Green ways for a good earth!
Vasudha Foundation

MANDLA DISTRICT ENERGY PLAN REPORT

Vasudha Foundation
CISRS House, 14 Jungpura B
Mathura Road, New Delhi - 110 014
www.vasudha-india.org

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Executive Summary

District Energy Planning, in India, is nothing new and was initiated in the late 1980s, early 1990s and up to mid 2000. Amongst the various districts for which “energy plans” were prepared, was Mandla, way back in March 1992 by a team led by Dr. Veena Joshi, then with the Tata Energy Research Institute.

While all the previous energy plans, though prepared for the Ministry for New and Renewable Energy, not only assessed the demand and projected demand for electricity and energy, but also looked at all forms of fuel supply to meet the energy demands. The Mandla energy plan prepared in 1992, focused on bio-mass supply, largely due to the vast forest areas.

However, this plan aimed at critically examining the possibility of converting Mandla into a 100% Green Energy District, maximizing the potentials of renewable energy and energy efficiency, while ensuring quality electricity and energy access to all households in Mandla. This plan also tried to look at the holistic energy needs of the people, to assess demand and also thereby to look at possible supply options, with the key being, Mandla to have its own generation and supply independence, while being sustainable to green, to the maximum extent possible.

Mandla district presented a very distinct agro-climatic and demographic area, largely because of the large forest area, surrounded by three large national parks and tiger reserve, namely the Kanha National Park, the Bandhavgarh and Pench National Parks and also because of its predominant tribal population.

This study clearly brings out the fact that “Greening Mandla’s Energy Supply” is not only possible but also economically feasible, and can be done with existing budgetary heads and provision of the Government of India, which has been largely unspent.

It further identifies the potential of the district show-casing models of public-private partnership in greening its energy, with private sector or community participation in setting up generation units with policy support from the Government of Madhya Pradesh, the Government of India and the District Administration of Mandla.
While the district has near 100% electrification, the quality of supply of electricity is extremely poor and therefore the per-capita electricity consumption of the district is only 300 kWh,

while the national average is 700 kWh. The district also faces peak shortage and, therefore, to address this peak shortage, the scheduled power cuts ranges from 12 hours to 4 hours in the entire district, with the rural areas experiencing 12 hours of power cuts every day.

Due to the power cuts, Kerosene usage is also extremely high, estimated to be 8000 Kilo Litres per annum.

Fire-wood is the pre-dominant fuel for meeting the cooking and heating requirements and all the 150 odd resorts in the district, being a predominant tourist district, use fire-wood to meet the water-heating and part of their cooking requirements. Therefore, the total usage of firewood in the district has been estimated to be 375,000 tonnes per year, or equivalent to destroying trees in about 1500 hectares of land every year.

Therefore, the priority energy direction or plan for the district would be to ensure 100% clean and modern energy access to all with electricity supply for all households.

Being a predominant agrarian and forest district, there is a huge supply of soft bio-mass (agriculture residue) and woody bio-mass (forest produce), in addition to having huge potential for small, micro and mini hydro, due to the surrounding water bodies, such as the Narmada river and its tributaries flowing through the district. Being in a distinct agro-climatic zone, Mandla also enjoys more than 300 days of sun shine with intensities that can maximize the potential of solar generation.

Energy efficiency is a relatively unknown concept in the district. With the exception of hotels and resorts which are shifting to Compact Fluorescent Lamps from Incandescent lamps, 100 Watt Incandescent lamps dot most households and other residential and semi-commercial establishments, inclusive of government offices. Most of the shops that sell electrical and electrical-electronic appliances do not really bother about “energy efficient labeling”.

The district also has a fairly high Transmission and Distribution Loss. The declared “transmission and distribution loss” for the district is 25% on an average, though, the total, commercial losses inclusive, is likely to be much higher.

Therefore the loss reduction and efficiency programme also has huge potentials for the district.

The current electricity consumption of the district is 87 Million kWh and projected to go up to 247.17 Million kWh by 2020, factoring in 100% electrification of all households, ensuring a minimum electricity supply of 1 kWh for every household per day, as is envisaged in the "National Energy Policy" and factoring in growth rates.

The current electricity supply is met from the Jabalpur Division Grid. It is however estimated that if the potentials of loss reduction, energy efficiency and tapping a part of the renewable energy potential is implemented, by the year 2017, Mandla district will not only be energy independent, but can also contribute "excess green and clean energy" to the central grid.

By 2020, if implemented properly and accordingly to timelines and detailed schedules, Mandla can potentially reduce its demand by 24 MW by energy conservation and efficiency measures and by reducing its losses. A further 55 MW can potentially come from bio-mass and its huge forest potential, without causing any further destruction to forests, but actually creating a huge forest sink. The small hydro sector can potentially contribute to 15 MW without exploiting its full potential and the solar photo-voltaic and solar thermal applications can contribute to 7 MW collectively, giving the district an excess power of 46 MW which it can sell to the grid at a profit.

The issue which would occur to all is on the all important economics and cost issue. The key questions being, "would it burden the consumers, particularly, since Mandla is predominantly a tribal district" and "what would be the burden on the state, which is already bearing a huge cost of energy supply".

This plan has kept the "economics and financial implications" as the bottom line and has estimated that the "end cost" to the consumers would remain what it is now, which is a combination of what they are paying for electricity and Kerosene, while assuring them of a 24 x 7 energy supply and not just electricity supply. In terms of costs to the Government, the plan estimates that the current budgetary support available through National Programmes will meet the entire projections. Assuming that the Government either directly or through its allied organisations such as the NTPC, NHPC invests the entire amount, the total cost to the Government would be Rs. 659 Cr over a period of 10 years, with the annual budgetary allocation being Rs. 65.90 Cr.

However, with adequate policy and support, which can bring in the required investments, the total outgo from the Government budget would only be Rs.271.41 Cr or Rs. 27.14 Cr per annum.

If the programme is implemented well, the district of Mandla will potentially save Rs. 15-25 Cr[1] of annual subsidy on Kerosene supply and protect 1000 Hectares of forest land. This could potentially mean in ensuring that a carbon sink which has the capacity to sequester 1111.5 tonnes of carbon per year[2].

Further, from the very second year of implementing the plan, which is by 2014, Mandla can reduce its carbon emissions from the electricity and energy sector, (not including transport sector) by 50 percent.

[1] Current cost of Kerosene per litre is Rs. 15/- but the cost of 1 litre of Kerosene to refinery is Rs. 40/- as per Dr. Kirit Parikh report on Fossil fuel subsidy submitted to the Planning Commission in 2010. So, therefore the costs have been worked at Rs. 25 x 8000 Kilo Litre

[2] The IPCC report of 2000 estimates that every acre of forest land has the capacity to sequester carbon to the extent of 0.1-0.3 tonnes (http://www.epa.gov/sequestration/faq.html#3)

Introduction

1.1 Background:

Electricity demand in India is expected to grow rapidly from 813 GWh in 2007-08 to 2,104 GWh in 2020 for a GDP growth rate scenario of 8% per year[3]. Current planning efforts call for the majority of this demand to be met by thermal power plants (i.e. coal and nuclear) due to the government's view that electricity generated from these sources (using either domestic or imported coal) is cheaper. Historically, electricity demand has consistently outpaced electricity supply, leading to severe electricity shortages. Actual supply capacity additions have been consistently lower than the targets set by the government[4]. As per the 11th five-year plan, approximately 80 GW of new coal capacity was expected to come online by 2012; to date only 50 GW of that capacity has been constructed. Further, progress was slow in providing fuel for much of the coal capacity that was installed in 2010-11, suggesting that the capacity factors may be significantly lower than expected.

Furthermore, in the recent past, a number of coal fired power plants had to slow down their electricity generation, (in some cases, even reducing it by half), due to severe shortage of coal supplies.

It also needs to be pointed out that despite the fact that electricity generation in India has grown substantially in the last two decades, primarily with a number of conventional power plants coming up, there continues to be a disconnect between electricity generation capacity addition and electricity access to rural poor. Approximately 289 million Indians do not have access to modern electricity[5]

With increasing pressure on India to address climate change coupled with the challenges of ensuring energy access for all, the country needs to re-look at its energy policy and direction.

Clean energy options, such as renewable energy (RE) and energy efficiency (EE), meet not only the environmental and energy security objectives, but also can play a crucial role in reducing chronic power shortages. Both RE and EE also can be deployed far more rapidly than conventional large-scale thermal power plants.

In the recent years, the renewable energy sector has received a boost in the form of a number of policy initiatives, which if properly implemented, could potentially lead to widening the markets for renewable energy ramp-up in India. Some of the policy initiatives are:-

1. **National Electricity Policy (2005)** - notified in compliance with the Electricity Act-2003, clause 5 of the policy lays down conditions to promote and harness renewable energy sources.

2. **National Tariff Policy (2006)** - elaborates the role of regulatory commissions and specifies a mechanism for promoting use of renewable energy.

3. **Rural Electrification Policy (2006)** - provides for the first time a policy framework for decentralized distributed generation of electricity based on conventional and non-conventional sources.

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[3] Planning Commission, Government of India (GOI), 2011
[4] (Sathaye et al., 2010)
[5] IEA Energy outlook 2011

4. **<u>State Renewable Purchase Obligations with feed-in-tariffs</u>**

5. **<u>National Solar Mission</u>**

6. **<u>Generation Based Incentives replacing Accelerated Depreciation for wind farms</u>**

7. **<u>Renewable Energy Certificates</u>**

Similarly, for energy efficiency and conservation, the enactment of the Energy Conservation Act 2001 has given a huge boost to the sector and the Bureau of Energy Efficiency which was set up to in accordance with the Act, has so far done an exemplary job in prioritizing energy efficiency, despite a lot of resistance from various quarters, inclusive of some fellow ministries and government agencies.

