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CHAPTER 1 : INTRODUCTION

1. The Power Sector is an important part of the infrastructure of the Indian Economy and power generation has been accorded a high order of priority in our Five Year Plans. The State Electricity Boards, which are under the control of the State Governments, are the important instruments for generation and distribution of power throughout the country. Initially, the State Electricity Boards were given the responsibility to generate, transmit and distribute power throughout the country. The Central Government had to intervene in the seventies, when it became clear that the State Electricity Boards could not bear the burden of adding new capacities on account of the high costs of investment and amend The Electricity Supply Act in 1976.This led to the setting up of the National Hydro-power Corporation and the National Thermal Power Corporation initially and the other Central Public Sector Undertaking subsequently.

2. The installed capacity of the power generation in the country as on March 31, 2001 was 101,630 MW as compared to that of 1352 MW in 1947, of which 72% was thermal, 25% was hydro (including wind) and 3% was nuclear. The Working Group on Power constituted by the Planning Commission to formulate the 10^{th} five year plan estimated a feasible capacity addition of 47,000 MW, during the 10^{th} plan, 24,405 MW in the Central Sector, 12,033 MW in the State Sector and 10,501 MW in the Private Sector for which investment of the order of Rs.5,66,000 crore would be required.

3. As the primary resources for electrical power generation are unevenly disposed in the country, bulk transmission of electrical power over long distance becomes necessary for supplying the loads. The country was organised into 5 regional grids each of which is well integrated. Strong interconnections between the regional grids are planned to create a strong national grid. This objective is sought to be achieved in a phased manner by the end of the 11^{th} five-year plan (2011-12) through the Power Grid Corporation of India Limited.

4. A number of problems have been plugging the power sector, which needs to be tackled urgently. Transmission of power over long distances led to high transmission and distribution losses, which increased, from 24.8% in 1997-98 to 25.6% in 1998-99 (provisional). Inadequate investments in distribution systems, improper billing and high pilferage are among the important reasons for the high transmission and distribution losses.

5. The policy of economic liberablisation, adopted in the nineties, to attract private domestic investment and foreign investment, could not achieve the desired results owing to the poor financial health of the State Electricity Boards, their inability to pay the contracted tariff and a lack of mechanism

that could ensure safety of repayment to the foreign investors. Further, the effort was concentrated on the generation front and not on the distribution front. The Government of India have, of late, recognised the strategic

mistake, which was committed in the initial stage, and are now concentrating on reforms at the distribution end.

6. The electric power industry was built on the principle that large centralized power plants could achieve economies of scale, which would make them the least expensive sources of electricity. Conventional boilers and nuclear reactors reached unit sizes of over 1000 MW in the 1970's and 80's. In the 1980's small highly efficient gas turbines, which used technologies similar to an airplane engine, opened up the possibilities of producing inexpensive electricity on a relatively small scale. Since the mid 70's both the total annual capacity additions and the average unit sizes of OECD power plants have been dropping.

7. Around 1985 electric utilities started anticipating the possibilities of competition and concentrating on cost reduction. Large scale power plants that involved huge investments began to be perceived as unacceptable risks and demand side management emerged as an alternative to power plant construction.

8. The emergence of wholesale competition in 1996 in the U. S. A. opened up possibilities of a complete restructuring of the power industry and considerably slowed down investment in power plants. Demand side management, which seemed contrary to their goals, took the backseat and the restructuring of the power industry was given the pride of place. .

9. The consequent gap in capacity for generation resulted in tight electricity supplies in many parts of the USA. Distributed generation emerged as the preferred solution, as it avoids investment in both generation and transmission and brings the solution nearer the consumers by bypassing the need for long distance transmission. The concept of distributed generation, which is now gaining worldwide acceptance, was started in the USA almost a decade ago. Distributed generation which accounts for only 5% of USA's electricity is expected to account for 10 to 20% of new generating capacity over a period of next 15 year in that country.

10. Taking cognisance of the new trends, the Government of India thought of initiating steps towards Distributed Generation with special reference to rural electrification keeping in mind the overall objectives of providing power for all by 2012 and appointed a committee to examine the matter and make suitable recommendations. A copy of Government of India, Ministry of Power OM No.12/4/2002-APDP dated 8th March 2002 is enclosed as Annexure 1.

11. In the chapters that follow the concept of distributed power generation has been discussed in relation to the Indian context especially that of rural electrification in India.

CHAPTER - 2

The Concept of Distributed Power: It's definition, scope and relevance in the Indian Context

1. The Ministry of Power OM dated 6.3.2002 refers to distributive generation. However, the expression distributed generation is also used very widely in the relevant technical literature on the subject.

2. The focus in the case of distributed generation is on small/medium sized plants ranging from about 10 kW to 50 MW are substantially lower capital outlay, lower risks, shorter gestation periods and proximity to load centres. The main objective is to assure reliable and quality power.

3. Distributed power means modular electric generation or storage located near the point of use. It includes biomass generators, combustion turbines, micro turbines, engines/generator sets and storage and control technologies. It can be either grid connected or independent. Distributed power connected to the grid is the typically interfaced added distribution system. Distributed power generation systems range typically from less than a kilowatt (kW) to ten megawatts (MW) in size.

4. Distributed energy resources (distributed power) refers to a variety of small modular power generating technologies that can be combined with energy management and storage systems and used to improve the operations of the electricity delivery systems, whether or not these technologies are connected to an electric grid. Distributed energy resources support and strengthen the central-station model of electricity generation, transmission and distribution. Distributed power can assume a variety of forms. It can be as simple as installing a small electricity generator to provide back-up power at an electricity consumer site. On the other hand it can be a more complex system highly integrated with the electricity grid and comprising
electricity generation, energy storage and power management systems.

5. **Distributed Power Applications**

5.1. Distributed power technologies are typically installed for one or more of the following purposes: -

(i) *Overall load reduction* – Use of energy efficiency and other energy saving measures for reducing total consumption of electricity, sometimes with supplemental power generation.

(ii) *Independence from the grid* – Power is generated locally to meet all local energy needs by ensuring reliable and quality power under two different models.

a. *Grid Connected* – Grid power is used only as a back up during failure of maintenance of the onsite generator.

b. *Off grid* – This is in the nature of stand-alone power generation. In order to attain self-sufficiency it usually includes energy saving approaches and an energy storage device for back-up power. This includes most village power applications in developing countries.

(iii) *Supplemental Power*- Under this model, power generated by the grid is augmented with distributed generation for the following reasons: -

a. *Standby Power*- Under this arrangement power availability is assured during grid outages.

b. *Peak shaving* – Under this model the power that is locally generated is used fro reducing the demand for grid electricity during the peak periods to avoid the peak demand charges imposed on big electricity users.

(iv) *Net energy sales* – Individual homeowners and entrepreneurs can generate more electricity than they need and sell their surplus to the grid. Co-generation could fall into this category.

(v) *Combined heat and power* - Under this model waste heat from a power generator is captured and used in manufacturing process for space heating, water heating etc. in order to enhance the efficiency of fuel utilization.

(vi) *Grid support* – Power companies resort to distributed generation for a wide variety of reasons. The emphasis is on meeting higher peak loads without having to invest in infrastructure (line and sub-station upgrades).

6. Most of the early adopters of distributed power wanted to stay connected to the grid, which they used either as a backup or for selling their surplus power to the power companies.

7 The Benefits Of Distributed Power :

Energy consumers, power providers and all other state holders are benefited in their own ways by the adoption of distributed power. The most important benefit of distributed power stems from its flexibility, it can provide power where it is needed and when it is needed.

The major benefits of distributed power to the various stakeholders are as follows:

7.1 **Major Potential Benefits of Distributed Generation**

7.2 **Consumer-Side Benefits**: Better power reliability and quality, lower energy cost, wider choice in energy supply options, better energy and load management and faster response to new power demands are among the major potential benefits that can accrue to the consumers.

7.3 **Grid –Side Benefits**: The grid benefits by way of reduced transmission and distribution losses, reduction in upstream congestion on transmission lines, optimal use of existing grid assets, higher energy conversion efficiency than in central generation and improved grid reliability. Capacity additions and reductions can be made in small increments closely matching the demands instead of constructing Central Power Plants which are sized to meet a estimated future rather than current demand under distributed generation.

7.4 **Benefits To Other Stake Holders:** Energy Service Companies get new opportunities for selling, financing and managing distributed generation and load reduction technologies and approaches. Technology developers, manufacturers and vendors of distributed power equipment see opportunities for new business in an expanded market for their products. Regulators and policy maker's support distributed power as it benefits consumers and promotes competition.

8. The following are among the more important factors that contributed to the emergence of distributed generation as a new alternative to the energy crisis that surfaced in the USA.

i. *Energy Shortage* –States likes California and New York that experienced energy shortages decided to encourage businesses and homeowners to install their own generating capacity and take less power from the grid. The California Public Utilities Commission for instance approved a programme of 125 US million $ incentives programme to encourage businesses and homeowners to install their own generating capacity and take less power from the grid. In the long run the factors enumerated below would play a significant part in the development of distributed generation.

ii. *Digital Economy* –Though the power industry in the USA met more than 99% of the power requirements of the computer based industries, these industries found that even a momentary fluctuation in power supply can cause computer crashes. The industries, which used computer, based manufacturing processes shifted to their own back-up systems for power generation.

iii. *Continued Deregulation of Electricity Markets* – The progressive deregulation of the electricity markets in the USA led to violent price fluctuations because the power generators, who were not allowed to enter into long-term wholesale contracts, had to pass on whatever loss they suffered only on the spot markets. In a situation like that in California where prices can fluctuate by the hour, flexibility to switch onto and off the grid alone gives the buyer the strength to negotiate with the power supplier on a strong footing. Distributed generation in fact is regarded as the best means of ensuring competition in the power sector.

9. Both in the USA and UK the process of de-regulation did not make smooth progress on account of the difficulties created by the regulated structure of the power market and a monopoly enjoyed the dominant utilities.

10. In fact, the current situation in the United States in the power sector is compared to the situation that arose in the Telecom Sector on account of the break up of AT&T Corporation's monopoly 20 years ago. In other words distributed generation is a revolution that is caused by profound regulatory change as well as profound technical change.

11. **Distributed Generation in India**

11.1 We have witnessed two extreme situations of distributed generation in India. At one end we have the example of individual house-owners/apartment owners installing their own diesel generating sets in view of the most unsatisfactory supply of grid power, as was the case in Calcutta in the 70's and the 80's. At the other extreme we have the examples of large scale power intensive industries setting up their own captive power generating plants because of the severe cuts imposed by the electricity boards, the poor quality of power as well as the extremely high cost of power supplied by them.

11.2 Though knowledge based industries are emerging as an important engine of growth, these are not going to provide as strong a motive as the digital economy in the USA for distributed generation. Similarly, deregulation of the power sector in India has not made any significant progress. In fact, reforms at the distribution end in the power sector have just begun in the country. In India the push for the programme for distributed generation is expected to come from the need to tackle the following problems: -

i. *Peak Load Shortages* – In India the problem of meeting peak load demand has to be given the topmost priority. Small-scale power generation and distribution to supplement the grid seems to be the most effective solution to the problem.

ii. *Transmission and Distribution Losses* – These can be brought down by distributed generation because of the proximity to the consumption centres.

iii. *Remote and Inaccessible Areas* – There are many parts of the country where it would be well neigh impossible to take grid power. These are the hilly and inaccessible region like the Northeastern region or Islands that are inaccessible on account of their distance from the main land such as Andaman and Nicobar Islands and Lakshwadeep Islands.

iv. *Rural Electrification* – Rural electrification is a declared objective of the Government, which has a high degree of priority. It is in fact an integral component of rural development. Transmission and distribution losses, frequent interruptions in supply of grid power have necessitated a reorientation in own approach to the process of rural electrification. A distributed generation matrix for applications in India is appended Annexure 2.

12. The terms of reference of the committee very clearly emphasis the study of the problem of distributed generation in the context of rural electrification. The report therefore highlights the points relating to Distributed Generation in relation to rural electrification though some of the other issues are dealt with to the extent necessary, as the subject cannot be divided into strict watertight compartments. These issues are dealt with in the succeeding chapters.

Chapter - 3

Rural Electrification In India – The Current Situation

1. Definition of Rural Electrification

1.1 Rural electrification is an important facet of the economic development of the country. The number of villages electrified as on 31.3.2001 was 5,08,515 out of the total number of 5,87,258 villages. The number of villages that remain to be electrified is thus 78,240. The number of remote and inaccessible villages is estimated at 18,000. 31% of the rural households have been electrified as per 1991 census. There are a number of villages which have hamlets at a distance of about 1-3 kilometers from the main villages with populations ranging between 50-200 which are often not officially listed as villages and are not electrified.

1.2. The definition of rural electrification has been changing from time to time. Initially a village was deemed to be electrified if electricity was used within its revenue area for any purpose whatsoever. In Octoberl 1997 the definition was changed and a village was deemed to be electrified if electricity was used in the inhabited locality within the revenue boundary of the village for any purpose whatsoever. While these are the definitions adopted by the Ministry of Power, the Ministry of Non-conventional Energy Sources regard a village as electrified if 60% of the household in the village are provided lights for the purpose of assessing their own performance. Exact statistics according to the different definitions are not yet available.

2. The Setting-up Of The Rural Electrification Corporation And The Progress Thereafter

2.1 The Rural Electrification Corporation was set up in 1969 with the primary objective of providing financial assistance for rural electrification in the country. The Corporation is now one of the prime financial institutions in the country and extends financial assistance to State Electricity Boards, State Power Corporations, Electricity Departments of the State Governments and Rural Electric Cooperatives for various rural electrification schemes. The corporation was declared by the Reserve Bank of India as a non-banking finance company. The cumulative sanctions and disbursements of the loans sanctioned by the rural electrification department amount to Rs. 35353 crore and Rs.24687 crore. respectively as on 31.3.2002.

