

A theme Paper on Renewable Energy and Sustainable Development

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Global Scenario:

At the United Nations Millennium Summit In September 2000, world leaders agreed to a set of time-bound and measurable goals and targets for combating poverty, hunger, illiteracy, gender inequality, disease, and environmental degradation. The eight goals that were eventually agreed upon are what the development community now refers to as the Millennium Development Goals (MDGs). While there is no MDG specifically on conventional energy or on renewable energy, it has been taken for granted that access to any kind of energy services is a prerequisite to the achievement of all eight MDGs. This was recognized at the World Summit for Sustainable Development (WSSD) in Johannesburg in 2002. Unfortunately, much greater quantities and much greater quality of energy services will be required to meet these goals than are presently available in developing countries. Worldwide, 2.4 billion people rely on traditional biomass as their primary source of energy and 1.6 billion people do not have access to electricity.

To ensure that a lack of adequate energy (both sources) does not become a bottleneck to achieving the MDGs, urgent action is needed to move beyond the 'business as usual' approach to energy. It is no longer sufficient to think of energy usage as being driven by economic development. The time has come to begin assessing the role of energy versus other inputs as a means of stimulating human development. If approached as an integrated part of MDG strategies, access to energy services can be an important instrument in helping promote economic growth, social equality, and environmental sustainability.

UNDERPINNING THE MILLENNIUM DEVELOPMENT GOALS

Energy plays a critical role in underpinning efforts to achieve the MDGs and improving the lives of poor people across the world. Energy encompasses light, heat, mechanical power and electricity from a combination of fuels - fossil fuels such as coal, gas and kerosene, plus renewable energy sources such as solar power, wind power, hydropower and biomass - and fuel technologies - ranging from traditional three stone fires to efficient, clean electricity systems. Demand for energy is a 'derived demand': no one wants energy in itself but rather for the services it can provide. The wide range of 'energy services'- cooking, water heating, lighting, refrigeration, water pumping, transport and communications, etc. - made possible by fuels and fuel technology - can have a major impact in facilitating sustainable livelihoods, improving health and education and significantly reducing poverty. Conversely, the absence

of adequate, affordable, reliable, safe and environmentally benign energy services can be a severe constraint on sustainable economic and human development.

Poor people often have a limited choice of technologies that convert energy to useful services. The technologies most readily available to them are typically inefficient or low quality, so they end up paying much more per unit of useful energy service than the rich. For example, light generated from a kerosene lamp costs 70 times more than the equivalent light from mains electricity, while light from a candle costs 150 times more; power from a battery costs 10 to 30 times more than from mains electricity.

No country has substantially reduced poverty in modern times without massively increasing the use of energy from either sources, replacing human and animal labour with more convenient and efficient sources of energy and technology. Different income groups have different requirements for which they use energy and, as income rises, they meet their needs with different energy sources and different conversion technologies. Some energy sources are better suited for a particular use than others: electricity, for example, is much sought after as the most effective source of lighting and for powering motors and communication technologies; but is rarely used by poorer people for cooking. Renewable sources are better suited for rural and agricultural setup and can provide reliable and affordable energy supplies to millions of people in developing countries.

In the recent past, there has been an excessive focus on the provision of electricity to poor people. Electricity is not always the most appropriate form of energy, nor is it the quickest or most cost-effective way of providing energy services to the poor. For example, extending an electricity grid to households in rural areas can cost seven times more than for grid electricity in urban areas. In most of sub-Saharan Africa, less than 10% of the populations are connected to electricity. It is estimated that it would take over 250 years to supply all households in Uganda with electricity at current rates of electrification. In case of South Asian Countries, particularly in India, considering the current pace it may take a minimum of another 50 years to provide electricity in the remote inaccessible villages. The very poorest people, who cannot afford to pay for energy services and rely on energy sources that they can get free of charge, can gain indirect benefits from energy services provided to communities. For example, where it is cost-effective to provide electricity (through the grid or via decentralized systems or any other energy services) to remote communities such as schools, hospitals, trade and community centres. This can benefit a wider cross-section of the community, even if they are unable to afford household energy services themselves.