However, despite all this, the market for clean energy in India still remains very small and negligible. It needs to be said here that the clean energy market has largely been private investment driven, with very little public investment having gone into it, unlike the other sectors within the broad ambit of energy, such as nuclear energy, coal thermal and hydel energy.

Some of the reasons for the sluggish penetration of renewable energy and energy efficiency in India include-

- high costs of renewable energy solutions
- lack of awareness of the potentials of renewable energy not only to the common man but also to policy makers
- availability of technologies
- low levels of maintenance
- limited availability of resources such as land for solar power projects and biomass
- lack of entrepreneurial models

Therefore, despite the fact that a number of new policies framework to promote renewable energy has been brought out in the recent past, contradictions in policies also act as a major barrier towards the large scale deployment of green energy solutions.

There have been a number of research studies and reports that have been published which clearly show-case that a 100% clean energy solution is possible and feasible globally by 2050 and one such report was published recently by WWF titled the “Energy Report”.

However, what is required for a country like India, particularly where awareness levels, of the potentials and possibilities of renewable energy, are fairly low and where the general perception is that clean energy solutions are very expensive is a model of how such a solution is not only possible and feasible and also economically viable in the medium run. Such a pathway needs to not only show how renewable energy solutions can be made efficient but to also dispel the myth that the large number of failed renewable energy projects are due to poor technologies. In most cases, failed projects are largely due to poor design, poor management practices and systems and lack of involvement of the beneficiaries of the project.

In view of this, this project proposes to take up a detailed study of clean energy options in the Mandla district of Madhya Pradesh.

1.2 Scope and Objectives of the Study and Plan

The broad objective of the study is to prepare a detailed district energy plan that would look at all possible sources of energy and come up with possible scenarios for the district to have as much green energy as possible, with the ultimate objective being 100% green energy district, if feasible.

The study would do a detailed profiling of the districts, analyze the current energy demand and supply trends, conduct a detailed resource mapping of all clean energy options possible and conduct a detailed techno-commercial viability for the possible implementation of "clean energy plans" for the district.

1.3 Methodology

1.3.1 Field Survey

a) Village and Rural Energy Assessment:

A Survey conducted in identified 5 villages as a sample, covering the Bicchiya and Nainpur blocks and based on the following parameters:

i) Villages in the periphery of the national parks
ii) A mix of tribal and non-tribal villages
iii) A mix of electrified and un-electrified hamlets/Habitats
iv) A mix of economically backward villages and villages which have are fairly well-off.

The identified villages were

1) Chhapri in Bicchiya block, covering the 7 Hamlets, namely, Mahaveer, Harra, Lukhar, Chowki, Khursi, Gwari, Beeja,
2) Patpara in Bicchiya block
3) Indravan in Bicchiya block covering the five hamlets of Baiga, Rachhka,
4) Indri in Nainpur block, covering the three hamlets of chhindi tola, tikri tola and baheri tola
5) Atariya in Bicchiya Block, covering the three hamlets of Panda, Mukaddam, Jarra

Coverage was given to the households / data of selected villages / industry / other details wherever required as per the format. Household survey and industry survey was carried out as per guidelines.

Household Survey:

The basic objective of the study was to analyse the demand and supply scenarios of energy in various sectors of economy, assessment of local resources of energy and prepare a sustainable energy plan. The key parameters assessed in the household schedules are:

Land utilization: Information was collected on land used for various purposes, area under different crops, area irrigated and crop yield with respect to grain and it's residues and their utilization. Source wise irrigated area was also considered under this section.

Livestock details: In this part information was collected on livestock ownership, cattle feeding culture, production and utilization of dung, space for biogas plant, etc.

Daily energy demand & supply in domestic sector: Information was collected in detail on fuel used by households. This included collection of data on quantity of various fuels collected for different purposes. In the same way data on consumption of various fuels for different end uses was collected.

Ownership & utilization of Assets: To know the status of household, information was collected on the ownership of assets and their utilization.

Artisan:

Data was collected from, households under artisan category, about their occupation / activities, number of persons involved in it, time spent, sources and quantity of energy consumed and their monthly output.

Rural industry

Data was collected from rural industry owners. In detail the number of persons involved in industry, schedule of running, energy consumed and monthly output, and amount of agro-waste generated if any.

Village survey schedule

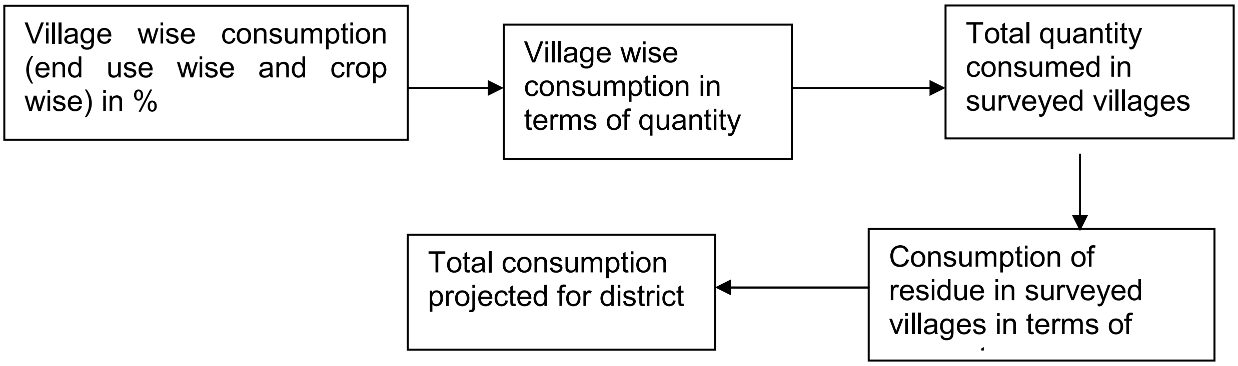
To collect the general information of the village a separate schedule was designed. The schedule had the following major information gathering points as given below.

▪ Village background information	▪ Demographic characteristics
▪ Electrification status (no. of connections)	▪ Land utilization
▪ Use of community land	▪ Fuel wood collection practice
▪ Cropping pattern	▪ Energy in agriculture Activities
▪ Biomass (crop residues) & its Utilization	▪ Animal husbandry details
▪ Industries in the village	▪ End use of Agro Industry by-product

▪ Hot water requirement in the industries	▪ Artisans details
▪ End use wise Fuel use status/variation	▪ Energy consumption in personal transportation
▪ Cooking hours	▪ Availability of technical manpower
▪ Education facilities	▪ Water resources in the village
▪ Rate of different fuels	▪ Commercial establishment's details
▪ Renewable systems details i.e. no. status & potential	▪ Details of rural development programmes implemented in the villages
▪ Source of income of villages	▪ General observations on the villages

Crop residue Consumption:

Crop residue consumption is assessed for all crops grown in the study area, end use wise, which is presented by the following steps:



Surplus Crop Residue = Production - Consumption (Fodder + Fuel + Thatching)

Fuel wood supply

To know the collection of fuel wood/residue from trees, the following information was collected; head loads, average cuttings per tree, trips to forests and wastelands etc.

Fuel consumption

Village level: End use wise quantity of fuel consumed per day

District level: Per capita fuel consumption x total district population

Biomass from Non-Agricultural Lands

Annual Biomass = **Area x Av. Sustainable biomass Availability from primary survey**

b) Commercial sector data:

i) Classification of the commercial sector in to the broad categories of

   a. Hospitality sector
   b. Educational Institutions
   c. Small Commercial establishments such as shops etc
   d. Mid-sized commercial establishments such as large laundries catering to the hotel industry and others
   e. Public and Government buildings

II) Schedule of Information:

a) Number of establishments in each of the category
b) Average monthly electricity usage
c) Pattern of usage – purpose
d) Source of electricity and energy
e) Case study audit of two iconic buildings of each category to give an overview of appliances and systems being used.

C) Industry Category:

a) Classification of the industry in to low energy intensive, medium energy intensive and high energy intensive categories
b) Number of establishments in each of the category
c) Average monthly electricity usage
d) Pattern of usage – purpose
e) Source of electricity and energy
f) Case study audit of two iconic industry category to give an overview of appliances and systems being used.