2.2 The authorized share capital of the Corporation was Rs.1200 crore and the paid up capital was Rs. 1780.60 crore as on 31.3.2001.

2.3 The setting up of the Rural Electrification Corporation surely acted as a catalyst to rural electrification and a total of 1.20 lac villages were electrified during the 6th plan period and another 1.0 lac during the 7th plan period.

2.4 Rural electrification programmes involve supply of energy for production-oriented activities like minor irrigation, rural industries etc. and also electrification of villages. While the emphasis under the programme of rural electrification is on exploration of ground water potential and energisitation of pump sets, which have a bearing on agricultural production, the accent in areas covered by the Revised Minimum Needs Programme is on electrification. One of the important objectives of the Corporation was to administer the funds allocated to the central sector for rural electrification in India and act as a catalyst of integrated rural development through massive exploitation of ground water resources and promotion of rural industries.

2.5 The performance of the Rural Electrification Corporation has, no doubt, contributed to the spread of rural electrification in the country. However, there are certain disturbing trends, which need to be corrected urgently.

i. The qualitative dimension of the problem of rural electrification is as important as the quantitative dimension.78,240 villages are awaiting electrification as already stated. The important point to be noted is that these are mainly in Bihar, West Bengal, Orissa, U.P. and Assam, the states that account for 40% of the countries population.

ii. A similar imbalance is noticed in the pump set energisitation programme. Most of the pump set energisitation has taken in Peninsular India where ground water utilization has reached a high stage of development while pump energisitation programme has not shown any significant progress in the states located in the Gangetic plain where the ground water potential is enormous. In fact, the states of Madhya Pradesh, Uttar Pradesh and Orissa accounted for a mere 9% of the pump sets during the year 2000-01.

iii. The overall pace of rural electrification as well as energisation of pump sets received a set back in the last decade. The number of villages electrified dropped from one lac in the 7th Plan Period to a mere 18,500 in the 8th Plan Period and less than 10,000 in the 9th Plan Period. The poor financial health of the State Electricity Board which are increasingly reluctant to move to rural areas because of high costs and low returns is largely responsible for this trend. The number of pump sets energized between 1986-87 and 1991-92 ranged between 4.19 lac to 5.52 lac per annum, but the same

decreased to 206071 in the year 2000-01. This is perhaps because the ground water potential in the Southern States has already been tapped and the pace of programme in the Indo-Gangetic has not picked up.

2.6 The following adverse features also plague the programme of rural electrification:

i. The cost of transmission lines is very high, Rs.20, 000-30,000 per kilometer depending on the terrain.

ii. High transmission and distribution losses which were estimated at 22.4% (National mean) especially due to low leads in 1992 increased to 26% in 1998-99.

iii. Low and fluctuation voltage on account of the overloading of the grid system

iv. The eraticity in power supply and maintenance

2.7 This apart, the programme of rural electrification has created a very serious problem of depleting ground water tables due to the faulty tariff policies adopted so far. As the tariff is levied at a flat rate, irrespective of the number of units consumed, the farmers drew very heavily on the under ground water resources, there by leading to lowering of the water table. Declining levels of water table have caused a great deal of anxiety among the State Governments, some of which have enacted legislation to ban digging of new wells. The problem was accentuated as simultaneous steps for recharging ground water sources through appropriate measures like soil conservation and watershed development were not initiated.

2.8 Another important issue that arises is the use of diesel pump sets in large numbers on account non-availability of reliable power. Farmers who draw subsidy on use of grid power make use of diesel engines to meet their total energy requirements with the obvious implications on outgo of foreign exchange.

2.9 The financial problem posed by the programme of rural electrification, which is subsidized, is enormous. The net subsidy after accounting for amounts received from state governments was Rs.5024 crores in 1991 and increased to Rs.22876 crores in 1999-2000. The gross subsidy of the state sector was about 36% in 1999-2000. Efforts to contain the burdening the subsidy have obviously to be initiated.

2.10 Notwithstanding the enormous amount spent on subsidy, the farmers do not get quality power. The World Bank has observed in its recent document “India Power Supply to Agriculture – Andhra Pradesh Case

Study (Report No.22171-IN) that *"------farmers are paying a higher price for electricity than stated by the utility because poor quality of power increases their cost on account of various factors including frequent motor burnouts, interruption due to transformer burnouts, unscheduled power cuts which impose an additional cost on farmers in terms of the potential crop loss in crop yields."* According to it "*the present tariff in the State based on the flat rate structure is regressive, penalizing, marginal and small farmers who are using less electricity for a given connected capacity*." and discourage the farmer from conserving the ground water resources as the marginal cost of pumping is zero.

2.11 The Government of India have, in the budget for the year 2001-02, treated electricity as part of the basic minimum services for the rural poor. The funds for rural electrification have, therefore been, allocated to the states under the Minimum Needs Programme and "Pradhan Mantri Gramodyoga Yojana."

2.12 The Government have recognized the need for new initiatives in rural electrification in the wake of various problems outlined above. This is reflected in the Statement of Objects and Reasons of the Electricity Bill, 2001, which views Distributed Generation as a possible alternative to the current problem. It envisages stand-alone systems for generation and distribution of power and decentralized management of distribution through Panchayats, Users Associations, Cooperatives or Franchisees. for rural and remote areas.

2.13 The concrete steps that could be taken to implement the new thoughts on rural electrification are discussed later in the Report.

Chapter 4

Renewable Energy Sources and Distributed Generation in Rural India

1. The experiments with models for decentralized systems for power generation are not of recent origin, though their inclusion as an integral part of the new legislation is of recent origin. It has been the result of various developments over a period of time. The realisation that fossil fuels are not unlimited, the difficulties faced by the developing countries on account of their dependence on excessive imports marked by high volatility of prices, and international opinion regarding adoption of eco friendly sustainable alternatives have been responsible for this development. India, the petroleum crisis of the late seventies triggered off the efforts for biomass based systems of power generation.

2. The Government of India set up a Commission for Additional Sources of Energy in the Department of Science and Technology on the lines of the Space Commission and the Atomic Energy Commission to promote R & D activities in the area. In 1982, a separate department of Non Conventional Energy Sources was created in the Smallstry of Energy. After a decade, the department was elevated and converted into a full-fledged Smallstry. The mounting burden of subsidy has also lead to the introduction of the new legislation referred to above.

3. There are a number of technologies for distributed generation, the details of which are given below:

   i. The Internal Combustion Engine.
   ii. Biomass
   iii. Turbines
   iv. Micro-turbines
   v. Wind Turbines
   vi. Concentrating Solar Power (CSP)
   vii. Photovoltaics
   viii. Fuel Cells
   ix. Small-Hydel.

2.10 **The Internal Combustion Engine:** The most important instrument of the D. G systems around the world has been the Internal Combustion Engine. Hotels, tall buildings, hospitals, all over the world use diesels as a back up. Though the diesel engine is efficient, starts up relatively quickly, it is not environment friendly and has high O & M costs. Consequently its use in the developed world is limited. In India, the diesel engine is used

very widely on account of the immediate need for power, especially in rural

areas, without much concern either for long-term economics or for environment.

3.2 **Biomass:** Biomass refers to renewable energy resources derived from organic matter, such as forest residues, agricultural crops and wastes, wood, wood wastes that are capable of being converted to energy. This was the only form of energy that was usefully exploited till recently. The extraction of energy from biomass is split into three distinct categories, solid biomass, biogas, and liquid biofuels. Solid biomass includes the use of trees, crop residues, household or industrial residues for direct combustion to provide heat. Animal and human waste is also included in the definition for the sakes of convenience. It undergoes physical processing such as cutting and chipping, but retains its solid form. Biogas is obtained by anaerobically digesting organic material to produce the combustible gas methane There are two common technologies, one of fermentation of human and animal waste in specially designed digesters, the other of capturing methane from municipal waste landfill sites. Liquid biofuels, which are used in place of petroleum derived liquid fuels, are obtained by processing plants seeds or fruits of different types like sugarcane, oilseeds or nuts using various chemical or physical processes to produce a combustible liquid fuel. Pressing or fermentation is used to produce oils or ethanol from industrial or commercial residues such as bagasse or from energy crops grown specifically for this purpose.

3.3 **Turbines:** Turbines are a commercialized power technology with sizes ranging between hundreds of kilowatts to several hundred megawatts. These are designed to burn a wide range of liquid and gaseous fuels and are capable of duel fuel operation. Turbines used in distributed generation vary in size between 1-30 MW and their operating efficiency is in the range of 24-35%. Their ability to adjust output to demand and produce high quality waste heat makes them a popular choice in combined heat and power applications.

3.4 **Micro-turbines:** Microturbines are installed commercially in many applications, especially in landfills where the quality of natural gas is low. These are rugged and long lasting and hold promise for Distributed Generation in India.

3.5 **Wind-turbines:** Wind turbines extract energy from moving air and enable an electric generator to produce electricity. These comprise the rotor (blade), the electrical generator, a speed control system and a tower. These can be used in a distributed generation in a hybrid mode with solar or other technologies. Research on adaptation of wind turbines for remote and stand-alone applications is receiving increasingly greater attention and hybrid power systems using 1-50-kilowatt (kW) wind turbines are

being developed for generating electricity off the grid system. Wind turbines are also being used as grid connected distributed resources.

Wind turbines are commercially available in a variety of sizes and power ratings ranging from one kW to over one MW. These typically require a Smallmum 9-mph average wind speed sites.

3.6 **Concentrating Solar Power**: Various mirror configurations are used to concentrate the heat of the sun to generate electricity for a variety of market applications that range from remote power applications of up to 1-2kW to grid connected applications of 200MW or more. R & D efforts in the area of distributed generation applications are focused on small, modular, and dish/ design systems.

3.7 **Photovoltaics:** Photovoltaic power cells are solid state semi conductor devices that convert sunlight into direct current electrical power and the amount of power generated is directly related to the intensity of the light PV systems are most commonly used for stand alone applications and are commercially available with capacities ranging between one kW to one MW. The systems are commonly used in India and can contribute a great deal for rural areas, especially remote and inaccessible areas. It can be of great help in grid connected applications where the quality of power provided by the grid is low. This is yet to be proved. High initial cost is a major constraint to large-scale application of SPV systems. R&D work has been undertaken for cost reduction in SPV cells, modules, and systems besides improvements in operational efficiency.

3.8 **Fuel Cells:** Fuel cells produce direct current electricity using an electro-mechanical process similar to battery as a result of which combustion and the associated environmental side effects are avoided. Natural gas or coal gas is cleaned in a fuel cell and converted to a hydrogen rich fuel by a processor or internal catalyst. The gas and the air then flow over an anode and a cathode separated by an electrolyte and thereby produces a constant supply of DC electricity, which is converted to high quality AC power by a power conditioner. Fuel cells are combined into stacks whose sizes can be varied (from one kW for mobile applications to 100MW plants to add to base load capacity to utility plants) to meet customer needs. However, the technology is not yet ripe for being considered for DG application in India, as it is very expensive, and has not yet been commercially tried on a large scale even in the U. S. A.

4. The technologies referred to above are applied under various schemes for generation of electricity from renewable sources of energy in the country. A bird’s eye view of the schemes would give a good insight into the status of Distributed Generation based on renewable sources of energy.

5. **Biomass Based Schemes:** This can be considered under three distinct heads, National Project on Biogas Development, National Programme on Bio-Mass Power/Cogeneration and Bio-Mass Gasifier Programme.

5.1 Biogas. The gas is piped for use as cooking and lighting fuel in especially designed stoves and lamps respectively and can also be used for replacing diesel oil in fuel engines for generation of motive power and electricity. The Floating Gas Holder Type, that is India or KVIC model and Fixed Dome Type which is made of brick masonry structure i.e. Deenabandhu model are among the indigenous designs of biogas plants. A Bag Type Portable Digester made of rubberized nylon fabric, suitable for remote and hilly areas, is being promoted. The recently developed methodology of on sight construction of Deenabandhu model with Ferro-cement, which costs about 10 to 15% less as compared to the model constructed with bricks and cement, is getting popular in the Southern States.

5.2. **The National Project on Biogas Development** was started in 1981-82. About 33.68 lac families have been benefited upto March 2002. The Community and Institutional Biogas Plants Programme was initiated in 1992-93. In order to achieve recycling the cattle dung available in the villages and institutions for the benefit of the weaker sections as well. Biogas is generally used for motive power and generation of electricity under the programme in addition to meet the cooking fuel requirement. A total of 3,901 plants, including 600 night soil based Biogas plants had been installed up to March 2002.

5.3 **R & D in Biogas:**

The thrust of the R&D efforts is on increasing the yield of biogas, especially at low and high temperatures, development of cost effective design of bio gas plants, development of designs and methodologies for utilization of biomass, other than cattle dung for biogas production, reduction in the cost of biogas plants by using alternative building material and construction methodology and diversified use of digested slurry for value added products.

6. **National Programme on Biomass Power/Cogeneration:** The Government of India has initiated a National Programme on Biomass Power/Cogeneration. It aims at optimum utilization of a variety of biomass materials such as agro-residues, agro-industrial residues, and forestry based residues and dedicated energy plantations for power generation through the adoption of latest conversion technologies. These include combustion, incineration, pyrolysis, gasification etc. using gas turbine, steam turbine, dual fuel engine, gas engine or a combination thereof either for power generation alone or cogeneration of more than one energy

forms viz steam and power of Smallmum 1 MW capacity connected to the grid. The technologies for exploiting the vast biomass resources for power generation are attaining maturity and reaching stage of commercialisation.