Energy's important role in underpinning the MDGs is yet to be fully recognized by the international development community. Developing a new approach to energy, where energy services are acknowledged not just as a result of development, but also as an actual driver of development, will be crucial if energy is to play a more prominent role in strategies aimed at achieving the MDGs. The upcoming 2005 World Summit—to be held in New York in September 2005—presents an opportunity to provide a real momentum in this direction. In 2006/2007 the Commission for Sustainable Development (CSD) will look at energy and sustainable development, presenting another opportunity to deepen the focus on energy and the MDGs. As such, awareness raised in 2005 on energy's linkages to the MDGs could be further elaborated into priority capacity building, financing, technical assistance, and technology issues to

be adopted through the CSD process in 2006 and 2007 as means to support the achievement of the MDGs. Breakthroughs made in linking access to energy services to multiple development objectives would need to be further elaborated in terms of technical options available, the minimum energy inputs needed to support each MDG, the associated costs, and the related policy and financial options of these alternatives.

RENEWABLE ENERGY AND SUSTAINABLE DEVELOPMENT

The Potential Role of Renewable Energy in Meeting the Millennium Development Goals, in achieving sustainable development and in conjunction with the 2005 World Summit at the United Nations. The report, produced and published by the "WorldWatch" Institute, brings together the expertise of the participants of REN 21, which provides a forum for international leadership on renewable energy and connects the wide variety of stakeholders that came together at the Bonn International Conference for Renewable Energies in 2004. Klaus Toepfer, Executive Director of the United Nations Environment Programme (UNEP), joined the "Worldwatch" Institute in UNEP's Green Room to discuss the report's findings with attendants of the UN Summit. "Delivering clean, efficient, reliable and renewable energy to developing countries is absolutely critical for poverty reduction and for meeting the internationally agreed development goals," he said. "Every time oil surges over \$50 a barrel, the overseas aid of many African countries--money intended for health care, schools and other vital services--is gobbled up in paying the extra fuel costs. It is also vital because, over the next few decades, the world is likely to invest some 16 trillion dollars in new energy infrastructure. We need to ensure that this is low carbon technology that gives us a better chance to fight climate change," said Dr. Toepfer.

The news sources from PTI (Aug 20th 2005) said that the United Nations has made a strong plea for intensified efforts to promote use of renewable energy sources, stressing that some 1.6 billion people still lack access to power and 2.4 billion depend on fuel wood, crops and animal residues for cooking and heating.

Persistent "energy poverty," as the world body said, is seriously impending socio-economic development, particularly in sub-Saharan African and South Asia.

In a report made public on August 19th 2005, UN Secretary-General Kofi Annan observed that accelerated development and increased use of new and renewable energy sources can offer multiple benefits for sustainable development.

"Renewable sources of energy can be used to provide modern energy services to the poor, contribute to meeting the increasing global energy demand, reduce air pollution, mitigate climate change and delay the eventual fossil-fuel depletion," he said. The report concludes the UN's follow-up to the World Solar Programme 1996-2005, the outcome of the World Solar Summit organized by the UNESCO in Harare, Zimbabwe. Annan, remarked that while the initial plan of the Programme, which included assessment studies of renewable energy potentials and initiatives to boost investment in the area, was quite ambitious, the number of projects actually funded did not meet early expectations.

The Renewable Energy Policy Network for the 21st Century (REN 21) released its report, "Energy for Development: The Potential Role of Renewable Energy in Meeting the Millennium Development Goals," on 15th September 2005, identifies renewable energy options that

A snapshot of energy's linkages to the MDG

MDG	Energy Linkage
Eradicate Extreme Poverty & Hunger	Energy inputs such as electricity and fuels are essential to generate jobs, industrial activities, transportation, commerce, micro-enterprises, and agriculture outputs. Most staple foods must be processed, conserved, and cooked, requiring energy from various fuels.
Achieve universal Primary education	To attract teachers to rural areas electricity is needed for homes and schools. After dusk study requires illumination. Many children, especially girls, do not attend primary schools in order to carry wood and water to meet family subsistence needs.
Promote Gender equality & empower women	Lack of access to modern fuels and electricity contributes to gender inequality. Women are responsible for most household cooking and water boiling activities. This takes time away from other productive activities as well as from educational and social participation. Access to modern fuels eases women's domestic burden and allows them to pursue educational, economic, and other opportunities.
Reduce child mortality	Diseases caused by un boiled water, and respiratory illness caused by the effects of indoor air pollution from traditional fuels and stoves, directly contribute to infant and child disease and mortality
Improve maternal Health	Burden of fuel collection and transport all contribute to poor maternal health Women are disproportionately affected by indoor air pollution and water—and food-borne illnesses. Lack of electricity in health clinics, lack of illumination for nighttime deliveries, and the daily drudgery and physical conditions, especially in rural areas.
Combat HIV/AIDS, malaria & other diseases	Electricity for communication such as radio and television can spread important public health information to combat deadly diseases. Health care facilities, doctors, and nurses, all require electricity and the services that it provides (illumination, refrigeration, sterilization, etc.) to deliver effective health services.
Ensure Environmental Sustainability	Energy production, distribution, and consumption has many adverse effects on the local, regional, and global environment; these effects include indoor, local, and regional air pollution; local particulates; land degradation; acidification of land and water; and climate change. Cleaner energy systems are needed to address all of these effects and to contribute to environmental sustainability.
Develop a global partnership for development	The World Summit for Sustainable Development (WSSD) called for partnerships between public entities, development agencies, civil society, and the private sector to support sustainable development, including the delivery of affordable, reliable, and environmentally sustainable energy services.