1.3.2 Desk Research:

The desk research involved sourcing documents from various departments from the web to get an overview of the following information:

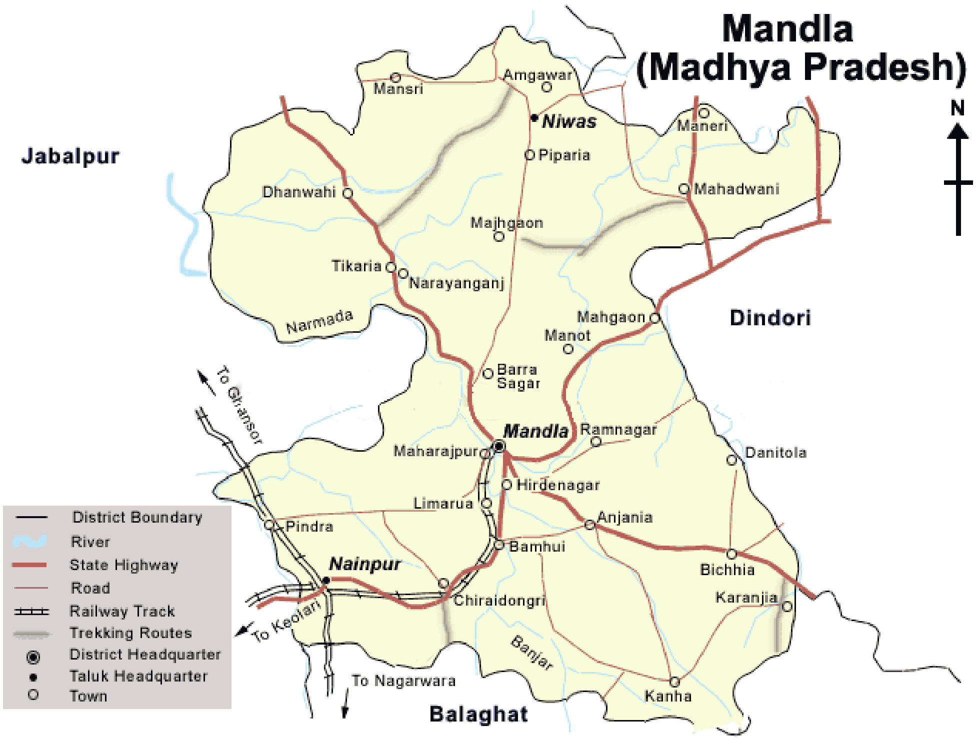
Data Perused from the Web

DEPARTMENT	TYPE OF INFORMATION
Directorate of Economics and Statistics, Madhya Pradesh (http://www.mp.gov.in/des/)	Statistical data for the state and sector wise data for the years 2006, 2007, 2008, 2009 and 2010
Block Development Office	Block details, land use, cropping pattern, demographic details, infrastructure details, map
Office of the Director General Census, New Delhi (censusindia.gov.in)	2001 Census
District Agriculture office (www.kvkmandlazpdvii.org)	Land utilisation pattern of the District/blocks, cropping pattern and crop yields of different crops, soil data, rainfall details
Animal husbandry office, Chief Veterinary Officer	Live stock population of the District/blocks
Madhya Pradesh State Electricity Board (www.mp.gov.in/energy/mpseb)	Electricity data of the District, substation details, Total number of connections in each category and connected load, sub-station details, un-electrified villages list, etc. Load Despatch etc
District Supply Office	Number of LPG, Petrol, Kerosene dealers, PDS shops and monthly/annual quantity supplied
Madhya Pradesh Renewable Energy Development Agency (www.mprenewable.nic.in)	Number of renewable energy system and devices installed in the district.
Department of Industries, MP State (http://mandla.nic.in/trade_and_indusries.pdf)	List of industries
Bureau of Energy Efficiency (www.bee-india.nic.in)	Status of implementation of Bachchat Lamp Yojana
Planning Commission, Government of India (www.planningcommission.nic.in)	State Plan for 2009, 2010 and 2011 Tentative plan prepared by the state for 2012
State Planning Commission (www. mp.gov.in/spb)	Sector wise plan outlay for 2011
Other Agencies (www.pacsindia.org) (www.pradan.net)	Information from local NGO – Pradan on the state Information from the Poorest Areas Civil Society Programme Office, Delhi for “PACS Programme” details being implemented in Mandla district.

CHAPTER – 2

PROFILE OF THE DISTRICT

2.1 Physiography and Climate Profile of Mandla:



Mandla lies on the Satpura plateau of Madhya Pradesh and extends up to the last ridges of Maikal hills. A major part of the Mandla district is occupied by the Narmada basin consisting of the North-Eastern part of the Son sub-basin and the South-Western (Wainganga subbasin) and South-Eastern extent (Seonath sub-basin) of the Godavari basin. Several tributaries of Narmada River namely, Banjer, Thanwar, Kharmer, Surpen, Matiyari, Balai, Hallow, Chayrar, and Makrar run through the district. Mandla is endowed with rich forests, and is abundant with minerals such as bauxite, dolomite, and limestone.

Undulating plains, numerous small valleys intersected by seasonal streams and rivers with tablelands at hilltops (locally known as “Dadar”) are prominent topographical features of Mandla. Other landforms in the Southern part are structural plains, structural hills and valleys, denudational plateaux, denudational slopes and pediments/pediplains, and in the Western part flood plains (including in filled riverbeds) exist along the course of the Narmada River. Rolling grass plains intermingled with Sal forests cover the Southern portion of the Mandla district.

Geologically the region of Mandla district is over lined by basaltic lava flow of Deccan trap formation, and the soils of district are generally black and stony. Due to weathering, the soil on sloping areas is shallow while in the plains it is quite deep. Other soils in the area include black cotton soil existing in low-lying areas, and alluvial soil along drains and streams. The district with its undulating and hilly topography lies 443-887m above mean sea level.

The District falls in the sub arid and semi arid region, and annually receives a high level of rainfall, between 1400mm and 1600mm of rainfall, mostly during the June to September monsoon period. The four main seasons of the area are; winter (December to February), summer (March to mid-June), South-West monsoon (mid-June to September), and post- or retreating-monsoon (October to November). As the district extends over the highest plateaus of the Satpura ranges (from 443-887m above sea level), it is relatively cool in comparison to low lying plains to the North and South with similarity to temperate climate. This is despite the fact that it is situated in the tropical climatic zone. January records the coldest temperatures with an average daily maximum of 26.0°C and minimum of 7.8°C. May is typically the hottest month with a daily maximum averaging 41.3°C and reaching a high of 44°C. The minimum temperature during this month averages 24.4°C.

2.2 Area and Population (Demographic Characteristics)

The total geographical area of the district is 8771 sq. km. The extreme length of the district is about 133 kms. from north to south and extreme breadth is 182 kms from east to west. Tribal population dominates the district, and the main tribal groups in the area are Baiga, Gond, Kol and Pradhan (ST population of the district is approximately 57%). The population of the district (as per Census 2011) is 1,053,522 with a sex ratio of 1005 females per 1000 males. Population density stands at 182 persons per sq.Km. Major languages of the district are Gond, Bigani, and Bundelkhandi. Literacy rate of the district (as per Census 2001) is 59.61%.

Table 1: DEMOGRAPHIC DETAILS OF THE DISTRICT[6]

Particulars	Census 2001			Census 2011		
	Total	Rural	Urban	Total	Rural	Urban
Total HH	190,035	171,366	18,669			
Total Population	894,236	802,322	91,914	1,053,522	923,309	130,213
Total Male	447,956	400,731	47,225	525,495	459,392	66,103
Total Female	446,280	401,591	44,689	528,027	463,917	64,110
Population below 6 yrs.	144,395	132,999	11,396	144,799	131,189	13,610
ST population	511,798	501,327	10,471			
Literate population	446,998	378,422	68,576	620,481	517,964	102,517
Illiterate population	447,238	423,900	23,338			
Working population	464,397	435,959	28,438			
Nonworking population	429,839	366,363	63,476			

Based on the Census figures the decadal rate of growth for the population in Mandla is 17%, with the annual growth being in the region of 1.7%

2.3 Economic Profile of Mandla:

The economy of the district depends upon tourism and agriculture. Main kharif crops in the area are paddy, maize, and soybean and rabi crops are wheat, rai, mustard, and pulses. The

[6] Source: Census, 2001 and 2011

district has low irrigation intensity of less than 20% leading to low productivity in rabi crops. Mandla is among the few states in Madhya Pradesh where 40% of workers are engaged as agricultural labourers, non-agricultural workers constitute 15% or less of all workers. Most of the tribal population of the district depends upon the forest for their livelihood, as the Mekal & Satpura hills are abundant with Teak, Sal and other timber woods.

The district is also home to the hotel industry due to proximity of the Kanha National Park (a tiger sanctuary) and a few small and medium scale industrial enterprises. Amongst the major industries present in the area are stone crushing, mills for rice; oil; pulses; and sugar, engineering works, aluminum and copper ingots, fertilizer, truck body manufacture, herbal powder, ceramic glazed tiles, and dolomite powder.

2.4 Land use Pattern:

The total geographical area of the Mandla district is 9,65,559 hectares. Forest dominates land use of the area, occupying around 61.43%, followed by cultivated land covering 27.75% of the area. Of this cultivated land, only 23.73% is cropped more than once a year.

About 14. 59% of the area is not cultivable. Other land use in the district includes revenue wasteland (6.28%), cultivable wasteland (2.03%) and other fallow land (2.06%).[7]

75.54% of Mandla's population lives below the poverty line[8]. The district is predominantly tribal with the tribal population accounting to 60%, followed by OBCs (27%) and scheduled castes (10%).[9] Further, as per the land ownership pattern, around 54% of the poor are landless, 30% are marginal farmers and 16% are smallfarmers.[10]

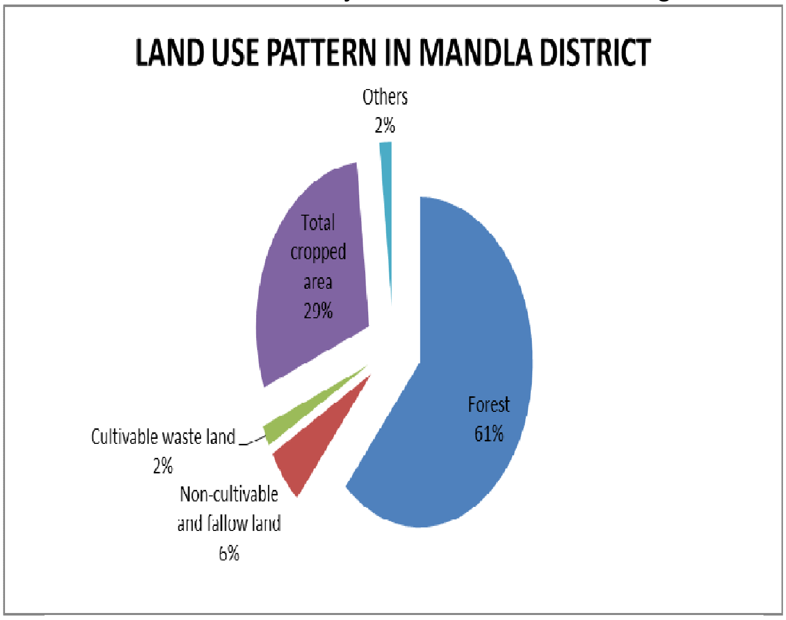


Figure 1: LAND USE PATTERN (ha.)