6.1. 41 bagasse based cogeneration projects with aggregate capacity of 280 MW have been commissioned and 30 projects with aggregate capacity of 298 MW are under implementation. 30 commercial grid connected biomass based power projects with aggregate capacity of 140 MW have been successfully commissioned and 31 projects with aggregate of 181 MW are under implementation. The bulk of the capacity installed/under implementation is in Andhra Pradesh, Karnataka, Tamil Nadu and U. P.

6.2. **Biomass Resource Assessment Programme:** Availability of biomass is of great relevance to The National Programme on Bio-Mass Power/Cogeneration. According to an estimate made by some experts, only 16 million hectares of land are required, if there is a need to grow wood separately for power generation, i.e. lighting and meeting stationary power needs of villages, as compared to 100 million hectares of degraded land available for planting. The results of an analysis at the macro level, however, may not correspond to ground realities. The Programme was launched covering all the States and Union Territories in order to provide inputs for preparing a **Biomass Resource Atlas for India,** which seeks to integrate the data obtained from field level studies under National Biomass Resource Assessment Programme and provide specific information, which would be useful to the user in preparing a feasibility study of a biomass based power generation project. The Project utilizes a stand alone G. I. S. package with satellite data identifying different agricultural crops, along with modeled information on biomass utilisation, to arrive at estimates of availability of surplus bio-mass.

6.3. **National Biomass Gasifier Programme:** Biomass gasification is the process by which solid biomass materials are broken down using heat to produce a combustible gas, known as the producer gas. Common feedstocks for combustion include wood, charcoal, rice husks and coconut shells. The producer gas can be used directly in a burner to provide process heat or it can be used in IC engines, but it requires cleaning and cooling for the latter application. It can also be used as a substitute for diesel oil in duel fuel engines for mechanical and electrical applications Encouragement to technologies such as biomass briquetting and gasification for various applications in rural and urban areas, and R and D on Biomass Production and Gasification, are the important objectives of the programme.

6.4 Biomass gasifier systems of up to 500 kW capacity based on fuel wood have been indigenously developed and being manufactured in the country. Technology for producing biomass briquettes from agricultural residues and forest litter at both household and industry levels has been developed. A total capacity of 51.3 MW has so far been installed, mainly for stand-alone applications.

6.5 **Research and Development on Biomass Gasifiers**: Five Gasifiers action research projects have been supported at IIT Delhi and Bombay, Indian Institute of Science, Bangalore, Madurai Kamaraj University, Madurai and

Sardar Patel Renewable Institute in Vallab Vidhyanagar. Gasifier systems have been defined for a variety of biomass and integrated for different application packages for rice mills, plywood, tea etc. Gasifiers of different ratings from 20 kW to 100 kW and for different modes of application have been tested under field conditions and are being promoted under the National Biomass Gasifier Programme. Biomass gasifiers capable of producing power from a few kW up to 500 kW have been developed indigenously and have passed stringent tests abroad and are now exported not only to developing countries of Asia and Latin America, but also to Europe and U. S. A. The main focus of work done under the gasification action research project in IIT is maximization of diesel replacement in duel fuel engines.

6.6 R&D on Biomass Production: Five R&D projects on biomass production have been taken up with the objective of selecting high yielding and short rotation fuel-wood tree species and developing and promoting suitable packages of practices for better survival and improve productivity of selected tree species for different agro-climatic zones in the country.

6.7. 1796 gasifier systems with an aggregate capacity of 51.3 MW have been installed in various states.

6.8 The Smallstry of Non-conventional Energy Sources has taken up the task of electrifying the 18,000 unelectrified remote and inaccessible villages based on the renewable energy technologies in a phased manner by 2012. During the 9^{th} plan the village electrification projects with an aggregate capacity of 5 MW equivalent which cover 84 remote villages and hamlets in West Bengal, Orissa, Tripura, Mizoram and Nagaland were initiated out of which an aggregated capacity of 2.14 MW has already been installed in West Bengal, Orrisa and Karnataka.The remaining projects, which are in the pipeline, would be commissioned by the end of the financial year 2001-02.

7. Initiatives taken at the Indian Institute of Science including SuTRA Project

7.1 The Indian Institute of Science, Bangalore is implementing a project in the Tumkur District of Karnataka on bio--energy for sustainable transformation of rural areas. In fact, the Indian Institute of Science has worked on a number of projects on rural electrification with the help of renewable resources. The experiments conducted by the Indian Institute of Science were initially confined to cattle dung for biogas production (Pura village).

7.2 The Institute later on developed biogas plants and wood gasifiers that used other biomass such as agro residues, forest litter, weeds etc. (Ungra and Hosahalli villages). According to some of the experts of the Institute,

the scale of power generation using a biomass gasifier should preferably be limited to a village or a cluster of villages, because large systems would require transportation over a long distance and might lead to depletion of forests, unless forest resources are carefully managed. The ideal system might be in the range of 10-100 kW, thus meeting the needs of a cluster of villages.

7.3 Later on, the Institute developed another model in order to reduce the capital costs. The possibility of exploiting one of the oil seed bearing trees in India, viz. Pongamia Pinnota, which is known as Karanj in Hindi, Honge in Kannada, Kanuga in Telugu and Pongam in Tamil, gave a golden opportunity for cost reduction. The indigenous tree grows all over India is drought resistance and its seeds have non-edible oil to the extend 30-35%. The new model has been experimented with some success in the villages of Kaggenahalli and Suggenahalli.

7.4 It is noticed that the cost of generation per unit of electricity is 4.50 in the case of Honge oil, Rs. 7.25 and Rs.9.50 in the case of wood gasifier and biogas, respectively, both operated on a duel fuel mode. The difference is mainly on account of the lower capital cost in the case of honge oil as compared to that in the case of wood gasifier and biogas based plants. This is the scenario when the cost of diesel per liter is Rs.19.00 at Bangalore.

7.5 Diesel based electricity supply is cheaper, Rs.4.66 per unit, as compared to 4.89 per unit in the case of honge oil, if the price of diesel is Rs.12.39 per liter at Bangalore. The difference between the two is purely on account of the higher capital cost of the former, which is due to honge oil seed expellers. However, this is a most unlikely scenario, as the price of diesel can be expected to remain at levels higher than Rs.12.39 per liter, on account of the dismantling of the AdSmallstered Pricing Mechanism. Annexure 3 may please be seen in this context.

7.6 The inherent advantage of honge oil Vis a Vis diesel is that honge oil is environment friendly, is renewable, locally available, and involves Smallmal transportation. Further, if used extensively, it would lead to self-reliance. Extensive use of diesel oil, would lead to loss of foreign exchange.

7.7 The success of the biomass-based schemes is crucial as the international prices of crude oil are very volatile, and the mechanism of the AdSmallstered Pricing Mechanism, which insulated the economy from their volatility, has been dismantled. The government are trying to Smallmise the hardship to the people by suitably adjusting the excise duties on petrol and diesel .The social and economic gains on account of

decentralized schemes will have to be taken into account, while the policies, especially the tariff policies are adopted in their respect.

8. **Wind Energy:** The programme was initiated in the year 1983-84. A market-oriented strategy has been adopted right from the beginning and hence commercial development of the technology has been successfully

achieved. Scientific assessment of wind resources throughout the country and a series of other systematic steps have facilitated the emergence of a cost effective technology.

8.1 The wind power potential of the country was initially assessed at 20000 MW and reassessed at 45000 MW subsequently assuming 1% of land availability for wind power generation in potential areas. The technical potential has been assessed at 13000MW assuming 20% grid penetration, which will go up with the augmentation of grid capacity in potential States. The installed capacity in the country is 1628 MW, 63 MW under demonstration projects and 1565 MW under private sector projects, which represents just 13% of the technical potential. Tamil Nadu alone accounts for nearly 50% of the installed capacity (857.5 MW) and the States of Tamil Nadu Maharashtra and Gujarat account for 1423.6 MW of the total installed capacity.

8.2. The Centre for wind energy technology (C- WET) is coordinating the Wind Resource Assessment Programme with the States and Nodal Agencies.

8.3 Wind diesel projects are being taken up in Island regions and remote areas which are dependent on costly diesel for power generation .Two machines of 50 kW capacity each have been installed in the first phase of the project at Sagar Islands in West Bengal. Similar projects are being considered for Lakshadweep and Andaman and Nicobar Islands.

9. **Solar Power Programme:** The solar power programme comprises Solar Photovoltaic Power Programme and Solar Thermal Power Programmes.

9.1 **Under the Solar Photovoltaic Programme**:, 27 grid interactive SPV projects have been installed, with an aggregate capacity of 2.0 MW in Andhra Pradesh, Chandigarh, Karnataka, Punjab, Kerala, Lakshadweep, Madhya Pradesh, Maharashtra, Rajasthan,Tamil Nadu, and Uttar Pradesh. These are meant for voltage support applications in remote sections of weak grids, peak shaving applications in public buildings in urban centers and for saving diesel use in islands. These are expected to generate and feed over 2.6 million units of electricity annually to the respective grids. In addition, ten projects of 900 kW capacity, are under different stages of implementation,

9.2 The solar photovoltaic systems can be used for a variety of applications, such as rural telecommunications, battery charging, road and railway signalling which are non subsidized. Only 3 MW out of the total aggregate capacity of 96 MW (9,80,000 systems) is used by the power plants. In so

far as rural areas are concerned, the SPV systems can be useful for the following:

i. Village electrification through SPVs: A five KW PV plant can serve a village of 50 to 80 households for street lighting, lighting homes/radio TV, and community requirements like post office school primary health center and drinking water supply. More than 2500 villages, mainly in U. P, Rajasthan, West Bengal and Islands and also in Nyoma town in Ladakh. Ninety villages in Bastar district of Madhya Pradesh and fourteen villages in Meghalaya have also been electrified through SPVs.

ii. SPV seem to be one of the best solutions on for the 18000 remote and inaccessible villages. Solar electrification is more economical in tribal areas and the North Eastern Region compared to grid extension beyond three kilometers.

iii. In Gujarat, SPV systems have been applied at ten rural milk collection centers of Panchamahal District Dairy Cooperative during 2000-2001, ten more were sanctioned in 2001-02. The deployment of solar PV systems for this application has a large potential for replication.

iv. SPV water pumping systems for agriculture and related are also being used by farmers. A cumulative total of 4500 SPV water systems have been installed by March 31, 2002

9.3 **R & D:** High initial cost (Rs.ten to twelve per kWh as compared to Rs one to Rs two and paise seventy five from small hydro, biomass and wind energy) is a major constraint to large-scale application of SPV systems. R & D work has been undertaken for cost reduction in SPV cells and modules and systems, besides improvement in operational efficiency

10 **Small Hydel Projects:** Small hydel projects have become very popular since the last decade on account of many problems, especially those relating to environment, which are associated with major irrigation projects .New technologies also make facilitate small sized projects to operate either in grid connected or decentralized mode and thus make them economically viable. The classification of hydro-power by size is given in Annexure 4.

10.1 A number of steps have been taken in the last decade by giving suitable incentives to attract private investment in commercial projects. The capacity in Small hydel projects (upto 3 MW) has increased from 63 MW to 240 MW in the last twelve years as a result of the positive steps taken so far. Capacity of over 200MW has been offered/allotted by the State Governments to the private sector. The current emphasis is on completing the projects offered to the private sector by the State

Governments and also making simultaneous efforts to identify potential sites, conduct detailed surveys and prepare detailed project reports for a shelf of projects.

10.2 The Small hydel potential in the country is about 15000 MW. Four hundred forty one projects (of up to 25 MW capacity each) with an aggregate capacity of 1438.43 MW have been installed upto 3782 March 2001 till now. Two hundred eighty seven projects with an aggregate capacity of 563.04 MW are under implementation. Fifty portable micro hydel sets of 5-15 kW capacity have been provided to local bodies and local communities in seven States through the State Government Agencies. Forty-one out of these have been installed and the response from the local communities has been quite encouraging. Small hydel projects are particularly suited for remote and hilly regions, Ladakh and the North Eastern States.

11. It would be obvious from the above that a great deal of effort has been made to generate power from renewable energy sources.

12. India, in fact, has great deal of potential in this regard and already emerged as a world leader in exploitation of renewable energy sources. India ranks first in biomass gasifiers (35 MW), fourth in biomass based power generation (400 MW), fifth in installed wind power capacity (1507 MW) and tenth in small hydel power capacity (1438MW) and fourth in solar photovoltaic. (50MW).

13. Though India has attained an eminent position in the world in the exploitation of renewable energy there is a tremendous gap between the potential and actual achievement as would be seen from the following statement.

S.no.	Source/System	Approximate Potential	Achievement (as on 31-03-02)
A. Power from Renewables			
1.	Solar Photovoltaic Power	-	1.99 MW
2.	Wind Power	45,000 MW	1628.2 MW
3.	Small Hydro Power (up to 25MW)	15,000 MW	143.47 MW
4.	Biomass Cogeneration Power	19,500 MW*	381.3 MW
5.	Biomass Gasifier	-	51.3 MW
6.	Energy Recovery from wastes	1,700 MW	21.98 MW
Power From Renewables (Total)		81,200 MW	3522.24 MW
B. Decentralised Energy Systems			
7.	Family-size Biogas plants	120 lakh	33.68 lakh
8.	CBP/IBP/NBP Plants	-	3901 Nos.
9.	Improved Chulha	12 crores	3.52 crores
10.	Solar Photovoltaic Systems	20MW/sq. km.	
	i) Solar Street Lighting Systems	-	41776 Nos.
	ii) Home Lighting Systems	-	206732 Nos.
	iii) Solar Lanterns	-	427687 Nos.
	iv) SPV Power Plants	-	1188 kWp
11.	Solar Water Heating Systems	140 million sq.m collector area	0.60 million sq.m collector area
12.	Solar cooking System		
	i) Box-type Solar Cookers	-	5,18,000 Nos.
	ii) Concentrating-type community cookers	-	175 Nos.
13.	Solar PV pumps	-	4500 Nos.
14.	Wind Pumps	-	793 Nos.
15.	Hybrid Systems	-	127.5 KW
C. Others Programme			
16.	Aditya Solar Shops	-	29 Nos.
17.	Battery Operated Vehicles	-	247 Nos.
18.	Energy Parks	-	278 Nos.
19.	IREP Blocks	-	860 Nos.