are currently in wide use in some regions and that are now ready for large-scale introduction in many areas of the developing world. Through 26 case studies, the report cites biogas, small hydro, solar, wind, ethanol, and biodiesel, among other technologies, as viable options for poverty alleviation in developing countries.

At local level, Renewable energy services help improve the quality of life and facilitate sustainable livelihoods. At national level, they help to facilitate stable economic development, and have an impact on the national and global environment and can affect national budget allocations. At the same time, lack of access to energy can cause conflict. Co-operation between regions over energy supply and access can help establish links between countries that can help reduce tension and conflict. Renewable Energy services are essential ingredients of all three pillars of sustainable development - economic, social and environmental. In the past, there has been greater emphasis on technical and economic issues and, more recently, on the environmental and community aspects of renewable energy, with social concerns receiving attention. To redress the balance, it is important to take a people-centered approach, looking at how renewable energy affects peoples' lives directly and ensuring that all three pillars are considered in parallel.

Renewable Energy facilitates economic development at the local level by improving productivity and enabling local income generation through improved agricultural development (irrigation, crop processing, storage and transport to market) and through non-farm employment, including micro-enterprise development. An emphasis on productive uses of renewable energy services is important in helping people out of poverty.

A number of statistics show the very strong association between increasing commercial energy (in both form) consumption and human welfare, as measured by indicators like the Human Development Index (which measures life expectancy and educational achievement as well as income). Renewable Energy services have the potential to help and to facilitate basic survival activities, for example, approximately 95% of staple foods (such as rice, grains and green bananas) need cooking before they can be eaten. Renewable is the appropriate sources to provide such energy, Indeed, equity of access to basic energy services for cooking, space heating and lighting, like access to water, could be considered a human right. The rights-based agenda highlights inclusion of poor people, their participation in decision-making about their development, and the responsibility of government, as well as the poor, to fulfill obligations. A recent study on "energy and poverty in China" found that access to electricity made the communities feel included in the modernizing process of the national economy.

Renewable Energy can contribute towards social capital, by powering transport (biodiesel) and communications (Solar powered telephone) so that poor people can maintain contact with their extended family and friendship groups. Renewable Energy is also used to prepare meals (Community Solar cookers) to celebrate special events, which is important for maintaining social capital. Poor households draw on their social capital in order to cope better at times of shock or stress.

Renewable Energy is strongly linked to the environment. Many renewable energy sources are drawn directly from the environment, requiring sound management for these sources to be sustainable. Renewable Energy use also affects the environment. Emissions from fossil fuels, excess use wood biomass for example, reach beyond the local and national levels to

affect the global environment and contribute to climate change. The poorest people often live in the most ecologically sensitive and vulnerable physical locations. These areas may be the most affected by the predicted effects of climate change such as increased frequency of extreme seasonal effects. The risks facing poor people are often increased by the unsustainable use of bio- resources by themselves or others. The poor may also face difficult trade-offs in their search for livelihoods: in the words of a resident of Ha Tinh, Vietnam, 'We know that cutting down trees will cause water shortages and that making charcoal can cause forest fires, but we have no choice. Because we lack food, we have to exploit the forest'.