[7] Sources: (A Rapid Landscape Assessment on Environmental Vulnerability of Matiyari Watershed in Mandla District-Foundation for Ecological Security & District Agriculture Contingency Plan)

[8] Madhya Pradesh District wise Poverty Estimates, MP State Planning Commison, November 2010 (http://mp.gov.in/spb/international-aided-projects/pmpsu/outputs%20to%20be%20upload%2008.11.10/District%20Wise%20Poverty%20Estimates.pdf)

[9] Source: MP State Planning Commission, District profile, November 2010

[10] Source: MP State Planning Commission, District profile, November 2010

Table 2: Land Use Pattern[11]

Category	Area (In Ha.)
Geographical area	9,65,559
Reporting area	
Forest	5,93,126
Non-cultivable	53,342
Misc. tree crops	45
Cultivable waste land	19,577
Other fallow land	19,703
Current fallow	25,499
Net area sown	2,14,460
Total cropped area	2,82,620
Area sown twice	68,160

2.5 Agriculture trends and practices in Mandla District:

Despite agriculture being a dominant source of livelihood, the net sown area out of the total geographical area of the district is only 23%.[12] This is low in comparison to other areas however could be attributed to the high level of forest in the area. The irrigated area is only 8% and mainly comes from canals. Fertilizer consumption per hectare is just 16kg,[13] which is one of the lowest levels in the state. The majority of farmers here practice traditional agriculture methods, evident through canal irrigation and low fertilizer consumption.

The Baigas traditionally practiced a type of shifting cultivation known as “Bewar”, however due to the ban on shifting cultivation this is now very limited. Bewar crops are diverse due to mixed cultivation, use of traditional crop varieties and customary cultivation practices. Though the Gond tribe is agrarian they also practice traditional agriculture, using elements from the forest and limited use of modern implements and inputs. There are two cropping seasons, the most important one being Kharif which is locally known as “Siari”. This season is of great importance in the area for growing principle cereals and millet crops. The largest grown single crop has traditionally been the minor millets of “Kodo” and “Kutaki” which form the staple food of most tribes in the area. Rice has now become the most extensively cropped grain and wheat is now also grown in significant amount in the district.

[11] Sources: (A Rapid Landscape Assessment on Environmental Vulnerability of Matiyari Watershed in Mandla District-Foundation for Ecological Security & District Agriculture Contingency Plan)

[12] Source: Krishi Vigyan Kendra, Mandla

[13] Report by FES, Mandla (http://fes.org.in/includeAll.php?pId=My04My0z&mandlaprj&img=mandla-madhyapradesh)

Table 3: CROPPING PATTERN OF THE DISTRICT (FIVE YEAR AVERAGE)[14]

Category	Area ('000 Ha.)	Production ('000 Tonnes)	Yield (kg/Ha.)
Kharif season			
Paddy	111.40	82.60	782
Minor Millets (Kodo-Kutki)	39.70	9.50	233
Maize	19.0	28.00	1525
Pulses	3.10	2.80	929
Soybean	0.60	0.50	763
Nizar & Others	8.0	1.60	207
Rabi season			
Linseed	4.39	1.52	346
Wheat	38.80	27.50	995
Peas	15.30	3.20	246
Lentil	11.50	4.00	384
Mustard	14.30	7.20	717
Gram	5.80	3.43	628

Table 4: CROPPING PATTERN OF THE DISTRICT (ANNUAL DATA)[15]

Category	Area ('000 Ha.)					Production ('000 Tonnes)					Yield (kg/Ha.)				
KHARIF	05	06	07	08	09	05	06	07	08	09	05	06	07	08	09
Paddy	115	115	114	115	108	92	85	90	83	97	743	785	732	950	900
Jowar	0.2	0.3	0.2	0.3	0.1	0.3	0.1	0.3	0.2	0.1	742	930	932	1050	950
Maize	19	19	18	18	18	39	19	29	21	31	1007	1530	1120	1750	1700
Others	43	42	40	38	38	13	9	10	10	12	200	240	245	320	300
Arhar	3.5	3.7	3.8	3.9	4	3.3	3.5	3.7	2.7	4.2	1001	1020	717	110	1050
Moong	0	0.2	0.4	0.5	0	0	0.1	0.1	0.1	0	0	306	440	440	0
Urad	2.5	4	2.2	2.3	2	1.2	0.7	1.2	0.5	0.5	290	300	229	250	275
Til	2	2	1.6	1.6	1.6	0.4	0.4	0.4	0.3	0.64	177	190	200	425	400
Soyabean	0.6	0.6	1.3	1.3	2.4	0.5	0.5	0.8	1	2	642	780	784	900	900

[14] Source: District Agriculture Contingency Plan/Krishi Vigyan Kendra, Mandla
[15] Source: District Department of Agriculture, Mandla

Nizar & Others	**8.2**	**8.2**	**8.2**	**6**	**8.6**	**1.6**	**2.4**	**2.4**	**2.5**	**1.92**	**290**	**295**	**293**	**230**	**225**
RABI															
Wheat	**36**	**32**	**29**	**29**	**35**	**28**	**33**	**30**	**29**	**26**	**920**	**960**	**985**	**915**	**910**
Gram	**5**	**5**	**5**	**5**	**7**	**2**	**2**	**3**	**5**	**3**	**484**	**560**	**595**	**565**	**570**
Peas	**16**	**17**	**15**	**16**	**15**	**3.6**	**3.9**	**4.7**	**4.5**	**4**	**246**	**270**	**280**	**242**	**240**
Lentil	**13**	**15**	**14**	**14**	**13**	**4.9**	**5.6**	**5.6**	**5.4**	**6.1**	**411**	**360**	**375**	**410**	**410**
Others	**1.5**	**1.6**	**1.5**	**1.6**	**1.6**	**0.6**	**0.5**	**0.7**	**0.7**	**0.7**	**364**	**410**	**430**	**430**	**430**
Mustard	**16**	**16**	**16**	**14**	**16**	**9**	**9**	**9**	**8.7**	**12.3**	**560**	**580**	**590**	**760**	**760**
Linseed	**5**	**7.5**	**4**	**4**	**4**	**1**	**1.5**	**1.3**	**1.3**	**1**	**200**	**297**	**302**	**260**	**260**
Sugarcane	**2**	**2**	**3**	**3**	**3**	**6**	**6**	**8**	**9**	**10**	**3640**	**3650**	**3700**	**3712**	**3712**

2.6 Livestock Population and Trends of the district:

Livestock constitutes the most important resource for livelihood strategies of the tribal people. Livestock resource, especially in tribal areas is marked by untapped potential and low productivity. Listed below is the approximate livestock population of the district.

Table 5: Animal Husbandry, 2007 Census Data (In Numbers)[16]

Animal		**Male**	**Female**	**Total**
Cows				
	Breed	609	2047	2656
	Local- Low Yield	251906	189698	441604
Buffaloes				
	Breed	728	169	897
	Local – Low Yield	37931	40116	78047
Goat		26716	83196	109912
Pig		3588	9723	13311
Poultry				141528

[16] Source- 18th Animal Husbandry Census, 2007 (Department of Animal Husbandry, Mandla)

2.7 Electricity Sector Overview of Mandla

The Madhya Pradesh Human Development Report of 2007 lists Mandla among the districts having less than 50 percent access to electricity, with per capita consumption being lower than 300 kWh per person per year. 17 villages in the district remain unelectrified, while 1180 out of the total 1214 villages have been taken up for intensive electrification.

Table 6: ELECTRICITY DATA OF THE DISTRICT (In Thousands) (April 2010-March 2011)[17]

	LT	HT
Number of Consumers	74994	16
Billed Consumption (‘000 kwh)	100,621	4542
Connected Load (KW)	36014	3204
Length of Lines (Km.)	2806	2975

Table 7: Month wise Electricity Supply Details[18] (Unit in Lakh kWh)

Description	PLACE	Jul-11			Aug-11			Sep-11			Oct-11		
		Net Energy Input	Units Billed	% Energy Loss	Net Energy Input	Units Billed	% Energy Loss	Net Energy Input	Units Billed	% Energy Loss	Net Energy Input	Units Billed	% Energy Loss
Division - with HT	MANDLA	102.85	75.51	26.58%	110.46	85.41	22.68%	114.66	80.72	29.60%	120.10	90.70	24.48%

[17] Source- MP Poorva Kshetra Vidyut Vitaran Company Limited, Jabalpur Circle

[18] Source- MP Poorva Kshetra Vidyut Vitaran Company Limited, Jabalpur Circle

Nov-11			Dec-11			Cumulative (July 2011 to December 2011)		
Net Energy Input	Units Billed	% Energy Loss	Net Energy Input	Units Billed	% Energy Loss	Net Energy Input	Units Billed	% Energy Loss
111.74	86.13	22.91%	119.67	93.27	22.06%	679.48	511.74	24.69%

The average electricity supply works to 87 Lakh units per month with the average T & D Loss being in the region of 25% per month.