Sq. Km.= Square Kilometer	**Sq.m.= Square meter**
MW= Mega-watt KW=Kilo watt	**kWp-kilo watt peak**

* including Biomass Gasifier

14. The emphasis in the North Eastern region and other inaccessible areas that comprise 18000 difficult villages will be on decentralised generation using locally available energy options like biomass, Small hydel, photovoltaics, solar cookers and lanterns, etc. The overall position in respect of the North Eastern Region of the country is as follows:

Item	All India potential Identified	North East Potential	All India capacity set up	Capacity set up in N. East
Small hydel	10071.81♠	2028.34♠ (20.14)√	1438.43♠ (14.28)	153.02♠(1.52)
Biomass/cogeneration	19500♠	N. A. separately.	381.3♠	Nil♦
Biomass gasification			51.3♠	Nil;φ
Wind Energy	12835♠(technical)		1628.3♠	Nil•.
Solar Energy SPVs	20MW/sq. km		96 MW∝	∩

♠shows MW;♦43biomass resource assessment studies awarded; R &D on sustained production of biogas at low temperatures is on
φResearch on biomass production survey and evaluation of selected species for energy plantation in N. E region is on
•27 probable windy sites identified; √ figures in brackets indicate percentages.
∝ Of this 40 SPV products have been exported
∩.4 power plants of 25kWp capacity each in Mizoram, 3 power plants of aggregate 4.5kWp SPV capacity IN Assam, 3 power plants of aggregate 9.2 kWp capacity in Arunachal Pradesh are under implementation66 solar home lighting systems sanctioned for a village in East Kamang District of Arunachal pradesh170 special solar street lighting systems sanctioned in Manipur

15. It would be seen from the statement that it is only in Small hydel that a beginning has been made in the North Eastern region. It may be noted that out of a total capacity of 563.04 MW under implementation, 165.42 MW capacity, which is 29.38 % of the total capacity is in the North Eastern Region.

16. At present out of a total installed capacity 0f 100000 MW about 3500 MW is generated by φusing various renewable resources, i. e. almost 3.3%of the total installed capacity from all resources.

17. The Government have taken cognizance of the gap between the potential and the actual installed capacity/achievement under various items under Renewable Energy Sources**. In keeping with the world wide trend of encouraging distributed generation and having a green environment, the New Renewable Energy Policy stipulates that by the year 2012,**

10% of the total addition to generation capacity will be from renewable sources. Assuming that another 100,000 MW will be added by the year 2012,the contribution by renewable energy fuels would be between 10-12000 MW, about 13-15,000 MW in all. This would be 6- 7.5% of total power generated in the country.

18. The new thrust of the Government of India is enshrined in clauses 4, 5, and 6 of the Electricity Bill, 2001,Section 4 stipulates that the Central Government after consultation with the State Governments prepare and notify a national policy permitting stand systems (including those based on renewable sources of energy and other non conventional sources of energy) for rural areas. Clause 5 stipulates consultation with the State Governments and the State Electricity Regulatory Commissions for a national policy for rural electrification and for bulk purchase of power and management of local distribution in rural areas through Panchayat Institutions, users' associations, cooperative societies, non-governmental organizations and franchisees.

19. Clause 13 of the Bill exempts a local authority, Panchayat Institution, User's Association, Cooperative Societies, Non governmental organizations and franchisees from obtaining a licence to transmit, distribute and trade in electricity.

20. The increasingly greater importance being attached to non conventional sources of energy becomes clear from the fact that the financial allocation for them, as a per centage of the total plan allocation, increased from 0.1 % in the Sixth Plan to 0.2 % in the Eighth Plan and 0.44% in the Ninth Plan (1997-2002. Progressive power generation from renewables has, in fact, shown a rapid increase only in the last two to three years. It increased from 1185.50 MW from March 1997 to 1698.50 MW in March 2000 and from 1698.50 MW in march 2000 to 3500 MW in March 2002. The details may please be seen in Annexure 5.

21. Concerted action would be required to achieve the above mentioned objectives. It is, however, not easy to bridge the gap between the potential and installed capacity because of certain constraints in renewable energy development, which have got to be taken note of. Some of the important constraints are listed below:

Product/Technology Related:

♦Many products and technologies are not yet mature.

♦Smallmum economic sizes are under evaluation.

Raw Materials Related:

• Resource availability assessments are based on rough estimates, especially in biomass power and hilly hydro projects.

Land Related:

♠; Govt/forest land /irrigation land are not mortgageable.

Climate Related:

♦Photovoltaic cells do not work on a cloudy day and windmills do not mill the wind without a breeze.

♦**Policy Related**

Frequent changes in policy.

Market Related:

♠ Distortions in energy market on account of subsidized conventional electricity

22. The committee is of the view that despite the constraints mentioned above, the programme will have to be carried forward with vigour, especially in the case of the 18000 villages where no other solution seems to be feasible. In the case of other villages, whether connected by grid or not, decisions will have to be taken on a location specific basis.

CHAPTER - 5

Organisational and Managerial Aspects : People's Participation

1. The programmes and schemes of the power sector in the country do not enlist the involvement and support of the beneficiaries. The policy makers had however, envisaged a cooperative and participatory model for rural electrification in the country. One of the directives which was issued to the Rural Electrification Corporation by the Government of India was as follows:-

2. "….The Corporation will consider providing loans on suitable terms to these cooperatives with a view to encouraging the cooperative type of organizations for distribution of electricity in the rural areas". The reality however is far removed from the ideal contained in the Government of India's Directive.

3. The following alternatives can be thought of in the context of ensuring people's participation in the programmes of rural electrification including those relating to Distributed Generation.

   i. Local bodies and communities

   ii. Cooperatives

   iii. Users Associations

   iv. NGOs

   v. Electric Service Company working in conjunction with entrepreneurs/contractor and Local Bodies/Communities, NGOs

4. **Local Bodies**

4.1. Article 243 G of The Constitution Seventy Third Amendment Act, 1992 empowers the legislatures of States to enact suitable legislation and endow the panchayats with such powers and authority as may be necessary to function as institutions of self government and prepare and implement plans for economic development and social justice. The Eleventh Schedule, which lists out the items in respect of which such powers can be conferred, includes rural electrification and distribution of electricity and non conventional energy sources.The State Governments, however, have not enacted such legislation, The Panchayat Raj

institutions, again, are not well equipped to take up such schemes as of now.

4.2. The participation of the Local Bodies in relation to rural electrification programme is seen in different forms.

i. The National Project on Biogas Development is being implemented with active support and association of local bodies in several states. In Gujrat Taluka Panchayats and Gram Panchayats are involved in implementing and monitoring. Gram Sabhas motivates the individual beneficiaries in Andhra Pradesh and Maharashtra. The Panchayat functionaries through their respective Sthayee Smithies are involved in identifying induvidual beneficiaries in West Bengal.

ii. 50 portable micro hydel projects have been taken up under a demonstration project. Micro hydel sets of 5-15(kW) capacity have been provided to local bodies and local communities in 7 states through the state agencies in the North-Eastern region of the country and 41 sets have been installed and the response from the local communities is reported to be satisfactory. The Ministry of Non-conventional Energy Sources in encouraging the local bodies and NGOs to take up such mini hydel projects.

iii. The Local Bodies are also involved in the distribution of solar lantern among the households in the villages.

4.3. There are only very rare examples in which the Zila Parishads, Panchayat Smithies and village Panchayats have directly participated in generation and distribution of electricity. For instance the Biomass Gasifier plant at Gosaba in Sunderban Islands is managed by a local cooperative and Chairman of the Panchayat Smithi is the Chairman of the Cooperative.

5. **Cooperatives**

5.1 Rural Electric Cooperation were set up with the help of Rural Electrification Cooperative, the State Electricity Boards and the State Governments. 5 pilot cooperatives were formed initially. Hukkeri in Belgaum district of Karnataka Sirilla Taluka in Karimnagar District in Andhra Pradesh, Kodinar Taluka in Amerali District in Gujrat and Rahuri and Srirampur Talukas in Ahmednagar District of Maharashtra and a part of Lucknow District in UP. The number had increased to 37 in the year 1994-95. The Committee on Rural Electric Cooperatives under the Chairmanship of Shri N.S. Mathur which was constituted to examine all aspects of the working of the existing cooperative societies and evaluate their performance, made the following important observations:

i. Overall performance – The overall physical performance of the rural electric cooperatives, except in a few cases, where there were management and other problems, was quite encouraging .

ii. Load growth – As a cooperative society is more responsive to the local needs of distribution, it can ensure load growth quicker than a State Electricity Board.

iii. Operational Procedures - Cooperatives being organisers of the consumers, whom they serve try to make their operational procedures more tuned to the convenience of their respective customers.

iv. Transmission and Distribution Losses – With the emergence of rural electric cooperatives specific quantities of energy purchased by the cooperatives and sold to the consumers could be ascertained and the losses quantified. The problem of T&D losses got focussed more prominently on account of them though the desired watch dog effect on identifying inadequacies of management such as defective meters and theft of energy did not take place.

v. Diversion of Funds – There was no diversion of funds for purposes other than rural electrification. Some of the cooperatives generated their own resources for being ploughed back for further intensification of electrification in their respective areas.

5.2 Many of the cooperative societies are now being run by administrators because their management has been taken over by the concerned State Governments. It may however be noted that the rural electric cooperatives did have some genuine problems and were not allowed to function properly. The following deficiencies were noticed :

i. The staff of the cooperative societies were on deputation either from the State Government or the State Electricity Boards. The societies did not perform well in cases where the staff deputed by the State Governments/State Electricity Boards were incompetent.

ii. Most of the States took to a system of flat rate tariff for agricultural consumers under which the farmers, consume much more units than are actually paid for. The societies faced an anomalous situation in as much as the energy purchased by them was on a metered basis, but the supply thereof to consumers was made on an unmetered basis and naturally incurred losses.

5.3 The fact, that many of the cooperative societies did not succeed because of the various reasons cited above, need not deter us from trying out that model once again, especially in the States where the cooperative movement has been quite strong.

5.4 Initiatives by cooperative societies are not wanting even now. For instance Bantwal Rural Electricity Cooperative Society has been very keen on taking over distribution of electricity within the Bantwal Taluk of Mangalore District. Its efforts were frustrated mainly because the

erstwhile Karnataka Electricity Board did not agree to part with its distribution rights over the area to the society. The society proposes to convert 750 km of low tension lines into high tension lines, replace 145 out of the 773 distribution transformers that have failed and replace all the inefficient 13,143 irrigation pump sets. All the improvements are estimated to save about 10 lac units per month.

5.5 The Rural Electrification Corporation has in the Annual Report for the year 1996-97, expressed the view that the most feasible and effective option appears to be to promote more and more Rural Electric Cooperative with active participation and involvement of local people and Panchayat Raj bodies.

6. Users Associations

6.1 The village panchayats are perceived as being controlled by the village strong men with considerable influence which is used to the detriment of weaker sections . It is this perception which is responsible for the formation of groups of beneficiaries for implementing programme of poverty alleviation. These are implemented through associations of beneficiaries or Users Associations. The Self Help groups which have been set up of late, under the poverty alleviation programmes, must be take cognisance of in this context, as many of them have been successful in achieving their objectives. Village level committees are another manifestation of Users Associations.

7. Village Level Committees

7.1 In so far as the power sector is concerned, the concept of village committees which has been successfully tried out by WESCO and NESCO the two subsidiaries of BSES, needs a special mention. Under this novel project, the villagers are involved as partners in a programme that aims at ensuring better quality of supply and service in rural areas. They undertook pilot projects in Burger and Anandpur respectively, and the projects were executed by the Xavier Institute of Management.

7.2 The objective of the two projects was to form village committees (Vidyut Sangha) in order to ensure that the consumer got the bills regularly and not burdened with payment of bills for six months at a time and improve the quality and stability of power. The committees were accorded formal recognition and functioned as a Customer Care Centre in villages. The committees appoint persons from the villages, designated as Village Contact Persons for taking meter readings and distributing of bills in the villages. The committees function as a one point collection centre for WESCO and NESCO. WESCO and NESCO contact the village level committee on dates fixed for collection.

7.3 The Committee exercises its judgment on matters pertaining to sanction of new connections, installment agreements, disconnections, regularization of unauthorized consumers etc. The number of villages covered by the

scheme is 4900. The Village Level Committees have succeeded in achieving a breakthrough in certain important areas.

7.4 **Achievements of Village Level Committees**

i. The consumers have started demanding meters and consequently, consumers have stopped using heaters in many villages. Voltage has therefore, shown a dramatic improvement.

ii. Since the villagers are educated about issues relating to tariff, they are able to plan their consumption of electricity in a much more rational manner and have been able to bring down the bills to Rs.50 to Rs.85 from Rs.226 p.m.

iii. A sense of ownership has developed among the members of the committee and the villagers and the villagers themselves are curbing unauthorized usage of electricity.

iv. In some committees, all members are ladies, which is a very encouraging sign as problems of power and water supply have a major impact on the quality of life of women in the rural areas.

v. Specific instructions were issued stipulating that disconnections would take place only if recommended by the village committees. The collections increased by more than 60-85% as all payments were made voluntarily and not under duress.

vi. In villages where the distribution transformer was metered the Village Level Committee became a partner in identifying losses due to theft. In a cluster of 17 villages, it was observed that the input energy supplied to the village was reduced by more than 23 percent over a 4 month period.