Many dilemmas of this kind are posed by the search for environmentally responsible renewable energy services. The World Commission on Dams highlights the fact that hydropower from large dams has made a significant contribution to economic development, but at unacceptably high prices with respect to environmental and social outcomes. Learning from the past and negotiating outcomes where the interests of the most powerful stakeholders are balanced with the needs of less powerful stakeholders, and are both more equitable and transparent can address such imbalances. Use of indigenous renewable resources combined with efficient supply and use of fossil fuels, with cleaner technologies, can help reduce the environmental effects of energy use and help developing countries make a 'technology leap' that avoids 'lock-in' to more polluting fossil fuel technologies. At the same time, careful management of renewable energy resources, such as forests for fuel wood and water for hydropower, is important to promote economic growth, protect ecosystems and provide sustainable natural resources.

A flexible approach that recognizes that 'one solution does not fit all', should have greater success in providing renewable energy services to meet people's needs. A full menu of renewable energy options should be considered since in some cases, efficient, clean wood for gasifier will be the best option, while in others, multi utility bio diesel or a hybrid system may be preferable.

ACCESS TO ENERGY AND THE IMPACT ON PEOPLE'S LIVES

'...In South Asia, rural women use the word "darkness" to express their drudgery...anxiety, also, of knowing that this is all you have to pass on to your daughter...'

Renewable Energy or energy in general interacts with people's lives in many different ways, from the basic survival activities to increasing productivity. Extending the working hours during the evening can increase productivity. With the help of lighting and by mechanization, several activities like for example, processing & packaging of food and spices, enterprises activities like weaving & stitching can be accomplished. When communities gain access to energy services, it can have a marked effect on their lives, particularly with respect to freeing up their time, improving their health and well being, and opening up opportunities.

Most poor people currently meet the bulk of their inanimate energy needs by collecting fuel wood and other biomass. This costs very little in cash terms, but is hugely expensive in terms of the time it takes. Patterns of time use typical to Indian villages illustrate the impact of the absence of energy services. Typical families spend 2-6 hours each day collecting 10-30 kilograms of wood over distances of 4-8 km. In the Drass region of Leh in the Himalayas, women sometimes have to camp overnight when collecting fuel-wood, as the distances they

need to go are getting longer.

ENERGY FOR THE POOR

Access to alternative or renewable forms of energy may also affect people's health. Use of biomass fuels for cooking and space heating creates indoor air pollution, which has been linked with increased rates of acute respiratory tract infection (ARI) in children and women. Energy is also important in facilitating access to health care by powering transport to health clinics. Fast access to medical services is important for the health and well being of both mother and child when there are complications during childbirth. Access to good healthcare is also reliant on an efficient, functioning healthcare system. This requires a number of elements including appropriately trained and supervised personnel, a reliable supply of drugs and essential equipment, and an appropriate physical infrastructure. Renewable energy services can contribute in a number of ways to the efficient performance of this system in remote public health centers, for example, through ensuring reliable heating, lighting, sterilisation and refrigeration, as well as safe disposal of medical waste.

Renewable energy for lighting allows study at night and facilitates access to learning materials through radio, TV and other ICTs. There are at least 1.2 billion people in the world that cannot read and write, with the number of women far exceeding the number of men. Literacy can improve people's employment prospects, enabling them to increase household income. Access to energy services also opens up opportunities for income-generating activities like access to markets through transport and communications, and thus a way out of poverty. An example of the importance of energy comes from West Africa, where fish processing and trading at the artisan level provide diversified employment opportunities, especially for women in fishing communities.

THE SCALE OF THE PROBLEM

In 1997, the OECD countries consumed 54% of commercial primary energy compared to 12% in transition countries, 11% in China and 23% in other developing countries. This means that slightly more than one billion people in industrialized countries consume about 54% of total commercial energy supply and around five billion people in transition and developing countries consume the remaining 46%. In practice, per capita energy use in Africa has barely increased since 1970 and is less than 10% of that in North America.

The number of people without access to energy services to meet their basic needs is staggering: two billion people lack clean, safe cooking fuels and must depend on traditional biomass sources; and 1.7 billion are without electricity. Most of these people live in Asia and sub-Saharan Africa. To meet the basic cooking needs of the two billion people not served by modern fuels would correspond to no more than 1% of global commercial energy consumption. This figure should be achievable, especially if lessons are drawn from the past.

Given the importance of energy in facilitating poverty eradication, why are there still so many poor people without access to appropriate energy services?