2.8 Electricity Consumption Patterns:

With a per-capita electricity consumption of less than 300 kWh and with only 16 HT Consumers, bulk of the consumption comprises of lighting and non-energy intensity usage.

Figure 2: Sources of Lighting in Mandla Town an Urban Centres of the district

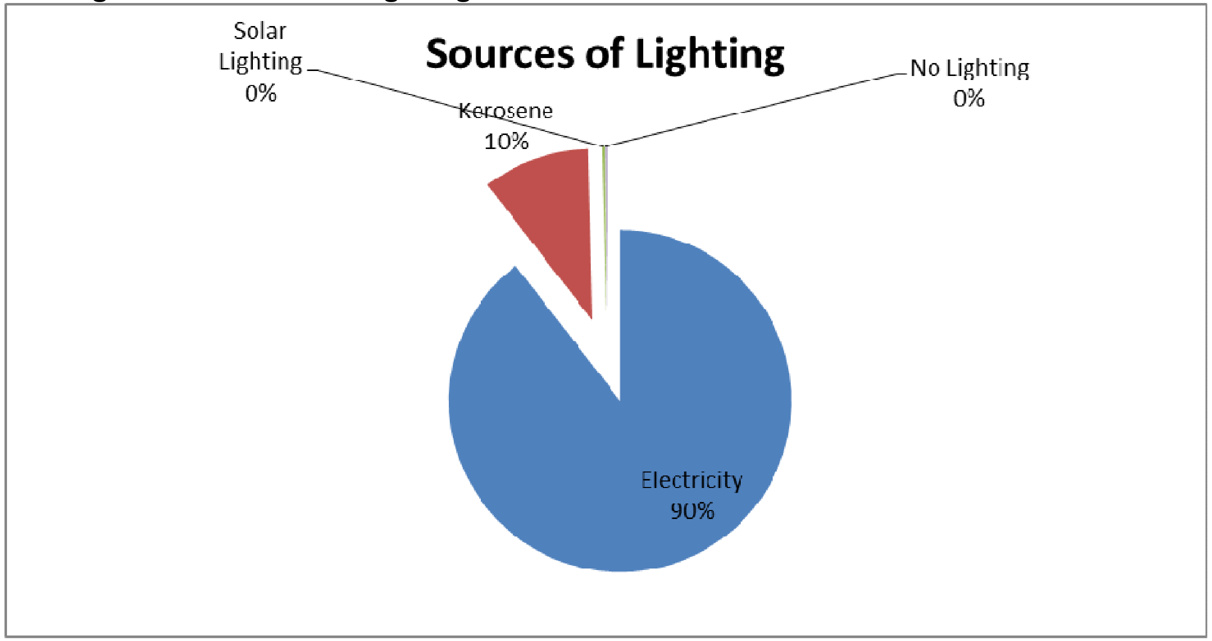


Table 8: Sources of Electricity for lighting purposes in Mandla Town[19]

No of Households	Electricity	Kerosene	Solar Lighting	No Lighting
10,383	9295	1050	28	10

The household electricity supply in Mandla town averages to roughly 20 hours a day, with scheduled daily outages for 2 hours in the morning and 2 hours in the evening. However, in the rural areas, the supply is for 12 hours, with scheduled power cuts, between 4AM to 12 PM and 4PM to 6PM every day. The supply of electricity in the Tehsil head quarters averages about 15-16 hours every day.

Consumption Pattern of Government Building:

The major government building in Mandla town is the collectorate office and the average consumption of electricity in office works roughly to 3000 Units per month. The usage varies depending on the season. The maximum consumption is usually in the month of June, where the air-conditioner usage is the highest and the consumption in the month of June 2011 was 4605 kWh. The least consumption was in the month of December. This was in our view a combination of holidays and also daily usage. Table 9 gives an overview of the seasonal electricity consumption pattern of the district collectorate.

Table 9: Indicative Consumption Pattern by the District Collectorate (Data for the months of June, August, and December (2011)[20] (In kWh)

	Jun-11	Aug-11	Dec-11
Collector Court Complex	1250	435	289
Collectorate Computer Room	1344	1711	328
Deputy Collector Bar Room	294	115	241
District and Sessions Judge	1463	708	1105
Bar Association Court Complex	254	197	64
Total	4605	3166	2027

It must be pointed out here that, the collectorate has CFL lightings, but all the other electricity fixtures and appliances are not “star rated products”.

Electricity and Energy Consumption Pattern in Rural Households:

In general, most of the rural households have one or two light points, with one out of 5 electrified households having a television. The general usage of electricity is primarily for lighting and occasionally to charge mobile phones.

BPL households that have electricity connection, generally pay a flat rate of Rs. 56/- per month for 30 units of consumption every month, with the Government subsidizing their electricity by Rs. 77/- per month.

[19] Source: MP MP Poorva Kshetra Vidyut Vitaran Company Limited, Jabalpur Circle

[20] Source: - Madhya Pradesh Poorv Kshetra Vidyut Vitran Co. Ltd. (Mandla)

For a metered connection, the per kWh tariff is Rs. 1.75 (subsidized). As can be seen from the bill below, this consumer has consumed 129 units in a two month period and if the tariff were to be non-subsidized, he would have to pay Rs. 419/- (tariff of Rs. 3.75 per unit). However, he now pays only 1.75 per unit.

On an average, a household in rural areas, even assuming that they consume the full quota of Kerosene, which is 5 litres per month at the price of Rs. 15/- per litre and with the electricity metered tariff of Rs. 65/- per month on an average, the total expenditure for energy without factoring in the price of firewood in rural households is Rs. 135/- per month.

Electricity Consumption Pattern in the Agriculture Sector:

In the agriculture sector, there are only two HT connections in the entire Mandla district for irrigation purposes. The normal electricity supply in the LT category is usually “single phase” connection with very few “three phase connections” and therefore, the usage of electricity for irrigation purposes is extremely low.

Table 10: ENERGY CONSUMPTION IN AGRICULTURE SECTOR[21]

Category	Animal/Manual	Diesel	Electricity
Tilling	90%	10%	0
Irrigation	85%	15%	10%
Threshing	90%	10%	0
Transportation	75%	25%	0
Average	**83.5%**	**17.5%**	

[21] Source: Field Data collection corroborated with MP Electricity Utility data

Electricity and Energy Consumption in the Hotel/Hospitality Industry:

Only one of the hotels in Mandla district has a HT Connection, while all the other hotels/resorts/guest houses have only LT connection. There are a total of 135 hotels/resorts/guest houses in the Mandla Electricity supply circle. The biggest of the resort is “Celebrations” having 34 rooms and a HT connection. The other large resorts are “Kiplings Court”, with 16 rooms, “Krishna Resort” with 33 rooms, “Indian adventures” has 16 rooms, “Tuli Resort” with 20 rooms, Taj Properties, Chitvan and Baghtola.

Most of the hotels have installed CFLs for lighting, but the main energy consumption is for hot water and cooking. All the resorts/hotels use fire wood boilers for hot water and use a combination of LPG and firewood for cooking needs.

The average consumption of electricity for lighting purposes in resorts is approximately 3000-5000 units per month. However, the summer consumption ranges from 5000-7000 units per month, due to usage of air-conditioners.

Case Study: Hotel Celebration

• 8 boilers (capacity of 100 liters each) are used for heating water for the rooms in the resort. Water is heated in the boilers by burning firewood.

• Hot water is provided to the guests for half an hour in the morning (before forest visit) and half an hour in the evening (post forest visit), and sometimes during the afternoon at the request of the guests. Such a schedule allows them to prevent water wastage, and excessive usage of firewood.

• The resort buys 20 quintals of firewood every month.

• The resort has a 72 KVA diesel generator, but it is hardly used.

• The generator consumes 18 liters of diesel for running, and the resort buys approximately 300 liters of diesel in a year. They want to avoid the noise and the air pollution emanating from a diesel generator. And their use of the generator is further minimized by the 24 hour supply that they get.

• Other hotels in the area use diesel generators when occupancy levels are high.

• The property is the largest in the area with 34 rooms, and is open for 9 months.

• The resort is a HT consumer, although not all hotels in the area are HT consumers. Most are LT consumers, since it is difficult to get a HT connection.

• They are the highest paid consumers of electricity in the area. They pay a flat rate of approximately Rs. 64,000/- every month as their electricity bill.

• Electricity is used for appliances such as television, air conditioning, and heating of water in the kitchen through the use of geysers.

• LPG consumption is worth Rs. 1,56,000/- every year. The resort falls under the commercial cylinder category (1 commercial cylinder= 19 kg)

• The forest department charges Rs. 1000-1500 for every truck of firewood brought into the resort. Approximately Rs. 15,000-20,000 is spent every month on the purchase of firewood.

Case Study: Krishna Resort

- There are 33 rooms in the hotel
- Resorts in the area use firewood for boiling water.
- Fallen leaves etc. in the resort is put back into the flower and plant beds.
- 1-2 hotels in the area have tried using Solar water heaters last year during the winter season but it was not very successful.
- Water is wasted through the boiler as 2-3 buckets water flow out and then hot water starts coming through the tap.
- The resort has requested Bharat Gas for LPG pipeline.
- The resort has a metered connection, they pay approximately Rs. 29,000-30,000 per month.
- During the off-season there electricity bill goes down to Rs. 17,000-18,000/-, during the summer season due to excessive use of air-conditioners their bill goes up to Rs.40,000/-
- The resort has mostly CFLs installed.
- During the 9 months of business, the resort uses 30 tonnes of firewood.
- In the resort electricity is used for television, lighting of common areas and of staff quarters.
- The area has high voltage fluctuation.
- Rs. 12,000 is spent per month (average) on firewood.
- Biogas is the favoured option due to prior experience.
- 10-20 kilograms of kitchen waste is produced every year. If fallen leaves are added then the quantity must be much higher.
- The resort has a pit dug for dumping of waste, although the waste is not segregated before dumping.
- The park is closed from 1st July to 15th of October, the rest of the year is peak season for the resort.

