs to address two critical issues in a comprehensive manner, access to and affordability of reliable and quality energy services. Similarly, it should look at the entire gamut of fuels (renewables, biomass, and fossil-based) and technologies rather than compartmentalizing into technology or fuel-based initiatives. Fostering of energy markets, which offer a wide menu of options to the people at affordable prices, is the way to the future. Targeting subsidies to the poor and disadvantaged and diverting them to other ‘software’ issues, such as capacity building, infrastructure support (e.g. for repair and maintenance), capital for setting up energy-based enterprises, and initiating/supporting micro financing, is required.
At the institutional level

It is important that the concerned ministries, such as the MNES, the Ministry of Rural Development, the Ministry of Power, and the Ministry of Environment and Forests, develop mechanisms for frequent consultation and effective coordination in order to set realistic objectives, realizable time frames, effective monitoring mechanisms, and procedures for increased accountability and transparency.

There is tremendous scope for finding common grounds in the functioning of the various ministries, which will help avoid duplication of effort and, thereby, check wastage of resources. For example, most of the programmes of the Ministry of Rural Development are geared towards creating assets and providing employment. However, none of these programmes that aim towards poverty alleviation talk of energy as an important tool for social and economic change. The programmes aim at providing basic utility services, however, nowhere has the provision of basic energy services been integrated. There is considerable potential for integrating the delivery of energy products and services in these schemes. For example, under the programmes for self-employment (the SGSY), the energy entrepreneurs or the skills of existing entrepreneurs can be strengthened to provide quality energy products and services. The concerned ministries can pool their resources for setting up and supporting the market infrastructure for the individual swarojgaris, or self help groups, in which along with other goods and services, energy products and related services can also be provided. Similarly, under housing programmes (such as the Pradhan Mantri Gramodaya Yojana or Samagra Awas Yojana programmes) where other support services like credit and subsidy are already available, technologies such as a smokeless chulha, biogas plants, and solar photovoltaic lighting products can be easily provided. Some effort has been made by making the smokeless chulha an integral part of the Indira Awas Yojana programme. However, there is room for much better coordination and pooling-in of resources at the ministerial and department levels.

Better networking is also required among the various stakeholders—the government corporates, foreign and national
funding agencies, NGOs (non-governmental organizations), community-based organizations, PRIs (Panchayati Raj Institutions), etc. Some efforts have been made in this direction with the Working Group on rural electrification for the Tenth Five-Year Plan (2002–2007) suggesting that the government do a survey in collaboration with the PRIs to determine the unelectrified villages in remote areas (<www.renewingindia.org> accessed on 14 September 2002). Likewise, in cases when it is not sufficiently attractive for the private sector to provide off-grid rural electrification, NGOs or civil society could be directly involved. For this to happen, there is a need to build the capacities of local institutions in technical and financial matters. This needs to be seen as a process that empowers people financially and politically, i.e., in the ability to make decisions, for the long-term sustainability of rural development programmes.

At the planning level
There is a need to design integrated systems that meet the twin needs of market and subsistence. Energy systems need to be designed that allow for a complex transitional pattern of energy use in which fossil-based fuels such as coal, diesel, and kerosene continue to share a place with the new and renewable energy sources. This is also reinforced from the experience in the household sector in which a complete switchover to the use of new (commercial) fuels is not being witnessed. It is, however, important to ensure that the system addresses the subsistence needs that include household requirements (say for lighting, cooking, and space heating) as well as social purposes (new fuels). Such systems can be designed only with the people participating and are bound to find wide-spread acceptance.

In this context, Alburquerque (1986)\textsuperscript{24} has identified the following five basic steps.

- Description of the system to be studied
- An energy analysis of the system

Identification of possible technological paths for the supply of energy to the system
An assessment of alternative technological paths
A plan for the introduction of the chosen project.