In June 2001, a workshop organized by FAO was held to enable artisan, fish processors and traders to identify common problems in relation to fish processing and trade at the regional level. In a group discussion, participants reflected on barriers to fish processing and trade. Overall, a significant number of problems raised by the participants related to energy,

particularly in terms of processing. These problems highlight the interconnected nature of livelihood needs related to energy. The workshop identified the need to have a reliable power supply at processing sites, to promote appropriate technology for greater fuel efficiency in ways that reduce the health hazards due to smoke. Women processors identified these and to facilitate access to land to be managed by women processors as woodlots for fuel supplies, poverty and improve their quality of life. All energy services cost money, and are bought and sold in various markets. At present, energy markets are not very effective in providing energy services in developing countries. Reform of these markets and improvement of their governance arrangements are central to the strategies currently adopted by the international community to increase the supply, improve the efficiency and extend the access of modern energy services.

Four issues are particularly important for poverty reduction:

- 1) How to improve the effectiveness of energy sector management.
- 2) How to attract more capital in order to increase access to energy.
- 3) How to make subsidies and other government policies work for poverty reduction.
- 4) How to make energy services affordable.

The challenge is to create a policy framework that allows renewable energy to be introduced where it makes long-term economic sense, and to allow poor countries to benefit from the declining cost curves that characterize renewable energy markets in many industrial countries. Among the policies that have proven their ability to advance renewable.

New sources of capital are necessary to meet the growing demand for energy project financing in developing countries. It is currently difficult for RET project and companies to attract investment because they tend to be small transactions, require more time and effort to bring to investment quality than large conventional projects, and often in n involve less familiar t e technologies.

Innovative financing mechanisms, particularly when integrated with targeted concessional funding, can help to make renewable energy technologies more attractive for commercial funding and more accessible to customers. Several such mechanisms have been developed to complement cash sales. They include micro-credit from the company, potentially through dealers, or from a third party, such as a micro-finance institution or community-based organization.

Micro-credit approach can involve specially designed credit lines through larger financial institutions, potentially backed by the government. The new financing mechanisms also include micro leasing or fee -services approach. For example a utility-style concession in which concessionaire owns the system, charges a monthly fee, and is responsible for the services.

In order for renewable-energy services to advance the MDGs, they must be part of multi-sector oral approach, coupled with existing development activities for water, health, education, and enterprenurship. In particular, project planning should address poor women's needs for reducing labor, improving health, and providing security and income. In many developing countries, reducing indoor air pollution deserves particular attention.

In many situations, the largest consumers of energy services are big industrial unit and government. As governments recognize with their own purchasing the values of RET's, costs can be reduced through economies of scale, initial investment costs can be shared with private citizens and companies, awareness of renewable energy's potential can be more widely disseminated. By integrating renewable energy into rural electrification, rural development, poverty alleviation, and social welfare programs, the effectiveness of these programs can in many cases be advanced.

Renewable Energy and India

India's search for alternative source of energy that would ensure sustainable development on the one hand and energy security on the other began in 1970 itself.

The importance of the increased use of renewable energy to meet the increasing energy demand in a sustainable and environmentally sound manner was recognized in the early seventies. In fact, the renewable energy technologies (RETs), such as, biogas plants and improved cook stoves were available in India even in the late forties, though the renewable energy programme started in earnest only after the creation of CASE (Commission on Additional Sources of Energy) in 1980, and then the DNES (Department of Non-conventional Energy Sources) in September, 1982. Over the last twenty-five years or so, the initiative on increased use of renewable energy in various sectors and applications strengthened significantly. A continued thrust towards wider use of renewable energy devices at domestic, community, commercial and industrial levels not only resulted in greater awareness but also significant installed capacities. As shown in table above, a variety of renewable energy technologies are being used.

During the eighties, the DNES programmes were driven by direct Government subsidies and focused on the development, dissemination, and demonstration of various RETs. However, in comparison with the conventional sector, these programmes were low in investments in RET promotion. Between 1980 and 1992, the cumulative government expenditure for the renewable energy sector totalled only Rs 11.55 billion, as compared to Rs 812 billion for the power sector, Rs 335 billion for the petroleum sector, and Rs 158.5 billion for the coal sector (GOI 1996). Likewise, in the Eighth Plan (1992-97), allocations for renewable energy were about 0.8% of the total funds allocated for the energy sector (GOI1996). In the late eighties and early nineties realization grew that somehow private sector had to be involved to achieve greater penetration of renewable in the energy sector. Instead of pushing renewable in a limited way through a subsidy driven programme, one felt there was a need for appropriate policy framework and fiscal benefits that created an environment encouraging private sector players to invest in renewable energy projects. It was envisaged that the role of the DNES had to change from that of an implementing agency to a facilitator. As a result, the DNES was converted into a full-fledged Ministry (Ministry of Non-conventional Energy Sources, or MNES) in July 1992. Since 1992, the ministry's initiative has been largely in the direction of creating an environment that facilitated greater penetration of renewable through a market led approach.