Industrial and high energy intense sector:

There are only 16 connections in the HT Category, which includes one hotel and two irrigation connections. The remaining 13 connections are largely four rice mills, one hospital, one commercial vehicle body building unit, 2 sugar mills, one school, one telephone Exchange, The Mandla Railway Station, Mandla All India Radio Station, and a small fabricating unit.

An indicative electricity consumption of 5 of the largest consumers of electricity in the HT Sector, season wise is found in table 11 below.

Table 11: Season wise electricity consumption of 5 of the largest HT Connections in Mandla[22]

In kWh

HT Consumer	Units Consumed			
	Contract Demand	Jun-11	Aug-11	Dec-11
Commercial Vehicle Body Builder	11 KV	96840	105493	78400
Rice Mill	11 KV	16550	24075	29846
Tourist Hotel	33 KV	11728	1003	8335
Hospital	11 KV	31170	24200	15910
Non-Industrial (Mahalakshmi Commercial)	11 KV	7713	1517	3653
Rice Mill	11 KV	5200	5968	5345
Total		169201	162256	141489

As can be seen, the hotel has its highest consumption in the month of June 2011, due to increase in use of Air-Conditioners, while, has very negligible consumption in August 2011, largely because, the Kanha National Park is closed for tourists in August. The air-conditioning usage is also reflected in the electricity consumption pattern of the hospital and the office of Mahalakshmi Commercial, a trading organization.

On the other hand, the commercial vehicle body building unit consumes the highest in August 2011, as it is the period, where in tourist operators get their vehicles repaired, due to off-season for tourism.

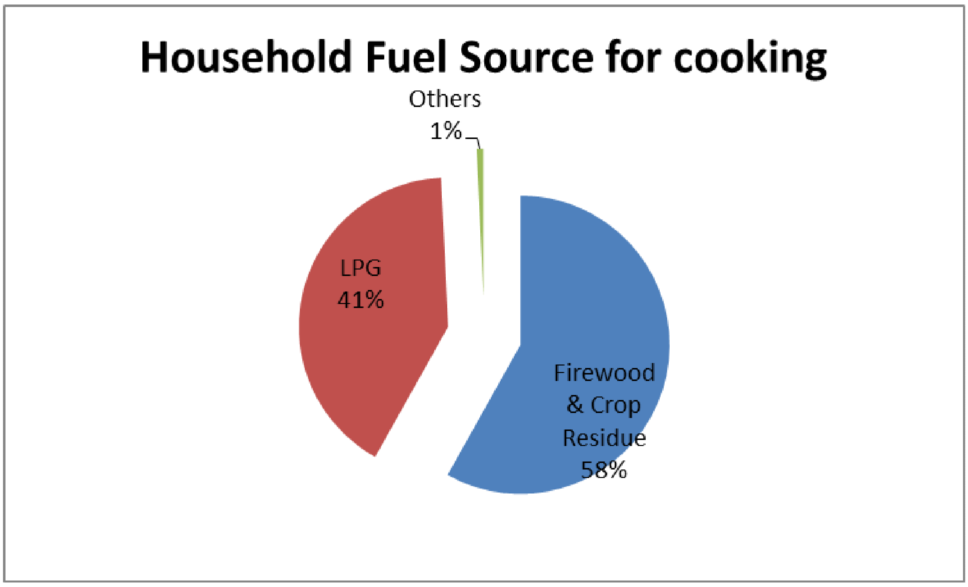
2.9 Other energy consumption patterns and overview:

Table: 12: Sources of fuel for cooking in Mandla Town: (Usage in Numbers)

Total HH	LPG	Firewood	Crop residue	Cow dung	Bio-gas	electricity	Coal & other
10,383	4153	4451	1418	18	43	2	12

[22] Source: Madhya Pradesh Poorv Kshetra Vidyut Vitran Co. Ltd. (Mandla)

Figure 3: Sources of cooking fuel in Mandla Town



The approximate Kerosene consumption per household ranges from 3 ltrs to 5 ltrs per month.

2.10 Waste Generation Trends

Currently 18 tonnes of waste is generated every day in Mandla town and the total waste generated in the entire district is estimated to be 27 tonnes. It is expected to touch 23 tonnes and 45 tonnes by 2025.

2.11 Tourism Sector Flow:

On an average it is estimated that 10,000 tourists visit Mandla every year, out of which approximately 500 of them are foreign tourists. While Mandla has a few interesting tourist spots, most of the tourists use Mandla as the transit point to Kanha National park. However, it is important to look at the tourist inflow to Kanha National Park, the Pench National Park, as it would be part of a circuit for many and Mandla will be a transit point.

As is evident from the table below, the months of October has the largest tourist inflow in the Kanha and Bandhavgarh national parks, with all the other months, with the exception of July-Sept having a moderate flow.

Table 13: Month wise tourist flow to key destinations in Madhya Pradesh[23]

Center	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Bhopal	97103	92051	98388	85233	82992	92989	111170	26261	74993	112249	85421	115991	1074841
Sanchi	3981	399	1518	1213	740	499	216	776	5104	1802	782	311	17341
Pachmarhi	13519	18508	18680	14267	15706	29424	15746	21880	11844	22589	16342	15175	213680
Jabalpur/Bhedaghat	19332	9077	11987	16790	19798	23259	0	35006	35647	23958	11819	10242	216915
Kanha National Park	1399	1040	1666	2502	2733	2693	0	0	0	5327	2512	2299	22171
Bandhavgarh National Park	148	800	245	533	837	893	0	0	0	1951	387	462	6256
Pench National Park	0	929	1519	859	449	1537	675	1185	621	9198	2042	1572	20586
Amarkantak	12823	4458	10123	8354	13581	38487	24677	37870	20055	27458	15921	8778	222585
Chitrakoot	5956	5986	5592	1569	1835	2142	2221	5451	3651	7989	8620	6339	57351
Khajuraho	7406	7480	6911	2132	3492	2330	3770	4051	2263	15895	13933	13622	83285
Orchha	4237	14073	3421	4672	2830	3809	5730	5264	4538	12745	13856	12369	87544
Gwalior	47499	47175	37373	28076	30175	32910	113178	34704	30271	29574	31786	21153	483874
Shivpuri	15235	11622	6278	6262	7688	6435	4970	6840	4115	3835	5366	5973	84619
Chanderi	0	305	341	424	421	273	169	244	207	364	327	457	3532
Indore	17543	30980	26378	58400	38290	34592	28844	30264	27404	34810	33882	35124	396511
Ujjain	3461	4781	3521	10252	6445	6422	6489	4045	5267	7967	5535	5291	69476
Mandu	2283	2472	1985	5851	3210	5116	2990	2565	4689	5839	5474	3631	46105
Maheshwar	4021	3621	3698	4116	3405	5309	3530	4276	4468	7106	5998	3053	52601
Omkareshwar	5011	6590	6298	13615	17042	22292	12721	18508	17580	26554	22615	18148	186974
Burhanpur	0	4061	2254	3856	4690	4911	3701	3260	32928	4703	4054	3635	72053
All Centers	**260958**	**266408**	**248175**	**268975**	**256360**	**316321**	**386318**	**242451**	**285646**	**361913**	**286672**	**283628**	**3463825**

Table 14: Annual Tourist flow to Places around Mandla[24]

Place	Annual Domestic Tourist inflow	Annual Foreign Tourist inflow	All Tourists
Kanha National Park	66,300	19,000	**85,300**
Bandhavgarh National Park	6256	2195	**8451**
Pench National Park	20587	1101	**21686**

So, this will have a bearing on energy consumption in hotels too, as October has a moderate weather condition and therefore the use of neither air-conditioners nor water heaters would be high.

Furthermore, a Green Energy Plan for a tourist district also serves the purpose of show-casing the efforts made by the State and District administration in opting for a low carbon pathway.

2.12 Forest and Wildlife:

Mandla has 61% forest area (Source: District Statistical Handbook, 2006) and is home to the Kanha National Park that is home to over 100 tigers. Spread over an area of 1945 sq. Km, Kanha was among the first nine Reserves included in the Project Tiger Network in 1973. Species found in the area include spotted Deer, Indian Swamp Deer, Wild Pig, Jackal, Tiger, Panther, and over 260 species of birds.

[23] Tourism Statistics for the State of Madhya Pradesh, Ministry of Tourism, GOI

[24] Tourism Statistics for the State of Madhya Pradesh, Ministry of Tourism, GOI

Mandla has a good variety of trees including Sal (Shorea rubusta), Teak (Tetona Grandia), Saj (Burades), Salai (Barwellie serrata), Palas/Chheola (Butea frondosa), Harra/Myrabolam (Terminalia chebula), Mahua (Vassia latifolia), Achar (Buchhananania latifolia). Other trees include Tinsa, Bija, Koha, Dhawa, Lendia, Dhamin, Haldu, Aonla/Anora, Tendu, Jamun, Mango, and Khaner. It is also covered by a vast variety of forest types, majority being Teak and Sal forests occurring in natural transition with the southern tropical dry deciduous forest.