The complexity of such an analysis involves a trade-off between the quantity of detailed information required and the resources available. Where base-line data exists, this must be sourced. However, the relevant data is sometimes found in places where many energy planners would not think of looking, such as nutrition surveys or anthropological studies. Also, not all the relevant data may necessarily be quantitative. An understanding of the historical background of a community is vital as it is the historical experience of underdevelopment that conditions what the local population perceives as resource. Deeply rooted social relations often define access to these resources.\(^\text{25}\)

To exemplify, the following are the set of recommendations made for developing food and energy integrated systems that identify the scope of establishing inter-linkages between food and energy technologies (Peemans 1987).\(^\text{26}\)

1 Developing the maximum number of synergies between food crops, livestock, fish production, and new sources of renewable energy (bio-digestion of wastes, biomass production, and treatment) in order to increase the local energy potential for household purposes, irrigation, bio-fertilization, and transport.

2 Focusing greater attention on the role of small-scale rural industries oriented towards the processing of local staples for ‘export’ to urban consumers. This could include the enrichment of local flours with vegetable protein and the production of soybean milk, both of which would help to reduce imports.

3 Giving attention to a variety of technologies assessed for their utility in every local context.

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Assessing carefully the institutional framework, including the feasibility of a network of rural and urban cooperatives to support community-based integrated development schemes.

Promoting the participation of local authorities and central agencies in such a network, in which they could take initiatives and give support.

Some specific measures for sustainable rural energy development include the following.

**Linking rural energy with economic growth: enhancing rural employment and incomes**

The benefits of large-scale and rapid rural industrialization are many and this can be effectively achieved by monetizing biomass. A UN ESCAP (United Nations Economic and Social Commission for Asia and the Pacific) study\textsuperscript{27} concluded that a biomass production/industrialization scenario for India would generate 2000 million work-days of employment and 90 million tonnes of charcoal, serve as a reliable energy base for rural industrialization (Box 3), and put 20 million ha of wasteland under forest cover, while still being a bankable proposition.

*Box 3* Energizing rural industries: a social objective

Today India is facing a severe crisis in terms of the rapid population increase and rural–urban migration, both permanent and seasonal. The primarily agrarian economy of rural India however cannot absorb fully the surplus labour. On the other hand, the industry too cannot absorb the migrant labour force even with a high rate of industrialization. It is therefore critical to encourage off-farm employment opportunities in the rural areas to avoid the exodus of the rural poor to urban areas and the ever-growing urban social problems. Such industrialization should start with the use of existing resources and raw materials. The use of agriculture residues and biomass production are suitable choices.

\textsuperscript{27}ESCAP. 1985. Poverty, productivity and participation: Contours of an alternative strategy for poverty eradication. UN Economic and Social Commission for Asia and the Pacific, Bangkok.
Revisiting the institutional frameworks and capacity building of the concerned organization to plan and implement rural development programmes requires attention. For example, the electricity sector, represented largely by the state electricity boards in India, is characterized by financial mismanagement, high transmission and distribution losses, and huge cross-subsidies among others problems. The gaps between electricity supply and demand are widening because of the poor cost of recovery, managerial inefficiency, and inability to attract sufficient capital. The above has led to reforms being introduced in the electricity sector, with the objective of reforming the sector to promote the development of an efficient, commercially viable, environmentally sustainable, and competitive power industry, which provides reliable quality supply at competitive prices to all consumers in the state, while becoming a net contributor to the state budget.

The MNES has been entrusted with the responsibility of electrification of 18,000 remote villages. The MNES, on its part, is planning to coordinate with the state energy development agencies, NGOs, and other organizations to implement the programme at the national level. Although the state energy development agencies are experienced in implementing diverse RET projects, they do not have any experience in the supply and sale of electricity under the reforms scenario. Institutional capacities, therefore, need to be enhanced to deliver quality and reliable energy services to the rural masses.

Tackling the pricing issues

In order to give impetus to the multi-sectoral approach in rural energy development planning, the distortions in energy pricing need to be addressed. However, despite reforms, because of the high up-front cost of rural electrification and low cash capacity of rural households, electricity distribution companies may not be willing to extend the electricity services to rural poor communities.