While the frequency of rise in oil prices is increasing each decade, the possibility of a downward trend in global oil prices seems bleak. Energy security of India, as an issue of

national strategic importance, came to take the centre stage of the planning process against the backdrop of frequent rise in global crude oil prices. Our strong dependence on fossil fuels will continue for most part of the 21st century. National energy security has an important bearing on achieving national economic development goals and improving the quality of life of the people. The level of per capita energy consumption has for long been considered as one of the key indicators of economic growth. The continued dependence of the nation on fossil fuels is loaded against it with inherent price volatility linked to finite global reserves. In addition, global warming, caused largely by greenhouse gas emissions from fossil-fuel generating systems, is also a major concern. India needs to develop alternate fuels considering the aforesaid two concerns. In addition, indiscriminate and inefficient burning of fuel wood in traditional chulhas and in industries for thermal process heat has resulted in environmental pollution and health hazards.

To free the villager from the energy insecurity s/he faces, the Village Energy Security Programme is being conceived to exploit the opportunity offered by the technologies developed indigenously involving coordinated participation from several ministries such as Power, Environment and Forests, Rural Development, Planning Commission and State Governments. Several meetings, workshops and seminars have taken place to discuss the modalities of such a programme. The Ministry plans to take up pilot projects in different States to demonstrate the concept, provide operational experience and test different institutional structures.

The village energy security plan based on biomass conversion has been mooted by the Union ministry of non-conventional energy sources in an attempt to equip villages to satisfy their energy needs. As many as 1.73 lakh villages located in fringe areas of forests and another 25,000 remote and un-electrified villages will be initially covered in the programme. For a village unit of 100 households, around 10,000 units of electricity are needed every year. An investment of Rs 20 lakh @ Rs.20, 000 per house hold would be required to meet all the energy needs of the village with the help of four dung-based plants, four leafy mass-based plants and two biomass gasifier.

Energy experts feel that to give a boost to the plan, the government should revive the Wasteland development corporation, which earlier gave financial assistance of Rs 4,000 per hectare for wasteland development. The entire wasteland in the country can thus be brought under biomass/ biodiesel plantation, which in turn will sustain the energy security plan. It is essential to note that no irrigation will be required for cultivating biomass/ biodiesel plantations. All the tree varieties are rain-fed. (Times Of India, 24th march 2005, Pune)

Now it is high time to give utmost importance to the renewable energy. Our country is heading towards an era of blackouts and burnouts and renewable energy source is the only solution. Currently the wind energy sector was growing at 30 per cent and felt that India needed to tap its solar energy potential since solar power from one square km area can generate 20 MW power. At the same time it is also important to define the role of renewable energy in context of rural India, because if we are seriously thinking of energy security, renewable has a grater role to play in the rural sector. The Indian rural scenario is rich with natural resources. Looking at the previous experiences of Ministry and state nodal agencies, it is important to design an effective management system at the grassroots level giving priority to people or end users participation at every stage and hybridizing of technology on the basis

of availability of resources and financial capabilities of users. Therefore it is also very essential in built the resources mobilization, social capital and livelihood aspects in the energy security domain.

Rural India and Renewable Energy Need for Sustainable Development:

Today India, a country with more than a billion people, faces the challenge of achieving growth and development in a sustained manner.

Economic growth and development call for huge capacity additions in the energy infrastructure of the country. The challenge is in achieving the developmental objectives without adversely impacting the environment, natural resources, wild life and climatic conditions. Presently, fossil fuels, mainly coal and oils are being used in the commercial sector while biomass is being used in an inefficient manner in domestic and rural sectors. However, limitations of fossil fuels are all too obvious. Coal reserves will last a little over 200 years and the oil reserves would have dried up much before that. There is a need for a shift in our national energy strategy. More compelling than the diminishing reserves are the environmental reasons. Today, development based on commercial fuels with current rates of pollution and deterioration in natural resource base is not sustainable. Threat from GHG (green house gas) has caused worldwide concern. Kyoto Protocol, agreed at the Conference of Parties to the Framework Convention to Climate Change, in December 1997, is an indicator of global resolve to address this concern. In India electric power generation is the largest source of GHG emissions and accounts for 48% of the carbon emitted. These concerns point towards more rational energy use strategies.