The district's mixed forest provides a vast number of Non Timber Forest Produce (NTFP) that support tribal livelihood. Tribals, especially Baigas, have an intricate relationship with the flora of the area, which is useful for their daily lives. They use a variety of tubers, leaves, flowers and fruits derived from the forest. The area is rich in medicinal plant varieties which is the main provision of medicine for the local villagers.

2.13 Industry Profile

The following is a list of the established industries and the workers employed by them in Mandla district:

Small Scale Industries	Medium Scale Industries	Large Scale Industries
Ceramics glazed tiles Re-rolling mill Truck body manufacture (HT Connected) SDPI moulded container Block wood/plywood Herbal Manufacturing Brick kiln Aluminum ingots Corrugated box Leaf Spring Fertilizer- 16 Table & Ceiling fan PVC Water storage Leaf spring trolley and vehicle U-Bolt center Stone Crushing Mill board Transformer Computer Stationery	Automobile cabin/chassis (HT Connected) Soybean Oil LPG filling (HPCL)	Sugar (HT Connected)

CHAPTER – 3

SUMMARY OF ENERGY CONSUMPTION IN THE DISTRICT

3.1 Overall Electricity Consumption of Mandla

The Overall Electricity Consumption of Mandla, category wise consumption is as follows:

Table 15: Category wise Consumption[25] in Lakh kWh

Category of Consumers	2008-09	2009-10	2010-11
Domestic	620.00	650.00	660.00
Non-Domestic (Shops and offices	113.00	120.00	125.40
Water Works	33.60	33.60	33.60
Street Lights	51.30	51.50	52.00
Industrial Power (LT)	55.00	56.00	57.00
Industrial Power (HT)	13.00	14.00	15.00
Irrigation Pumps	120.00	125.00	130.00
Total Units Sold	1005.90	1050.10	1073.00

The average consumption per month is roughly 105 Lakhs kWh.

The average consumption of electricity for different uses in all category of consumers is as follows:

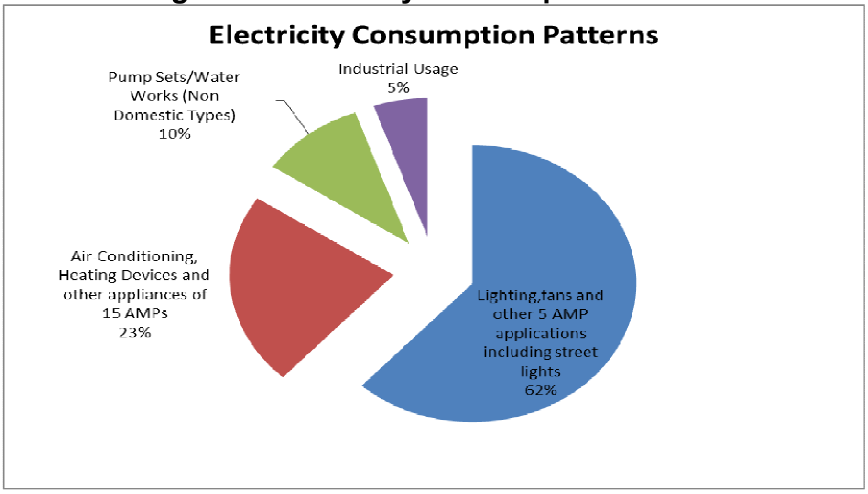
Table 16: Consumption Patterns[26] (in Lakh kWh)

Electricity Consumption pattern	2008-09	2009-10	2010-11
Lighting, fans and other 5 AMP applications including street lights	512.50	534.50	542.80
Air-Conditioning, Heating Devices and other appliances of 15 AMPs	186	195	198
Pump Sets/Water Works (Non Domestic Types)	153.60	158.60	90.60
Industrial Usage	40.80	42.00	46.80

[25] Madhya Pradesh Poorv Kshetra Vidyut Vitaran Co. Ltd.,Mandla

[26] Madhya Pradesh Poorv Kshetra Vidyut Vitaran Co. Ltd.,Mandla

Figure 4: Electricity Consumption Pattern



3.2 Overall Energy Consumption in Mandla

1. Firewood:

As per the 2001 Census, the total number of households in Mandla District was 190,035, with 171,366 households in rural Mandla and 18,669 in Urban Mandla.

Particulars	**Census 2001**			**Census 2011***		
	Total	**Rural**	**Urban**	**Total**	**Rural**	**Urban**
Total HH	190,035	171,366	18,669	2,10,704*	184,661*	26,042*
Total Population	894,236	802,322	91,914	1,053,522	923,309	130,213

*Note * : The total number of households in 2011 has been computed on the basis of dividing the population as per the 2011 census by 5, assuming an average of 5 people per household.*

On an average, 75% of the rural households in Mandla use firewood for cooking and heating purposes, with 50% of urban households resorting to firewood for heating and cooking purposes. The hotel industry uses firewood for boiling water and partially for meeting cooking needs. On an average, the hotel requires 10-15 quintals of firewood every day, which in itself would mean 150 hotels x 15 quintals = 225 tonnes every day.

The average consumption of firewood in houses is about 7-10 Kgs a day. Therefore, the domestic consumption of firewood is approximately 1000 tonnes per day.

Therefore, the average firewood consumption in Mandla will be approximately 1250 tonnes a day, or approximately 375,000 tonnes per year, which is equivalent to using trees covering an area of 1500 hectares per year.

In Mandla District headquarter the consumption pattern of fuel for cooking and lighting is as below:

Cooking and heating

Total HH	LPG	Firewood	Crop residue	Cow dung	Bio-gas	electricity	Coal & other
10,383	4153	4451	1418	18	43	2	12

Lighting:

No of Households	Electricity	Kerosene	Solar Lighting	No Lighting
10,383	9295	1050	28	10

2. LPG:

A total of just 30% of all households in Mandla district have access to LPG connection, which means just about 60,000 households have LPG connection. On an average, the consumption per household is one cylinder of 14.2 Kgs per month, which translates to 720,000 cylinders per month in the domestic segment or 10,224 tonnes of Gas per annum.

On an average, a hotel/resort consumes an average of 120 cylinders per year and with approximately 150 resorts, and road side stalls, the average LPG consumption in the hospitality sector translates to 20,000 cylinders per year or 380 tonnes of Gas per annum.

3. Kerosene:

Approximately 30% of the households do not have access to electricity and of the houses, which have access to electricity; power outages and technical problems result in power cuts. It has been estimated that of the 210,000 households in the district, approximately, 147,00 households have access to PDS Kerosene, which is 5 Litres per household per month. The consumption of Kerosene in Mandla district is 8000 Kilo Litres per year, which has been corroborated by the Food and Civil Supplies department.

4. Diesel for Pump sets:

Only 8% of the total cultivated land (2,14,460 Hectares)) in Mandla district is irrigated, translating to 17,156 hectares. Out of this, the department of agriculture has estimated that 80% of the irrigated land is through canal and downstream irrigation, which means that only 4000 hectares of land is irrigated using pump sets. Out of these, approximately 50% use electricity for irrigation purposes, which means only 2000 hectares of land is irrigated using diesel pumpsets. Therefore the total number of diesel gensets in use is approximately in the region of 500-1000 gensets, operating at 6 hours a day for 100 days (Single crop). This translates to 1200 Kilo litres of diesel per year.

CHAPTER – 4

SOURCES OF ELECTRICITY SUPPLY

4.1 Sources of Electricity for Mandla District:

The district receives its electricity from 3 key substation, namely, Amanala, Maneri and Samnapur. These substations generation receive electricity from the Rani Avanti Bai Sagar Hydroelectric project of NHPC across Bargi River, the matiyari Project across the river Matiyari, The Omkareshwar project and the Indira Sagar Power Project.

4.2 Supply – Demand Gap:

The current supply of electricity to Mandla is roughly 35 MW with an annual supply of 1100 Million kWh. This is factoring in unelectrified villages, roughly 17 in number, unelectrified hamlets and with 35% of the households not having access to electricity. Further, it also factors in the power outages of 2-4 hours in Mandla town, 6-8 hours in Tehsil Head Quarters and 10-14 hours in villages.

Therefore, the MP Poorv Khsetra Vidyut Nigam estimates the requirement of the district to be in the region of 45 – 50 MW or approximately 1900 kWh of electricity per annum.

The gap therefore in the current scenario is roughly 10 MW or 800 million kWh.

4.3 Other Sources of Energy:

The other sources of energy are largely fire-wood and Kerosene.

The average firewood consumption in Mandla is approximately 1250 tonnes a day, and the annual kerosene consumption is approximately 8000 kiloliters.