8. **Unresolved Issues**

8.1 There are still two areas where considerable improvement is yet to be achieved. These are as follows:-

i. Though the collections have improved, the cost of supplying electricity to villages continues to be very high on account of technical and non-technical losses and the effective cost of delivery works out to almost Rs.4 per unit. There is real temptation to cut supply to cut losses.

ii. Though the quality of service has improved, there has been no improvement in terms of the access of electricity to consumers, in villages which still remain unelectrified.

8.2 The Xavier Institute of Management has expressed the view that the two concerns listed above could be addressed by Distributed Generation and

has proposed that a pilot project may be taken using distributed generation to improve access of electricity in villages. It is proposed to have one such project in village nahalla in Orissa.

9. The Experiment of Tata Energy Research Institute (TERI) at Dhanawas

9.1 TERI implemented schemes of improved chula, biomass gasifier and solar and other technologies and also of reclaiming degraded land through energy plantation for nearly 10 years at Dhanawas in Haryana. The Institute has documented the results of its field study, which would be very useful .

9.2 Four Stages of Interaction

9.2.1 TERI found that there were 4 stages of interaction between its representatives and the villagers.

9.2.2 In the first stage, there is rapport building with the villagers so that all the issues connected with the village are understood. The people are associated with the village surveys, which ensures the involvement right from the beginning.

9.2.3 At the second stage, there is technology development and demonstration and the Village Energy Development Committee is constituted to motivate the villagers to participate in the process of induction of a new technology.

9.2.4 At the third stage, there was technology acceptance and capacity building among the villagers. The success of a newly developed technology evokes a better response from the individuals who become increasingly more receptive to its adoption, largely due to its demonstration and dissemination. People were trained in maintenance and management of new devices. Masons for construction of biogas plants were also trained.

9.3 Dissemination of new technologies for which there was still a demand characterised the next stage which was that of withdrawal. Bulk of the work was carried out by the persons trained in the village with TERI assistance in terms of providing technical guidance. The technologies that were used for community use such as the solar water pump and the plantation were handed over to the village panchayats.

9.4 Lessons of Dhanawas Experience

9.4.1 The important lessons learnt by TERI as a result of Dhanawas experience which are very important from the point of view of people's participation, are listed below:-

i. People are not likely to take interest in any activity, unless it meets some of their demands or brings about an improvement of the quality of life in some way. An energy programme that benefits the people in some way in a shorter time is likely to succeed better. For instance, the people of Dhanawas regarded reclamation of degraded land and plantation on it, only as a research project. It was only when fodder from plantation was used extensively in the year of drought in 1989, that they began to see its potential benefits.

ii. Any technological innovation has to be brought to a threshold level till the people recognize the benefit. In the case of improved chulas it took considerable time to design the model that suited the needs of the villagers.

iii. Though the Village Energy Development Committees had been constituted to avoid village politics, the Panchayat always played an important role in planning and implementation of the scheme. Committee. A written approval was obtained from the Panchayat regarding the formation of such a committee and its members and charter of duties. A change in village leadership was always accompanied by reelection with the Village Energy Development Committee. The Sarpanch was made a member of the committee to ensure coordination with the village panchayat.

iv. Though people in villages are inconvenienced by energy shortages, they face more pressing problems and hence their participation is more likely to materialize, if these pressing problems are integrated with the other developmental needs of the people.

v. A village panchayat could ignore the interests of certain groups either because their members are not numerous or because they belong to the poorer strata of society without much influence. In a situation like this, mechanisms must be set up which rectify the imbalance. The interests of groups/individuals should be identified and taken into account, while planning for the nature of benefits and their distribution.

vi. During the demonstration phase, there has to be a strong and reliable maintenance backup system. TERI's staff rectified all problems of biogas plants. In Jaisalmer, a person from within the village was trained with repair and maintenance of solar lanterns which was of considerable help to the villagers.

vii. Energy technology that does not necessitate any major alterations in peoples practices has better prospects of success. Though there was good potential for biogas plant in Dhanawas village, many villagers were unwilling on account of constraint of space for construction.

viii Continuous monitoring and evaluation helped in identifying problems with plant design in which necessary modifications were made wherever these were required.

9.5 TERI's experience at Dhanawas showed that rural energy problems are extremely location specific in nature, and that in view of the vide variations that exist in the socio cultural environments in the rural areas, energy planning at a decentralized level will give better results as compared to a target oriented programme based on uniform technology specific programmes.

9.6 The village level committee at Dhanawas was different from the committees established by WESCO and NESCO as it was very closely associated with the village panchayat. The relationship between the villagers, the village panchayat, TERI and the Village Energy Development Committee is illustrated by the diagram at Annexure 6.

9.7 The Institution of Village Level Committees has been used in other countries as well as in the case of Chalan Micro Hydro Scheme in Peru and Dhandruk Micro Hydro Power Scheme in Nepal.

10 People's Participation in Distributed Generation Schemes And Village Committees

10.1 In all the examples that were cited above, there was no local generation and distribution of electricity in the form either of a grid or mini grid. The Indian Institute of Science, Bangalore which implemented some projects of Distributed Generation, also made use of the village level committees. A village management committee comprising of 8 villages including 2 women was constituted in village Hosahalli which assisted in protection of forests, supervision of operations and collection of electricity charges at Rs.6/- per month.

10.2 The Institute similarly established a Gram Vikas Sabha to oversee maintenance and operation of the system with the participation of the villagers in Pura village. The Gram Sabhas collection was in the order of 93% between 1988-1991.

10.3 The models of the Institute do indicate, like the BSES's model, that people can behave responsibly and manage a system, unlike the general belief to the contrary, if they are properly motivated. The constitution of the Village Level Committees led to a reduction in the consumption of electricity in many villages. In Pura village for instance, the villagers restricted access to water supply 3 times a day after they took over the management of the biogas plant and the consumption came down from 26 liters per head to 22 liters between October 1998 and August 1999.

11. Self-Help Groups

11.1 Self-help groups have emerged as a force to reckon with, especially after they were given role in poverty elevation programmes. The following are some of the examples of the role played by them in rural electrification.

i. The self-help groups played an important role in the villages of Karimnagar and Khammam districts of Andhra Pradesh where Project Chandrakanti was implemented. Nearly 10,000 lanterns have been distributed under the World Bank programme of SPV market development routed through IREDA.

ii. The Non-conventional Energy and Rural Development Society, a NGO, has established about 450 self-help groups and installed about 6,500 biogas plants, 2,400 smokeless chulas and a few solar cookers and water heaters to self-help groups. It conducted motivation camps, training programmes for masons on construction of biogas plants, potters on fabrication of improved chulas and women beneficiaries on operation and maintenance of biogas plants and smokeless chulas. Training of the potters in Kenya and stove makers in Sri Lanka also go to show the importance of training.

iii. The model of the Indian Institute of Science, Bangalore, was replicated in Chalpadi village, Adilabad District of Andhra Pradesh where electrification took place with the help of honge oil. It was joy at the jovial account of the children getting extra hours for their studies, that acted as a motivating factor. The unique feature here was that it was the women's self-help groups who took the initiative for such a project. Their savings were used for financing the project.

12. Non-Governmental Organisations

12.1 Reputed non-government organizations are implementing the programme of solar photovoltaics for various applications. NGO's like Ramakrishna Mission, Narendrapur, West Bengal, All India Women's Conference, New Delhi, The Rajgiri College of Social Science, Kochi, The Social Work and Research Centre, Tilania, Rajasthan, The World Renewal Spiritual Trust, Mount Abu and The Ladakh Ecological Development Group etc. are participating in the programme in a meaningful way.

13 Valuable Experiences Gained Regarding People's Participation

13.1 The experience gained by the Indian Institute of Science and organizations like TERI gives some valuable inputs regarding the process of people's participation The important trends that were noticed are as follows:-

i. Lighting is not the most important thing the villagers want. Drinking water followed by irrigation water occupies the pride of place in the

lives of villagers. It was the success in these fronts that brought about the desired attitudinal change among the villagers.

ii. The schemes at Sugganahalli and Kagganahalli led to a qualitative improvement in the lives of the villagers. Assured supply of water enabled cultivation of cucumber and watermelon and collection of honge oil seeds generated additional employment opportunities. Installation of water taps at homes removed the drudgery of women in walking long distances to fetch water and also solved problems of matrimonial alliance as such drudgery was a major reason for the people in the neighbouring villages not marrying their daughters to the youth in these two villages. Men could get honge oil to run their tractors and did not have to go to Kunigel to buy diesel for tractors. The benefits strengthen their faith in the new schemes.

14. Push And Pull Factors

14.1 In a country in which nearly 90% of the villages are technically connected to the grid the role of the push and pull factors would have to be critically studied before any scheme of distributed generation is introduced in the rural areas.

14.2 In the cases relating to Sugganahalli and Kagganahalli and other projects of distributed generation the push and pull factors operated as follows:

i. Both the villages were depended 100% on the new system because of the unreliability of the grid power which was the push factor. The factors enumerated above were treated as the pull factors.

ii. When the quality of grid power improved in Sugganahalli on account of installation of a sub station and transformer near Sugganahalli the people switched back to grid power for domestic lighting requirements. The scheme for water supply for irrigation however continued under the new system despite the improvement in the quality of grid power.

iii. TERI's experience in Orissa shows that the high rates of failure of school children in the examinations provoked some villagers who found that lack of electricity was an important reason for the same.It was this realization which provoked the villagers to think of distributed generation scheme.

iv. In a village in Haryana the pollution of river water caused by industrial effluence provoked the villagers to have their own schemes for meeting their water requirements

v. As people in many of the electrified villages are very much dissatisfied with the quality of grid power, such villages **should**

also be encouraged to go ahead with the Distributed Generation Schemes. These should also be the responsibility of the State Governments.

vi. The question whether Distributed Generation Schemes in rural areas should be on a stand alone basis or interconnected to the grid, should be decided on the merits of each case. As most of the villages are connected to the grid, and DG schemes may help the grid in meeting peak load requirements, it may be advisable to interconnect them to the grid .Further, as the working hours in the initial stages may not be adequate, it may be necessary to wheel the surplus power for third party sales. The type of DG scheme may be selected by the community itself after getting technical inputs from experts and taking into account its ability to pay.

15. The Institutional Models for Distributed Generation Systems

15.1 The following are the important institutional models for distributed generation within the country.

15.2 The Sunderban Model

15.2.1 The institutional models of Sunderbans is an important model to be studied. The remote villages and hamlets of the delta suffer on account of chronic shortage of electricity on account of non availability of grid power. Kerosene and diesel generator are the alternate fuel sources for lighting and other requirements of electricity respectively. As it would be very costly to take grid power to the islands, village level mini grids based on biomass gasifiers, solar photovoltaics, wind diesel hybrids and tidal power technologies are used for supplying electricity for domestic and commercial applications. Solar home lighting systems and portable lanterns are also used in many households.

15.2.2 The project was set-up by the West Bengal Renewable Energy Development Agency with the assistance of the Ministry of Non-Conventional Energy Sources. West Bengal Renewable Energy Development Agency, which owns all assets associated with the power plant and guarantees reliable generation and supply of electricity to its consumers in Sunderbans.

15.2.3 The biomass gasifier plant at Gosaba was commissioned in June 1997. Its membership has increased from 25 in 1997 to more than 600 now.

15.2.4 The plant is managed by a local cooperative and the Chairman of the Panchayat Samithi is also the Chairman of the Cooperative. Other members of the cooperative are from West Bengal Renewable Energy Development Authority and local political bodies.

15.2.5 The total number of members in the cooperative is 12-13. A person from the cooperative takes the monthly meter reading. The bill is sent by 2nd

/3rd of every month which has to be paid within 10 days at the office of the cooperative. If the payment is not received within the stipulated time, a notice of 7 days is given . If the payment is still not made, the connection is cut in a month's time and recollection requires payment of Rs.1000/-. All the revenue goes to West Bengal Renewable Energy Development Authority.

15.2.6 The tariff for domestic connections is fixed at Rs.3.25 per unit while commercial tariff is fixed at Rs.3.75 per unit. Tariff for grid electricity for Kolkata is Rs.2.50 per unit – domestic and Rs.3.00 per unit – commercial.

15.2.7 Initially, the maintenance of the plant rested with the supplier of the equipment, Ankur Limited. The contract has now been given to another company which is a manufacturer and supplier of the diesel engines in the plant. The relationship between the village committee, the local enterprise that operates and maintains the plant and the West Bengal Renewable Energy Development Authority, in this model is indicated diagrammatically at Annexure 7.

15.3 **TERI's Model**

15.3.1 The Sunderban model is the product of the initiative taken by Central Government and the Government of West Bengal. Private initiative in this respect is not wanting as can be seen from TERI's model. TERI acts in close cooperation with the manufacturers, financial intermediaries and entrepreneurs and other NGOs. Suitable entrepreneurs are identified to act as Independent Energy Service Units Network.

15.3.2 The Energy Service Unit facilitates rural credit and guided by the spirit of service for the people also undertakes tasks such as promoting awareness, demonstrations etc. The Energy Service Company is a part of The Energy Service Network and markets the renewable energy technology devices and provides the back-up services in the form of spare-parts and repair and maintenance services. The details of this model may please be seen in Annexure 8. Uttam Urja project of TERI in Rajasthan is an example of this project.

15.3.3 Another model which is being conceived by Wartsila a NGO in collaboration with BHEL for a cluster of villages in Madhya Pradesh, by organizing a village cooperative in Annexure 9.

15.3.4 The models referred to above can be considered for operating Distributed Generation and Distribution Systems. It is doubtful whether the local bodies will be able to own operate and maintain such systems as of now. The Village Level Committees will have to be established on a very big stage in the initial stages and thereafter wherever conditions are found to be suitable full fledged systems can be developed.