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pricing need to be dealt with. For example, to prevent excessive ground-water pumping, there is a need to do away with the flat tariff rates. It is well recognized that the pricing of electricity in the agricultural sector is highly subsidized. In fact, in states such as Tamil Nadu, Punjab, and Madhya Pradesh, electricity is provided free of cost. Further the supply is unmetered. In order to improve the water-and energy-use efficiency, there is a need to meter the supply and increase prices.

The increase in tariff could either be in the form of an increase in the current fixed rates or in the form of a prorata tariff with the installation of meters. Amongst the two, it is felt that there is a glaring need to charge the prorata power prices to improve the end-use efficiency and, thus, reduce the wastage of power in agriculture. Farmers are willing to pay more provided the quality and reliability of supply is ensured.

Studies have shown that in areas where irrigation water is supplied by private, instead of public bodies, farmers have been willing to pay six-to-nine times the water charges levied for official supplies (Myers and Kent 1998;\textsuperscript{28} cited in TERI 2000;\textsuperscript{29}). Ensuring regular and reliable supply of power should be the major objective of policy reforms in this sector.

Similarly, in order to reduce distortions in the supply and use of energy and to prepare for a deregulated energy sector, the system of energy pricing should move from being one of least-cost expansion to one of integrated resource planning.


The high upfront cost of RETs and the subsidized costs of conventional fuels, are the main deterrents in their adoption and use. The problem is further aggravated by the lack of mechanisms to internalize external costs (such as environmental damage) and benefits (TERI 2001). Finally, energy consumption and income are positively related, but while energy spending rises with income, it generally does so less than proportionately. The poor generally spend a much higher portion of their income on energy than the rich do. The use of instruments to defray the upfront cost and well-targeted subsidies can help mitigate this disproportionate cost burden.

**Targeted subsidies on conventional energy forms**

The huge subsidies on fossil fuels makes the economics of RETs seem unfavorable. Further, private players and markets fail to flourish in a subsidy regime. Taking the specific example of kerosene for rural lighting, there is a urgent need to reformulate the policy on kerosene allocation and distribution such that the parallel marketing system for kerosene becomes effective. The quantity of kerosene marketed under the parallel marketing scheme in 1999/2000 accounted for just about 10% of the total kerosene consumption in the country (MoPNG 2001). Making kerosene freely available in the open market to those who are willing and able to pay for it will reduce the pressure on the subsidized supply meant for the relatively poor segment (Parikh, Smith, Laxmi, 1999).

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Decentralizing energy delivery

There is a sizeable rural market in India for rural and renewable energy products and services. There is, hence, a need to establish a decentralized energy products and services delivery system. The basic principles of such a 'system' are based on a 'single window' approach that essentially consists of

- decentralized market-based promotion of RETs,
- entrepreneurship development,
- local credit lending, and
- institutional strengthening with local capacity building.

Such systems would be able to meet the ever-expanding and diversifying energy needs typical to the rural areas. This need stems from the past and current approach to RET dissemination, especially in the rural areas, that is characterized by centrally planned and target-oriented programmes.

The results have not been very encouraging with limited pockets of success. Only a small portion of the total potential for RETs has been achieved in the last two decades. This has been primarily due to the limited subsidy available and the government’s budgetary constraints. Further, due to the lack of suitable financial mechanisms (local credit institutions) in the rural areas, RETs are largely 'unaffordable', especially for the rural poor. Community-level decentralized delivery mechanisms are required to facilitate the process of commercialization of energy-efficient and renewable energy technologies as well as entrepreneurship development at grass roots level.

The Working Group’s report to the Planning Commission (for Tenth Five-Year Plan) submitted to the Ministry of Power also talks of such systems for the 18000 villages to be electrified, with renewables, by 2012. It talks of a revolving fund to be created with contributions from beneficiaries to run individual systems like solar lanterns and home systems. Emphasizing the need to adopt a barefoot approach to train the unemployed rural youth, the panel
estimates job opportunities for nearly 50000 employed youth. It also talks of a decentralized system involving village communities in planning technology options, installing systems, and collecting revenue (<www.renewingindia.org> accessed on 14 September 2002).