Perhaps, renewable energy based technologies, functioning in a sustainable manner is the way forward. The country having diverse climatic regions is well endowed with renewable energy resources. From the woody tropical forests of Andaman's to Sunny mountains in Ladakh, renewable can play a crucial role in meeting end use energy needs in a decentralized manner. In a country as vast as India, Renewable energy is seen as an effective option for ensuring access to modern energy services. Dwindling fossil fuels, the impact of oil imports on foreign exchange reserves and the national energy security concerns are additional stimulants for greater thrust on renewable energy.

Rural Development in India and Energy Security: Role of Renewable Energy

The, energy needs of the village, be it for cooking, motive power (operating pumps) or electrification, can be met through biomass conversion. Oil-producing trees or leafy mass can be used to run gasifier to produce energy which will help over 77 million people, who depend on kerosene for lighting, he said. For example, since the past few years over 2,000 engines were being run on biogas/biodiesel in villages of Karnataka state road transport corporation has been running three buses on pongamia oil (biodiesel).

Plant species like *acacia auriculiformis*, *acacia nilotica* and bamboo species can provide the biomass. Charcoal briquettes, vegetable oil, ethanol and organic waste can be used to create energy for the village. Wasteland in villages can be used for cultivating biomass plantations of non edible oil bearing plants, which can supply oilseeds and biomass for the energy security plan of the village, this will also create employment opportunities for the local youth and women. On the economics of the energy security plan, the investment can be raised with

the help of government grants and soft loans. The household contribution for maintaining the energy plant of the village would range between Rs 65 and Rs. 120 per month.

In the rural, demand for energy (electrification) is a 'derived demand': mostly as a secondary because the rural people do not want energy in itself but the 'energy services' it provides – cooking, lighting, heating, water pumping or irrigation, transport, etc. A full menu of options should be considered for providing energy services to the poor, renewable energy sources, traditional biomass, and fossil fuels combined with cleaner, more efficient energy technology. The benefits of cleaner technology need to be balanced against the benefits that other technologies can provide. Analyzing the above facts Participatory Renewable Energy Management (PREM) should be the approach to overcome the barriers, which in turns ensure Sustainable, Adoption of Renewable Energy Technology Application.

Participation of primary stakeholders. Evidence shows that if primary stakeholders are involved in the design and implementation of development initiatives they are much more likely to prolonged benefits. Local community possessed invaluable local expertise that should be taken into account in defining and implementing any energy project. As the end users of the technology, their involvement at early stage of planning will generate ownership that helps achieve long-term success. Project characterized by high levels of community engagement will typically generated a grater sense of community empowerment, ensures that improvements are tailored to a community specific needs, and create a much higher chance that the improvements will be well maintained by the community after installation.

PREM ensures to enhance livelihood options, such as forest and large plantation based enterprises, edible and non-edible oil exploration, products processing in the extra illumination hrs. Plantation management and biomass production for energy itself can be assured as viable means of income for women. A viable means of livelihood ensures sustainability to biomass based rural energy programme.

Renewable Energy (RE) based Rural Electrification in a development context is not about technology provision, first it is about understands the role that RE services play within people's lives, and responding to constraints in improving livelihoods. RE must be considered as one of the facets of service provision affecting the livelihood opportunities of the poor, and understood in terms of how the poor value and use it.



Today, when we are discussing on energy security of our country we must share the views of our scientist, His Excellency President of India, Dr. A.P.J.Kalam. On his address to Nation during 59th Independence Day he stressed upon the energy security and its transition to energy independence is the call of the hour.

While dedicating his speech on 14th August evening, he said:

“Energy Security rests on two principles. The first is to use the least amount of energy to provide services and cut down energy losses. The second is to secure access to all sources of energy including coal, oil and gas supplies worldwide, till the end of the fossil fuel era, which is fast approaching. Simultaneously we should access technologies to provide a diverse supply of reliable, affordable and environmentally sustainable energy.”

“Energy Security, which means ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times, is thus a very important and significant need and is an essential step forward. But it must be considered as a transition strategy, to enable us to achieve our real goal that is - Energy Independence or an economy, which will function well with total freedom from oil, gas or coal imports. Is it possible?