15.4 **Bangladesh Model**

15.4.1 As conditions for establishment of totally independent models for local bodies is not ripe now the model of Bangladesh could also be considered for adoption. The Rural Electrification Board a semi autonomous body in Bangladesh is responsible for generation, transmission and distribution of electricity to the rural areas through the rural electric societies i.e. Palli Bidyut Samity. Each PBS has a local board constituted by elected area representative.

15.4.2 The Palli Bidyut Samithies have a special division for Member Education to appraise beneficiaries of the rights and obligations of cooperative members. The Samithi appoints a Village Advisor for each village. They hold an honorary post and have to provide information to the people on operational status and policy of the Samithi, give basic education such as how to use electricity, and report to the Samithi on village needs and promote early construction of distribution lines . The General Manager communicates the customers via Villager Advisers.

15.4.3 The members of the PBS elect a Board of Directors which are a maximum of 15 members. 3 women nominees are nominated by the Board to ensure representation of women. The Board of Directors gives policy instructions to the management and ensures that the management implements them. The General Manager who is appointed by the Board is accountable to both the Board of Directors and the Rural Electrification Board. The Board of Directors cannot remove the General Manager without the prior approval of the Rural Electrification Board. However, incase of necessity the Rural Electrification Board can remove the General Manager without the concurrence of the Board of Directors.

15.4.4 In order to ensure that the system is financially viable, lines are given on the basis of established criteria and the lines that do not fulfill the revenue requirements are not included in the programme. The Palli Vidyut Samity avoid unnecessary staff and average employee consumer ratio is 1: 2.50.

15.4.5 Before the Samithi is established in a village, an adhoc project team called Institution Development Team, visits a Thana, a Rural Administrative Unit and explains the plans of electrification to the representatives of a Union, a smaller village unit that forms a Thana. The team provides a information and educates the potential beneficiaries about the importance and convenience of electricity. The teams obtains the consent of residents from the Union after its representatives reach an agreement to introduce electrification. Those who want power have to pay a small sum for the right to have power supply and obtain membership of the cooperative. **The Institutional Development Team chooses a representative of the area, who is to be the first Director of the Electrification Cooperative. The Director should be politically neutral and is forbidden to belong to any political party. After 3 years of establishment of PBS a new Director is elected by direct votes by residents in the region.**

15.4.6 The Bangladesh model is not without its problems. As the project is capital intensive the need for additional capital is always felt. The poor consumer mix, the limited revenue per km of line due to small load of domestic consumers, the difficulty in reaching remote areas are some of the constraints being experienced there. Further, the general approach towards tariff determination is one of a cross subsidy between industrial and commercial clients and residential or agricultural PBS members which
has given rise to problems as the growth in industrial load has not been fast enough to compensate the shortfall in recovery from residential consumers.

15.4.7 The Bangladesh model is relevant to India because the National Rural Electrification Cooperative Association, a central organization of rural electric cooperatives in the USA was entrusted by US Agency For International Development to extend technical assistance to the Rural Electricity Board. Further, the conscious effort made by the government of Bangladesh to keep the scheme free from all politics is a matter of significance for India where elected representatives of the people, political parties etc. have worked to the detriment of dedicated work being done by the NGOs by promising subsidized or even free supply of power.

15.4.8 The scheme has been a success and the collection rate was as high as 94% due to the emphasis placed on promptness in the payment of bills by the consumers. Despite these positive features the scheme has to face challenges. The need for capital is also felt as it is a capital intensive project. The poor consumer mix, the limited revenue per kilometer of line due to small load of domestic consumer are some of the constrains the Board is trying to tackle. The pace of progress is slow though the collection rate is as high as 26%. However, the Bangladesh model has ensured people's participation in the process of distribution of power right from the initial stages of development.

15.5 **To sum up**

i. Village level committees, self-help groups, users associations may be set up all over the country initially, as the Zilla Parishads, the Panchayat Samithies and the Village Panchayats are not as of now capable of implementing Distributed Generation projects. These may be gradually converted into bodies for generation and distribution of electricity over a period of time.

ii. In areas where cooperative movement is strong, as in Hukkeri and Bantwal Taluk or the Rural Electric Cooperative Societies may be constituted and they may be asked to take over responsibility for distribution within their respective areas.

iii. Full-fledged models of local generation and distribution can also be tried wherever it is feasible, either with the effort of government

through the cooperative model as in Sunderbans in West Bengal or private initiative TERI's in Rajasthan.

iv. Bangladesh model may also be considered for adoption with suitable modifications, if need be so that it acts as a precursor to people's participation on a larger scale in future.

v. The rebalancing of the tariff structure must be initiated quickly so as to make the working of the decentralized generation schemes viable.

vi. Systematic efforts will have to be made to create awareness among the people on the relevance of Distributed Generation schemes.

vii. The efforts will also have to be made to keep the entire process free from politics. The depoliticised model of Bangladesh may be kept in mind.

viii. Very few of the local bodies are likely to reach the final stage, of local generation and distribution, However, in order to give an impetus to the new concept, some demonstration projects should be taken up either by the Government or private agencies to give a lead to and motivate others into replicating such models .The demonstration projects should be taken up very carefully after assessing the potential of a village/cluster of villages for development, the degree of cohesion among the villagers, the attitudes of the elected representatives of the people in the area concerned, and the ability of the Panchayat Raj institutions. Success of the demonstration projects is a must, as people go back to the traditional systems with a vengeance, if such nprojects fail.

15.6 A study may be commissioned to evaluate the effectiveness as well as the shortcomings of the efforts made so far to secure people's participation in the process by organization like the Administrative Staff College, Hyderabad or the Institute of Social and Economic Change, Bangalore. It would be useful to pool the experience gained by NGOs, cooperatives etc. in distributed generation so that a proper strategy for the future may be devised. An All India Conference at which all the voluntary groups, NGOs etc. who have made attempts to enlist people's participation in the Rural Electrification may be called at which the above mentioned options may be discussed.

Chapter – 6

Financing Schemes of Distributed Generation

1. Distributed Generation is a new concept in the country and has not been tried on a large scale as yet. Needless to mention, a clear and well established l framework for financing D. G. schemes is yet to emerge.

2. There are many barriers to financing DG schemes because of lack of familiarity with them due to a dearth of already existing projects. The following are the most important barriers to financing DG schemes.

   i. *Project Risk* - Many DG technologies(wind turbines, fuel cells, micro turbines and the like) are perceived by the lenders to have high resource and technology risks, especially risks associated with transfer of technologies to the rural communities. Most of the financial institutions in the country have not had sufficient exposure to DG schemes and, therefore, do not have sufficient experience in evaluating risks associated with DG schemes. As many DG technologies are perceived as unproven, it is not easy to get lenders for financing DG schemes.

   ii. *Small Project Size* - Technological and resource constraints limit the size of DG projects. Further, transaction costs of small projects are proportionately high as compared to those of conventional projects. Since DG schemes are site specific, a lot of time and money has to be spent with regard to the investigation of the sites. It has also been observed in some projects that optimum capacity utilization cannot be attained on account of limited working hours or inadequacy of demand. Many financial institutions are, therefore, unwilling to invest in DG schemes.

   iii. *Uncertainty In Policies* - The economics of many DG projects/enterprises is heavily dependent on government policies towards interest rates, accelerated depreciation, tax credits etc. Uncertainty with regard to them affects the economics of DG projects and adds to the hesitation on the part of the financial institutions to finance DG schemes.

   ix. *Cost Of Innovation And Being a Trailblazer* - As DG schemes, especially in the rural areas, these are almost in the nature of innovations or new experiments which necessitate time consuming negotiations with all the stake holders which include the local bodies, protracted interaction with the local communities, manufacturers, the State Governments, State Electricity Boards etc. Site specific models

have to be evolved by the entrepreneurs to suit local needs and conditions. The financiers do not give due consideration to the time and resources that the borrowers are expected to devote to these processes.

3. The Government of India as well as the State Governments have adopted certain policies and given some incentives to encourage the DG schemes based on renewable sources of energy. A number of concessions are given to manufacturers of equipment under import duties and sales tax and excise duties. The producers who invest their funds in a grid connected DG systems, are assured a certain price by the State Electricity Boards/State Governments. The details regarding the concessions are spelt out in Annexures 10 (a) to 10 (c). .

4. The institutional frame for financing schemes in the power sector in the country comprises the Rural Electrification Corporation, the Power Finance Corporation, the State Finance Corporations and the Indian Renewable Energy Development Authority(IREDA). An understanding of the role played by each of these financing agencies is essential to understand the gaps in the present framework and the manner in which the same should be made good.

5. **The Role Played By The Power Finance Corporation**

5.1 The Corporation can finance micro, mini and small hydro generation projects as well as projects based on non-conventional energy sources. The emphasis of the corporation, however, has been on financing medium and large hydro and thermal power projects. This would be clear from the fact that out of the cumulative sanctions (as on 31-3-01) worth Rs.30674 crore, Rs.24709 crore were for thermal generation, hydro generation, and renovation of hydro power projects and transmission. . Renovation and modernization and life extension of old thermal and hydro plants is a priority area of financing by the Corporation The Corporation has also successfully implemented the Accelerated Generation and Supply Programme of the Government of India during the 9th Five Year Plan.

5.2 The Corporation has played the role of a catalyst in carrying forward the structural reforms in the power sector since the early 90's by adopting the three fold strategy of a proactive engagement with the States by providing grants/concessional loans for studies required for developing reform packages, formulation of special packages of incentives for reforming states including relaxation in conditionalities and exposure limits and grant of large scale financial assistance to power utilities in the power reforming states to take care of their investment needs during the next 5-7 years.

5.3 As of June 2002, the Corporation releases credit to the extent of 70% of the project cost for medium and large hydro generation and thermal generation in case of Central and State utilities and municipal run bodies, the corresponding the corresponding limits for private utility companies

being 25 and 20% respectively of the project cost. The terms and conditions of the assistance given by it are indicated in Annexure 11.

5.4 Most of the loans have been released in the favour of the Central and State Utilities. After the entry of the private sector in generation of power the corporation has supported 6307 MW of generation capacity through various types of thermal plants including coal, gas/naptha, furnace oil and DG based or hydro plants etc.

5.5 Financial assistance to small scale decentralized power projects has been a peripheral activity for the Corporation. In a number of projects based on bio-mass /cogeneration which it took up for consideration between 1995 and 2002, it found that difficulties arose on account non availability of long term arrangement for fuel as well as non availability of fuel, matters relating to quality and pricing of fuel, absence of a proper power purchase agreement, and weak promoters.

5.6 The Committee is of the view that the Corporation should concentrate on the area of its specialization and upgrade its skills and capabilities to face the emerging challenges in the power sector.

6. **Rural Electrification Corporation:**

6.1 The Corporation, premier development financial institution for promoting anfd f9inancing rural electrification in the country, supplements the resources of the State Electricity Boards/State Utilities/State Power Departments by way of loan assistance for their investments in rural electrification programmes which includes their investment in upgradation and improvement of their sub-transmission and and distribution system for supply in rural areas. It has, for this purpose devised specific portfolio of loan schemes that include financing their investment in installation and replacement of meters and any other related equipment such as transformers , conductors , capacitors etc. It was given the status of a mini ratna category I in October 1997.The budgetary support from the government has been considerably reduced over the years and from the year 2002-03, it is totally self reliant without any budgetary support from the government.. The Corporation has been mobilising resources through its market borrowing programmes including those through Capital Gains Exemption Bonds under section 54 EC and Infrastructure Bonds under section 88 of the Income Tax Act.The Reserve Bank of India agreed to treat subscriptions to the Corporation's bonds by banks as indirect finance for agriculture for computation of their priority sector lending. The scope for utilization of money so raised was extended to include system improvement programmes These measures enabled the corporation to raise money from the domestic capital market through issue of priority sector bonds.

6.2 The tempo of rural electrification which was very high during the 6^{th} and 7^{th} five year plans during which 2.20 lac villages were electrified, has come down drastically on account of the reluctance of the State Electricity

Board to take interest bearing loans for electrification of unelectrified villages and hamlets. The State Governments have been reluctant to avail themselves even of the assistance of the 100% grant under the Kutir Jyoti programmes on account of their apprehension of recurring revenue loss through such connections. States like Haryana, Goa did not lift grant even for a single connection and states like Bihar, Gujrat, Rajasthan, Punjab, UP and West Bengal utilized the grants only partly under the programme in the year 1999-2000. The same reluctance was noticed even among the North-Eastern states.

6.3 The Rural Electrification Corporation started giving greater emphasis after the rural network had expanded sufficiently on system improvement to cut down transmission and distribution losses, increase revenues and improve the quality of supply of power to the consumers. The Corporation sanctioned 300 SI schemes for a loan outlay of Rs. 2989 crore in the year 2001-02 for the purpose to State Electricity Boards/ State Power Utilities /State Power Departments. This included special category of loan schemes for procurement and installation of energy meters, replacement of transformers, capacitors and other equipment to improve the quality of supply of power and to conserve energy. The response to these schemes from the borrowing State Electricity Boards/State Power Utilities has been very good.