Box 4: Towards an energy service network, the 'Uttam Urja' model: promoting self-sufficiency

In the Uttam Urja model, the household lighting package is sold through local enterprises under the brandname 'Uttam Urja'. The customer pays a basic upfront cost and, then, the equated installments for a specified period after which the ownership of the device is transferred to him/her. During this period, the major maintenance costs, such as battery and printed circuit-board replacement, are borne by the service provider.

Agencies at the local level like non-governmental organizations and rural retailers/dealers form an ESN (energy service network), which works towards implementing a model wherein the RET (renewable energy technology) users are treated as 'consumers' of the 'service' that the ESN provides and pay for it at regular intervals. A part of these payments is the collection charge for the service-providing agencies, a part goes towards meeting the maintenance costs, and the balance is deposited as a revolving fund for further replication.

Payments can be made quarterly or biannually depending on the convenience of the customers. The objective of this approach is to free the consumer from problems of high upfront costs, maintenance, replacement, etc., which have been responsible for limited penetration and impact of RETs in rural areas.


Promoting technology shifts and product customization

There is a strong case for promoting new and sustainable technologies that can meet the various needs of the rural masses in a comprehensive manner. For example, in order to improve water-use efficiency, the effort must be to wean away from surface irrigation and encourage the use of sprinkler and drip irrigation, whereby application efficiencies can be
increased to as high as 90%. The current area under drip and sprinkler irrigation in India is more than 70,000 ha (Anonymous 1999). The technology has been demonstrated and promoted in Andhra Pradesh, Gujarat, Karnataka, Maharashtra, and Tamil Nadu where such irrigation systems are subsidized. In order to further promote these technologies, there is a need to bring down the cost of installation and improve the technical knowledge base (TERI 2001).

Similarly, the product subsidies on RETs, such as solar photovoltaic systems, have stifled innovations. The fixation with a particular product design fails to meet the variety of needs of the rural consumer. In order to reach a wider customer base and promote a technology switch to the use of cleaner and renewable forms of energy, it is essential that product customization be made an integral part of rural energy programmes.

**Conclusion**

The past experience in rural and rural energy development has made critical the need for developing and forging intersectoral linkages between rural energy initiatives and initiatives in other sectors. For example, the majority of the poor persons, in rural areas, are dependent on agriculture for their livelihood, but do not have access to grid-based electricity for pumping water to irrigate their fields. They also do not have sufficient means to install over-sized capacity pumps to make up for the time when the supply is restored. They are also the most impacted by the depleting natural resources for many are dependent on these (such as forests) for both their subsistence and livelihood needs. The ability of women to cope with situations of fuel insufficiency and poor efficiency is limited due to socio-economic constraints. These constraints limit a woman’s mobility, while she has little decision-making power at the household and community levels, especially with respect to monetary matters. This limits her access to services, information, technology, and credit. In such circumstances,

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her ability to cope with environmental degradation is severely effected. The drudgery of fuel collection or exposure to biomass smoke, therefore, continues unabated. The rural poor are also largely dependent on middlemen for market information due to the lack of direct market access. The rural poor are also dependent on the middlemen for getting soft credit since they do not have any collateral to show for availing of bank loans. In such situations, discrimination is rampant.

It is in this context that an integrated approach addressing the livelihoods and basic subsistence needs of the rural people is critical. A factor to be kept in mind is that the success of such an approach depends on the active participation of the local community (the beneficiary) from the stage of identifying the solutions to the implementation and monitoring of these. The technological advancements in the last 25 years, if harnessed for the benefit of the poor, can address some of these problems. These solutions range from agricultural interventions that seek to address issues of food/nutritional security to energy interventions that seek to harness renewable energy sources like solar and wind and those that provide energy-efficient ways of utilizing limited resources, to information technology interventions that seek to create one world with fast information access, and to natural resource management that seeks to conserve and protect the earth's ecosystems. For now, however, these are treated in a sectoral manner and an overall comprehensive way of looking at rural development needs is lacking.