Hence, Energy Independence has to be our nation's first and highest priority. We must be determined to achieve this within the next 25 years i.e. by the year 2030. This one major, 25-year national mission must be formulated, funds guaranteed, and the leadership entrusted without delay as public-private partnerships to our younger generation, now in their 30's, as their lifetime mission in a renewed drive for nation-building”.

“The strategic goals for Energy Independence by 2030 would thus call for a shift in the structure of energy sources. Firstly, fossil fuel imports need to be minimized and secure access to be ensured. Maximum hydro and nuclear power potential should be tapped. The most significant aspect, however would be that the power generated through renewable energy technologies may target 20 to 25% against the present 5%. It would be evident that for true Energy Independence, a major shift in the structure of energy sources from fossil to renewable energy sources is mandated”.

It is evident that, India does not have any alternative unless it bring the renewable energy resources to center stage of national energy policy, planning and implementing process to secure its energy resources in a sustained manner.

The argument is that, if rural India is capable of generating alternative resources to address their current need, why we are imposing them to use fossil fuel, this will end up resulting a huge foreign exchange burden from imported petroleum products. According to India Development report 2004: Rural households in India consume about 314 million tones of bio fuels in a year only for cooking. These bio fuels are mostly for cooking. These biofuels are mostly procured through gathering. In a year about 352 hours are spent per household on gathering of biofuels. An estimated 85 million households spent 30 billion hours on gathering 314 million tones of biofuels per annum. While this provides livelihood to some of the poor who sell these in local markets, most household gather these for self-consumption.

Besides the drudgery of collection and transportation of these fuels, about 174 million females are exposed to an average 6.8 mg/cum of respirable suspended particulate matter (RSPM) during cooking. Those who are in close proximity to the stove are some time exposed to even higher level of pollution (9.2mg/ cum) than the person doing the cooking.

The bellow tables give statistical views of household energy scenario of rural India.

The crucial need at this point is to bring technology, knowledge and experience together to provide right solution to the rural energy scenario. Undoubtedly renewable energy technology is the right option to provide a security to national energy resources. Not only that, sustainability can also be achieved.

The facts and figures given in this paper suggested that, currently Indian rural energy scenario is shelling without a navigator. At the same time rural India has enough of renewable energy resource potential and traditional knowledge to utilize it. It is clear that renewable



Household energy scenario in Rural India

- 96% household use biofuels, 11% use kerosene and 5% use LPG for cooking. Most of them however use multiple fuels.
- Forest contributes 39% of the fuel wood needs.
- 314 million tones of biofuels are gathered annually.
- 85 million households spend 30 million hrs. annually in fuel wood gathering.
- 15 million households use kerosene for cooking and light.
- 34% out of 15 million kerosene users procure from open market 7 97% procure from fair price shop.
- 49% households are willing to pay more than the market price to purchase kerosene for cooking.
- 0.2 % households use biogas for cooking
- 63% households are electrified.
- 33% household are willing to contribute to reduce kitchen smoke through installing better technology.

Source: India Development Report-2004

Estimated Energy Consumption pattern and time & efforts for gathering

Items	Estimate
Use of any biofuels (household in Mn #)	125.9
Fuel wood using household (Mn.)	103.9
Dung cakes using household	83.1
Croup residue using household (Mn)	53.6
Quantity of biofuels used per year. (Mn.Tones)	
Time and effort in biofuels gathering	
Biofuels gathering Household	85.1
Time spend on biofuels collection (Man hrs. per year)	29,998
Hose hold using petroleum product for cook	
Household using kerosene for cooking (Mn)	14.9
LPG / Biogas using Household (Mn)	7.4
Qty. of kerosene used for cooking exclusively (firing) and lighting (Mn. ltrs p.a)	211
Qty. of kerosene used for cooking as mixed fuel , (firing) lighting per year (Mn. Ltrs.p.a)	1233
Qty. of kerosene used only for lighting and the fire per year (Mn. Ltrs p.a)	6561
Cooking Involvement	
Involvement as chief cooks (Mn. Females)	173.8
Exposure for cook (No. of hrs. cooking)	1000 hrs p.a

energy is the only way out, which can navigate to reach at energy at energy independence, which means a way to sustainable development.

The policy maker, technologist, development advocates and corporate must join hand together to make energy Independence as national movement to achieve energy security. Secured energy being the pre-requisites to achieve the MDG which sets at the down of the millennium, renewable energy is the only source which will ensure sustainable and secured energy for development.

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