6.4 While the steps outlined above are welcome, the Corporation has to do much more to reorient itself, taking into account the following qualitative changes that have taken place in the power sector in the last few years and meet the new challenges..

i. *Entry Of The Private Sector* – The corporation had been dealing mainly with state government and state government entities like the State Electricity Boards. With the entry of the private sector companies in the area of distribution and generation especially in urban and semi-urban areas it has to reorient its approach.

ii. *Reorientation Of The Traditional Schemes* – As the need for improving the quality of power supplied to the consumers is getting more and more important the corporation will have to allocate higher allocations for improvements in the distribution systems. In fact in states where the scope for traditional activities like village electrification and pump set energisitation is not much today it will have to release more and more funds for improvement in the rural distribution system.

iii. *Decentralised Generation Of Power* – The concept of distributed generation has acquired a new dimension and energy in the last 2 to 3 years. The corporation's involvement in such projects has so far been modest. It hads so far sanctioned 23 small /mini/micro hydel generation projects of 69 MW capacity. To Stae Governments/Stae Power Utilities involving a loan outlay of rs. 284 crore. B.esides, it has sanctioned 6wind energy projects to private

parties 2 diesel generation projects of 4 MW capacity to JKPDC for supply in Leh and Kargil areas in winter months when hydro generation is zero. And one gas based project of 3 MW capacity to Rajastan State Electricity Board.The Corporation will now have to take a far more important role in such projects in view of the new challenges that it has to face.

6.5 The Rural Electrification Corporation is thus on the cross roads as the tempo of traditional activities has slowed down and new programmes are not yet being taken up on a large scale The Corporation, which has developed expertise over a period of time and has its network of offices throughout the country, needs to be utilized for financing Distributed Generation programmes, especially those based on renewable resources. The committee considers that this important point should be pursued in the time bound manner by the government There does not appear to be any difficulty in doing so as the executive order of the Government of India which permitted it do take up only schemes below 25 MW and restrict itself to towns with a population of 1.5 lakh has been withdrawn It can therefore function like any other power finance corporation .The redefinition of its role in the changed context needs to be brought out quickly.

6.6 Another observation needs to be made about the composition of the Board of Directors of the Corporation. The Board comprises the CMD, Director Finance and two joint secretaries from the Ministry of Power. This composition of the Board may have been relevant to the functions entrusted to the Corporation so far. In view of the new role envisaged for it, it is suggested that the Board may have in addition to its existing members, a representative of the Ministry of Rural Development and the Ministry of Non Conventional Sources of Energy.

7. India Renewable Energy Development Authority:

7.1 There is another important financing agency in the power sector viz. India Renewable Energy Development Authority, which was incorporated as a Public Limited Company in 1987. Its mission is to be a pioneering and competitive institution for financing and promoting self sustaining improvement in energy generation from renewable sources, and energy efficiency for sustainable development. Rapid commercialization of new and renewable sources of energy and upgradation of their technologies are among its important objectives It gives project and equipment finance. It can also operate through financial intermediaries and business development associates.

7.2 The authorized share capital of IREDA was Rs.300 crores and its paid up capital was Rs.250.35 crores as on 31.3.2002. It has mobilized considerable assistance especially from World Bank/GEF/SDC.

7.3. The terms and conditions of the assistance given by it may please be seen in Annexure 12 .It gives special concessions for North-Eastern

regions and Sikkim as per the details given in Annexure 13.The targets for the tenth Plan given to IREDA may please be seen in Annexure 14.

7.4 IREDA's loan commitment to the 1569 projects it has approved comes to Rs.5285.26 crores against which loans worth Rs.2732.29 crores have been disbursed. The power generation capacity of the projects assisted by IREDA is 1892.94 MW. The commissioned capacity under the IREDA schemes is 904 MW.The sector wise cumulative details of the capacities sanctioned by IREDA as on 31.3.2002 are given in Annexure 15. **It would be seen there from that out of the total capacity of 1892.94 MW sanctioned by IREDA 614.54 MW, 428.90 MW, 537.50 MW and 205.11 MW are on account of wind energy, small hydro, cogeneration and biomass power respectively.**

8. IREDA And The Solar Thermal Energy Programme

8.1 The Government of India promoted a subsidy based Solar Thermal Extension Programme in 1984, which continued up to 1993. The programme did help in disseminating the solar thermal products in different parts of the country and developed a manufacturing base as well.

8.2 After the discontinuance of the subsidy based extension schemes a soft loan programme was introduced under an interest subsidy scheme, which is implemented through IREDA and public sector banks to promote solar thermal products. The interest charged under the scheme ranges between 5%to 8%. IREDA provides loans directly and through its financial intermediaries for deployment of solar thermal products of any capacity .The banks provide loans for solar water heaters up to a maximum capacity of 2000 liters per day. Most of the banks and manufacturers associations have stressed the need to raise the capacity limit to 4000 liters, so that hotels, hostels, canteens etc can avail the facility of the loans directly from the banks. The necessary details are given in Annexure 16.

9. IREDA And Solar PV Programmes

9.1 The Government of India continued to give capital subsidy for SPV system as per the details given in Annexure 17. IREDA gives soft loans for installation of SPV systems and power plants.. The subsidy is given by the government as the cost of generation of Solar PV is Rs.10/- to 12/- per kWh as compared to that of Rs.1.00 to Rs.2.75 per kW from other renewable energy sources. The details may please be seen in Annexure 18.

9.2 Recent trends such as improvements in technologies, reduction in custom duties and expansion in market, have resulted in a decline in price level of SPV systems. In view of this trend, the government decided to reduce the subsidy levels for distribution/installation of SPV systems and power

plants during the year 2001-02 except in the North-Eastern region and Sikkim.

9.3 There are at present 20 companies that manufacture PV models. Samples of solar lanterns of more than 60 manufacturers and suppliers and samples of solar home lighting system of more than 35 manufacturers and suppliers were tested and certified for supply under the Government's SPV programme. The industry is thus quite competitive.

9.4 The programme is implemented by State Renewable Energy Development Agencies, reputed NGOs and selected Public Sector Undertakings. Some of the implementing agencies procure the SPV systems through tenders and organize their installation with the help of their district offices or through recognized Aditya shops. In contrast, some of the implementing agencies have adopted the market mechanism, which permits direct marketing of products by qualified manufacturers under the subsidy programme, so as to facilitate direct interphase between the users and manufacturers. The government encourages the use of soft loan facility offered by IREDA for this purpose.

9.5 There is need for change of strategy adopted by IREDA for implementing the scheme as costs are coming down on account of various reasons. The elimination of capital subsidy under the Solar Thermal Programme, after sufficient dissemination of solar devices, did not hamper either their growth or popularity.

9.6 As a matter of fact we have a successful example of a company which has sold SPV's without any capital subsidy in Karnataka viz. SELCO. It has installed about 10,000 SPV's in the rural areas so far. The success of the company could be attributed to the contribution, to the extent of more than 70% of its equity, made by a number of green investors from abroad, an efficient network of service centres set up by it, which ensures that all non functional systems are made functional within 24 hours, the assistance given by the Grameen Banks to the company and the decision of the Government of Karnataka not to extend capital subsidy to the scheme. The company made keept a substantial amount as deposit in the Grameen Banks, and used the interest earned from the Grameen Banks to subsidise the interest rates with the result that the borrower interest @ 9.3% per annum on the loans taken from the Grameen Banks.

9.7 The Government of Karnataka have not implemented the scheme of capital subsidy for the SPV's and hence the company is not facing unequal competition from subsidized products. It is strongly felt in certain quarters that the present system of tendering is a major hindrance to the direct interphase between the users and manufacturers . It is suggested that the effectiveness of the present capital subsidy schemes which had relevance some time back in SPV may be reviewed. The scheme may be discontinued based on the findings of the review and the government may

switch over to an interest subsidy scheme. The subsidy scheme may be confined to the North-Eastern region and other hilly and inaccessible regions.

9.8 It may be mentioned in this connection that, the Government of Indonesia have implemented a major scheme for installation of lighting and other electricity devices to approximately two lac households with assistance from the World bank and the Global Environmental facility. The Government provides subsidy to the extent of only one percent and the rest of the funds are obtained from the commercial banks loans are provided to the distributors. Similarly, Energi Surya, a private company, provides household systems for rural households by providing a network of service centres , which take care of service ,sales and credit. The company manufactures some key components and apart from the solar panels which are imported. It follows guarantee clauses for the components provided by the other suppliers. There is no reason why market forces cannot be allowed to have a free play in India subject the conditions mentioned above.

10. **Other suggestions regarding IREDA**

i The committee is of the view that there is a perceptible gap between IREDA loan sanctions(Rs.5285.26 crores) and disbursement Rs.2732.29 crores. It should be ascertained whether the gap is on account of the procedures and systems in vogue

ii Some of the international agencies has been lending funds to IREDA with a repayment period of 30 years. The question whether the benefit of the longer repayment period should be passed on to the borrowers or not and if so to what extent would have to be examined.

iii. The interest rates charged by IREDA range between 0-14%. In the regime of falling interest rates a downward revision of the interest rates charged by IREDA could be considered.

10.1 IREDA should be regarded as a repository of all wisdom and expertise with regards to renewable energy sources. A new pattern of relationship between IREDA and the Rural Electrification Corporation would be necessary in view of what has been stated above.

11. **Financing & Technological Issues:**

11.1 The decision between grid connection and decentralized generation has to be made on the basis of technical, managerial and economic issues .The

important ones among them are:-

(a) *Distance from existing grid:* There is often a cut off point beyond which grid extension is not viable. The terrain between the grid and the village must be considered to see if there are difficulties which can make line extension very difficult. It has been estimated that in the tribal and the North Eastern region, grid extension beyond three kilometers is not viable. In such situations stand alone systems are useful.

(b) *Load density:* If there is a high demand for electricity in a small area, there would be a strong justification for a grid connection in that area. Most local communities will require small quantities to be supplied to dispersed households leading to low load density s which affects the viability of some of the stand alone power plants.

(c) *System losses*: Significant power loss in the transmission and distribution system is the feature of any rural eletrification programme, especially where lower voltage transmission and distribution say 11 kVA or 33 kVA are extended over long distances. There comes a point .at which a decision has to be made whether a power line should be extended with the risks of higher system losses or whether a decentralized scheme can better serve the remote community.

(d) *Load Management*: Many rural communities use electricity mostly for lighting in the evening. and so the revenue collected by the power companies will be very low. Use of the available power for income generating activity as well as lighting makes grid extension economically viable. Stand alone systems with the low load factor will not be economically viable. A community owned stand alone power system is advantageous as it would enablee to plan productive end use for the generated power, in a much better manner. All the issues listed above have to be carefully taken into account while financing a Distributed Generation Project

12. Subsidy For Distributed Generation Schemes:

12.1 It is obvious that in many cases, Distributed Generation schemes will not be economically viable. Subsidy will have to be given in some form or the other, especially in the initial stages for electrifying villages in rural areas and remote and inaccessible areas. The Government of India have decided to treat electricity as a basic service and released funds under the Minimum Needs Programme and The Prime Minister's Grameen Rozgar Yojana. Under these two schemes, the funds are released to the States in the form of 90% grant and 10% loan for Special Category States and 30% grant and 70% loan to other States. Rs 175 crore have been

earmarked for the year 2001-2 under the Minimum Needs programme and Rs. 600 crore for the year 2002-3.

12.2 Under the PMGRY, Rs. 418 crore were earmarked for the year 2001-2 and Rs 2800 crore have been earmarked for the year 2002-3 for all components of the PMGRY with greater flexibility to the States to allocate the funds among the various components.

12.3 It is necessary that the amounts given as grant/loan is ` tilized in the best possible manner. The Committee would make the following suggestions in this regard.

i. In the case of decentralized electricity generation, concessions for the supply of electricity to a particular region may be given by inviting competitive bids. The contract should be awarded on the basis of lowest cost to provide a particular level of service. The maximum amount which the government is prepared to give as subsidy should be indicated in the notice for inviting tenders and the party that claims the lowest subsidy should be held eligible for the award of the contract. However, if the local body such as the village panchayat participates in the bid, and meets the technical criteria, it may be given a preference to the extent of 10% of the lowest offer. This is a policy decision which the Government may like to take to involve local bodies and communities in rural electrification. Such an approach is adopted in Argentine.

ii. Adoption of a cluster approach may make the schemes more viable as it would ensure adequate load for the power that would be generated. Experience has shown that the low load is responsible for the losses to be incurred by the schemes. The proposals should be preceded by a survey of the potential for development of the villages in the cluster and adequate awareness programmes

iii. The release of subsidy should not be made mechanically but on the basis of compliance of the terms and conditions of the contract. Evaluation of the performance by the scheme operator should be the main basis for release of subsidy.

iv. Where loads are very dispersed, it would be advisable consider supplying electricity to individual households, rather than installing community systems that may require an elaborate distribution network. In the alternative, a central battery charging system may be installed. There need be no rigid notions about the models that can be held eligible for subsidy.

v. The pattern for financing rural energy schemes that involves various types of funding such as grants subsidies, loans , contributions in kind by the local population, etc are getting increasingly common and may

be tried in India too. The 25 kW micro hydel plant located in the village Muktinath was funded by USAID and Intermediate Technology, a loan from the Agricultural Development Bank of Nepal and a contribution from the village. The share of grants, loans and the people's contribution was 52%, 31% and 16% respectively. The government's budgeted grants may be used for making a contribution of schemes of this type, subject to some eligibility criteria.

vi. The important principle should be that the recurring costs on account of maintenance, etc. .should not be a burden on the government. If the tariff levels are such that the people cannot afford them, the schemes will run into losses. It is, therefore, suggested that a one time capital subsidy may be given to schemes of Distributed Generation that fulfill the desired criteria in the manner outlined above, so that the tariffs are determined at levels the people can afford. For instance, in a mini grid comprising a group of villages, the capital expenditure on the transmission line connecting the villages could be subsidized.

vii. Where Distributed Generation Scheme connects a cluster of villages through a grid or a mini grid the capital expenditure on account the transmission lines linking the villages may be subsidized by the government.

viii. In order to ensure that only energy efficient pumpsets are installed, subsidy may be routed through the approved manucturers to the farmers. Such schemes may be given the benefit of subsidy, only if a group of small and marginal farmers comes forward, forma a cooperative, and agrees to use the water made available by the solar pump jointly and optimally.

13. The Concept of Viability of A Distributed Generation Scheme.:

13.1 It is necessary that the socio economic benefits that accrue to a local community on account of a Distributed Generation Scheme are evaluated while appraising it. It is necessary to do so, because the benefit accruing to a single stakeholder may not justify the project cost, though the totality of the benefits accruing to the various stakeholders may more than justify the same. The avoided costs of transmission and distribution losses can form a part of the evaluation of such schemes for instance. The positive distributed benefits like increased incomes, removal of drudgery, etc should also be a part of project evaluation. I*n the U. S. A,. some companies have made an effort to determine the financial value of the benefits of distributed power systems .and shown how the distributed benefits are substantially exceed the avoided cost resulting from the installation* . Unless the benefits are assigned to the scheme, and then quantified, the same would appear to be financially unattractive. An example of the effort made by an American company in the case of a PV array in California, is given in Annexure 19. .

14. Need For Innovative Financing For DG Schemes:

14.1 The norms for financing schemes will not work for D.G. schemes and the need for an innovative approach is paramount. The following could be important components of innovative financing.

i. **Equity Facility** – Equity may be provided on a concessional basis, which can be used to help defray the high start up costs of a particular DG project. The donors can supply the initial capital as a grant, long term loan or equity. In order to obtain maximum results such assistance should be provided as a match through capital already invested in the company. Such assistance in the form of equity would be extremely useful because DG enterprises are extremely site specific in nature and their success it intimately linked to factors like site specific, resource information and design and installation of the systems. Entrepreneurs in India would find it extremely difficult to initiate the first steps and obtain complimentary debt financing which is necessary to spread the cost over time. The question of using the amount provided for in the budget for the MNP and PMGRY can be used for providing equity in such schemes may be considered.

i. (a) The return on equity could be in the form of capital and credits for public goods like reduction in pollution levels. The investment could also be in the form of redeemable preferred shares that are sold to the firm or new investors at an agreed time and with an agreed yield. When the assisted companies mature they will seek a new equity investment from both active partners and financial institutions.

i. (b) Equity can also be used as loan reserves by the financial institutions and function in a manner similar to guarantee loss reserves. The capital could be put on deposit with the partner financial institution in such a fashion so as to meet bank system reserve requirements. The reserve monies can be leveraged through the fractional reserve system to leverage financial institutions, dead financing directed to a target firm.

ii. **Debt Co-financing Facility** – The resources are utilized in order to give loans at below market rates to the DG enterprises. The interest rate reduction is achieved by blending the donor finances with the resources of financial institutions which deals to a blended rate which is below the market rate. In the alternative the amount given by the donor as debt can be used as a bargaining point in order to bring down the rate of interest when the financial institution lends money from their own resources. Such a system need not distort the credit market as long as the subsidy keeps the interest rate close to commercial terms.

ii. (a) Donor funds could be provided on a subordinate basis i.e. the donor accepts a lower order of priority for repayment of the debt. The objective behind dead co financing facility is to meet the resources of the financial institutions more secure as a means to stimulate lending by them. This technique is useful where developers require loans for periods longer than financial institutions are willing to provide with their own funds. The only drawback with this method is that it is relatively resource incentive and its effectiveness would depend on the percentage share of co-financing from the donor.

iii. **Guarantee Facility** -Guarantees facility address the credit risk barriers and can be used appropriately when financial resources are available in the market but need an incentive to be deployed. There is always a gap between the perceived credit list as reflected in the credit underwriting practices and actual lists, which can be made good by guarantees. There are two types of guarantees, partial party guarantees and loss reserve. In each case the donor's funds are utilized as reserves against guarantee liabilities. Partial guarantees support a financial institution by sharing the credit risk of a DG loan made by the financial institution with its own resources. The amount of the guarantee will have to be precisely defined and a expressed as a percentage of the Financial Institutions remaining balance at past due interest at the time of due loss or default. When a default occurs the payment the guarantee claim would be made to the financial institution for the agreed portion of the loss. When the arrears are recovered, they would be distributed in the same proportion as the loss was distributed.

iii. (a) Donor funds can also be used to create loss reserves at the project or financial institutional level. The level of the loss reserve could be determined in terms of a percentage of overall portfolio of the value which is generally between 5-20%. The loss reserves should be sized at or even slightly greater reasonable worst case scenario of the default rate estimated for the portfolio. The loss reserves could be jointly funded by a donor and partner financial institution. The loss reserve works best when a portfolio consists of a large number of smaller loan transactions where a statistical approach can be given to the credit structure of the portfolio as a whole. Loan loss reserves achieve the highest level of leverage and often be contributed by the manufacturer or the financial institutions or even the donor.

15. The Committee is of the view that the special dispensation proposed with regard to equity contribution, debt co-financing and guarantees should be confined to projects of the size of between 1 MW and 5 MW. Entrepreneurs who go in for projects above 5 MW do possess some financial strength and have enough schemes to which support them financially.

Financial intermediaries can also play an important in innovative financing. The Infrastructure Development Finance Corporation and the Infrastructure Lease Finance Corporation can be requested to assist in the development in the new an innovative models.

17. A major handicap which the committee faces was on account of lack of necessary data regarding the functioning of mini-hydel biomass/gas projects and SPV projects. The Ministry of Non-conventional Energy Sources and IREDA were enable to give the full picture regarding the details of the physical and financial performance of the projects managed by them. The committee is therefore unable to make detailed and more specific suggestions about the financing mechanism based on actual performance of the relevant projects. It is suggested that a detailed evaluation of the projects of mini hydel, wind energy, biomass, biogas, SPV models which have already been commissioned. In the light of the actual experience gained new models may be developed. A task force comprising of the representative of Ministries of Power and Non-Conventional Energy Sources, IREDA, REC, ICICI and IDFS and ILFC be constituted to make detailed recommendations on innovative financing.

18. **Tax Incentives And Import Duty Concessions** - A system of import duty concessions and tax concession may have to be devised for making DG schemes viable. The following could be the important components of a suitable tax package.

i. Depreciation - If entrepreneurs are allowed to accelerate the depreciation of rural electricity equipment they get relief under the upfront cost which they have to incur in the schemes of rural electrification. High depreciation rates are an investment incentives. In India the benefit of 100% depreciation was misused by the parties that borrowed funds for setting up wind energy projects. These were mostly corporate entities which were more interested in augmenting their projects rather than implementing their projects. However, the technology with regard to wind storm projects has improved over the years and monitoring has also been tighter. The question whether benefit of depreciation should be restored or not would have to be restored in the light of this background. The committee is of the view the government may take such decisions as it deems appropriate in the matter. However a reasonable ate which is sufficiently attractive will have to be retained.

ii. Tax Holidays- Tax holidays on income generated by rural electrification schemes are used world wide as an investment incentive offset capital intensive nature of Rural Electrification schemes. Such instruments can also be used where rural entrepreneurs install rural energy supply schemes.

iii. Favourable taxing structures can be evolved for rural electrification schemes after taking into account that electricity generation from these schemes has lower environmental impact than generation from fossil fuels.

19 Assistance to the individual customers in financing the initial cost of connection can also be part of innovative financing. This can be done either through provision of specific subsidies or through support for credit schemes. In South Africa, where consumers in rural areas were given the choice of either paying for the connections themselves and then paying the normal tariff or having a free connection and paying a higher tariff, the majority chose the higher tariff. The use of load limiting devices, prefabricated wiring systems and prepayment meters can also be thought of as part of an innovative package as these may help the persons belonging to rural strata of society in rural areas.

20 It would thus be seen that the problem is not merely a financial one. Intricate problems relating to transfer of technologies to rural communities and their education have got to be tackled with tact and imagination to ensure smooth induction of systemic changes This is indeed a venture into new and uncharted waters. **The approach has, therefore , got to be innovative and the process of trial and error has to be necessarily gone through. The proposed scheme has a vital role to play in the economic development of the country. It is therefore, suggested that the entire exercise including that of demonstration projects be given the status of a Technology Mission. This would ensure that the scheme gets the priority it deserves in the national agenda for economic growth and reform**

Chapter – 7

Regulatory Issues

1. The Electricity Regulatory Commissions have started functioning both at the central and the state levels and are exercising their regulatory powers, which include, inter area, important issues such as tariff determination and interconnectivity. As has been already emphasized Distributed Generation Schemes are perceived as a risky propositions by Financial Institutions. Since these are mostly in the initial stages the regulatory framework for them will have to be evolved in a very careful manner.

2. It was noticed that there is no uniform policy or approach of the regulators with regard to such schemes. The Government of India have therefore initiated a dialogue the Central Electricity Regulatory Commission and the concerned State Electricity Regulatory Commissions to evolve uniform policies for power from renewable sources including preferential tariff. Some of the important issues are discussed under this chapter.

   i. The Distributed Generation Schemes being extremely location specific in nature cannot be subjected to rigid and uniform rules atleast till such time as we gain sufficient experience with regard to them. The rigidity of uniform may dampen the spirit of enterprise and innovation on the part of the entrepreneurs concerned. The committee therefore suggests that such projects should not be subjected to the discipline of the regulators in the initial phase i.e. next two to three years. DG schemes are also not going to be implemented on a very large scale in the next 2 to 3 years as a number of constraints have to be overcome. Only a few projects are likely to commence on a trial basis in the light of the dialogue which the government may initiate with the NGOs in view of its recent thrust on DG schemes. The committee therefore feels that there need be no difficulty in agreeing to the suggestion.

   ii An important point while determining the tariff should be the comparison between the tariff of the DG schemes and the tariff of the grid power at the specific location. In other words the cost of transmission and distribution losses in the grid system at the specific location will have to be taken into account while drawing the comparison. Secondly, allowance will have to be made for the fact that the plant load factor of a DG system would be much lower especially in the initial stages as compared to that of a central power station which is already stabilized. It will have to be assumed that the plant load factor of a DG system will increase over a period of time and the economics of the DG schemes will have to be based on such an assumption.

iii Include an assured price for buy back power generated by biomass projects and wind power projects by the State Electricity Boards. The details are given in Annexure 20. It would be seen from the Annexures that the buy back prices range between Rs.2.25 per unit with escalation at 5% for a period of 5 years in the case of biomass projects. In the case of wind power projects the buy back price ranges between Rs.2.25/kwh and Rs.2.89/kwh at 5% escalation. In the states of Madhya Pradesh and Tamil Nadu no escalation is allowed and in the state of West Bengal it is allowed on a case to case basis.

The incentive no doubt acted as a catalyst and helped in the installation of a number of biomass based and wind based projects. Some of the State Electricity Boards are now complaining that the buy back prices have reached unreasonably high levels and eroding the profitability. While it will not be correct to attribute the losses incurred by the State Electricity Boards entirely to the buy back prices as the energy bought from such projects constitutes only a small percentage of the turn over of respective grid systems, the matter no doubt needs to be reviewed. While the escalation clause may be retained for the present its implications over a period of time would have to be examined, the committee would suggest that the escalation clause may be reviewed at the end of every three years. A distinction will have to be made between fuel based and biomass based DG schemes while the matter is examined.

iv. An important risk to be borne by the DG systems rises on account of uncertainty of demand which is detrimental to scale economies. If the local demand does not pick up the surplus power will have to be wheeled into the system for sales to third parties. Third party sales are allowed only in the states of Maharashtra, Haryana and Rajasthan for biomass projects and Karnataka, Maharashtra in the case of wind power projects. It is necessary that third party sales are permitted especially in the case of DG schemes such measures would ensure that genuine competition emerges in the power sector. The third party sales the committee recommends should be permitted liberally as true competition can be introduced only then.

i. It is noticed that the wheeling charges which were as low as 2% in some states initially are being revised upwards(to even 28% in some cases) and that to with the approval of the State Electricity Regulatory Commissions. The committee recommends that the wheeling charges should be related to reasonable levels of transmission and distribution losses of the State Electricity Boards. This would ensure that State Electricity Boards do not mechanically ask for wheeling charges which are higher than necessary and also made responsible for controlling transmission and distribution losses. In any case it should be ensured that the State Electricity Boards do not suffer a financial loss on account of the policy

directives given by the state government in such matters by the State Electricity Boards.

3. It is most important that the question of interconnectivity between the state grids and the grids of the DG schemes is resolved on a most urgent basis. The rigidity and reluctance on the part of the incumbent operator has been a major obstacle all the world over for the development of the DG schemes.

4. Some of the Regulatory Commissions have tried to achieve demand management through tariffs by announcing concessions in tariffs to consumers to switch over to solar systems and devices. The State Electricity Boards of Rajasthan and Karnataka have done so.

5. As the entrepreneurs that operate the DG schemes are extremely venerable to discriminatory behaviour by the incumbent operators in connecting to the transmission and distribution grid the Central Electricity Regulatory Commission would have to establish technical interconnection rules so that DG schemes can be implemented before resolving the broader competition issues that arise on account of their implementation. Considering the overall benefits that accrue to the economy on account of DG schemes, it is imperative that the terms and conditions for the interconnectivity are finalized with the utmost expedition and DG schemes are allowed to commence their operations without a final resolution of all competition issues. This in fact was the approach adopted by the Federal Trade Commission before the Public Utilities Commission of the State of California.

5. While the regulatory issues need to be resolved the National Policy on DG schemes based on the Renewable Energy Sources needs to be urgently spelt out as the regulators are bound by the policy directives given by the appropriate government. The Government of Rajasthan are reported to have issued a policy directive to the State Electricity Regulatory Commission to regulate power purchase in such a manner that procurement of power from non-conventional sources reaches a level equivalent to 10% by 2005. The articulation of a clear policy in the matter in terms of Clauses 4 and 5 of the Electricity Bill 2001 at the National Level will a long way in giving a legal and conceptual framework within which the regulators can exercise their powers.