CHAPTER – 5

RANGE OF GREEN ENERGY TECHNOLOGIES AND CONVERSION OPTIONS AVAILABLE

5.1 Full Range of Green Energy Technologies and Conversion Options available

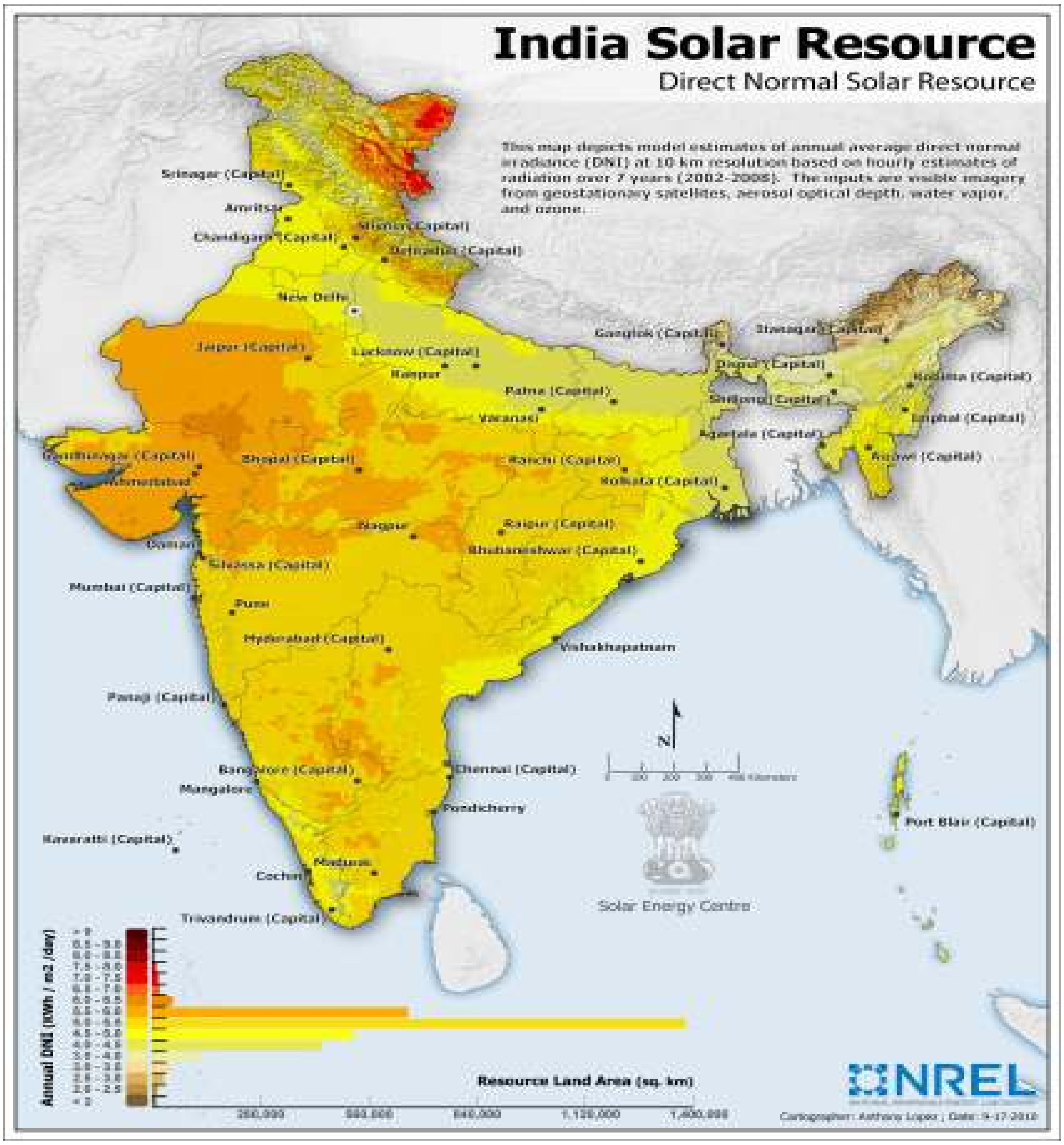
SL.	APPLICATION	AVAILABLE TECHNOLOGIES, DEVICES	Costs	Status of Application
1.	Cooking and associated domestic activities	• Use of Improved chulhas • Use of biogas plants • Use of pressure cookers • Use of high efficiency burners with LPG • Use of solar cookers • Use of solar water heaters • Use of biomass briquettes and pellets	Rs. 1000 Rs. 15,000 Rs. 1000 Rs. 1000 Rs. 2000 Rs. 14,000 Rs. 1/- a Kg	All of these are mature technologies, tried and tested and available in the market easily
2.	Domestic Lighting	• Move from kerosene to electricity • Move from incandescent lamps to fluorescent lamps/CFL/LEDs • Electronic ballast in place of electro-magnetic ballast.	Rs. 75 to Rs. 500 Rs. 50/-	All of these are mature technologies, tried and tested and available in the market easily
3.	Irrigation	• Move from diesel pumpsets to electric motor pumpsets. • Rectifications of existing pump set installations for improved efficiency and energy conservation. • Biomass gasifiers based pumping systems. • Water pumping windmills. • Solar PV pump sets. • Biogas based pumping systems. • Use of UPVC and HDPE pipes. • Improved pipe bends having low friction and bend losses.	Rs. 2000/- Rs. 500/-	Mature technologies available
5.	Industry and Artisans	• Improved biomass conversion systems for thermal energy		

		needs. • Increased availability of electricity. • Small cogeneration/gasifier systems. • A complete range of technologies and devices based on various renewable resources. • Leaf plate and cup making • Local handicrafts promotion using the abundantly available Lantana		
7.	Basic amenities/facilities	• Increased rural electrification facilities in case unelectrified District/remote hamlets to cover all basic amenities, the following are applicable: • PV street lights • PV powered TV sets/radio • PV pumpsets for drinking water supply. • Biomass gasification systems. • Solar water heating system. • Solar stills for water purification. • Community solar cookers for mid day meal schemes.		
8.	Power generation	• Biomass gasifiers options • Biogas engine-gensets. • PV power mini-grids/ Home Lighting systems/ Solar Thermal Applications/ • Wind-Solar Hybrid systems • Small hydro power plants		
9.	Renewable resource	• Energy plantation on waste lands • Biogas generation		

CHAPTER-6

6.1 Solar Radiation- Grid and Off-grid solutions and applications

Madhya Pradesh has high solar potential, as it is endowed with high solar radiation with around 300 days of clear sun. With radiation in the range of 4.8-5.8 kWh/ sq. meter, the state presents several ideal locations for installing solar based power projects. The map of India below shows the solar potential-



Under the proposed Solar Energy Policy of Madhya Pradesh (2010), the state government is targeting 500 MW of solar power by 2013.

Options of solar applications available today are Solar Photo-Voltaic Systems and Solar Thermal Systems. Solar Photo Voltaic is also now available in thin film versions, which are stated to be more efficient, with the efficiency being in the region of 13-15% as against the current efficiency levels of 8-10%.

6.2 Bio-Sources:

The total bio-mass power potential for Mandla districts has been estimated to be 57.4 MW[27] which is based on agriculture – soft bio-mass and forests and waste land – woody bio-mass.

Table 17: Taluk-wise Biomass Data - State : Madhya Pradesh ; District : Mandla ; Year : 2007-08 ; Considering All Biomass Class : All[28][29]

Taluk	Area (kHa)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)	Biomass Class
Mandla	109.6	112.6	196.2	35.7	4.23	Agro
Mandla	196.8	NA	257.9	172.0	24.1	Forest & wasteland
Nainpur	22.0	28.2	50.4	8.0	1.04	Agro
Nainpur	65.7	NA	69.4	46.3	6.5	Forest & wasteland
Niwas	98.3	72.8	128.7	23.2	2.93	Agro
Niwas	112.0	NA	199.6	133.1	18.6	Forest & wasteland
Total	**604.4**	**213.7**	**902.3**	**418.4**	**57.4**	
Agro-Total	**230.0**	**213.7**	**375.4**	**66.9**	**8.2**	
F & Waste Land-Total	**374.4**	**0.000**	**526.9**	**351.4**	**49.2**	

Table 18: Taluk-wise Biomass Data - State : Madhya Pradesh ; District : Mandla ; Year : 2007-08 ; Season : Agro-Kharif

taluk	Area (kha)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Mandla	98.7	103.2	179.4	31.5	3.67
Niwas	77.3	54.4	96.6	15.2	1.86
Nainpur	10.8	16.4	36.0	4.39	0.56
Total	**186.8**	**174.1**	**311.9**	**51.1**	**6.1**

Table 19: Taluk-wise Biomass Data - State : Madhya Pradesh ; District : Mandla ; Year : 2007-08 ; Season : Agro-Rabi

[27] Based on the computation found in tables 17-21

[28] Source: The source of all the above tables are self computation based on bench rule estimates (see annex) with the land and productivity data from the Department of Agriculture, Mandla District

[29] Corresponds with the bio-mass atlas data prepared by Indian Institute of Science (http://lab.cgpl.iisc.ernet.in/atlas/Tables/Tables.aspx)

taluk	Area (kha)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Niwas	20.8	17.9	32.2	8.0	1.07
Mandla	10.9	9.4	16.9	4.22	0.56
Nainpur	9.4	7.9	14.2	3.55	0.47
Total	**41.0**	**35.2**	**63.3**	**15.8**	**2.11**

Table 20: Taluk-wise Biomass Data - State : Madhya Pradesh ; District : Mandla ; Year : 2007-08 ; Season : Agro-Yearly

taluk	Area (kha)	Crop Production (kT/Yr)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Nainpur	1.85	3.87	0.19	0.048	0.007
Niwas	0.26	0.54	0.027	0.007	0.001
Total	**2.11**	**4.41**	**0.22**	**0.055**	**0.008**

Table 21: Taluk-wise Biomass Data - State : Madhya Pradesh ; District : Mandla ; Year : 2007-08 ; for Biomass Class : Forest & Wasteland

Taluk	Area (kHa)	Biomass Generation (kT/Yr)	Biomass Surplus (kT/Yr)	Power Potential (MWe)
Mandla	196.8	257.9	172.0	24.1
Niwas	112.0	199.6	133.1	18.6
Nainpur	65.7	69.4	46.3	6.5
Total	**374.4**	**526.9**	**351.4**	**49.2**

However, Mandla has a forest area of 5,93,126 hectares with a further area of 53,342 hectares of land that is not cultivable with the wild variety of Lantana found in abundance.

The lantana could be used in the form of briquettes.[30]

6.3 Bio-Gas Potential estimates:

Cow Dung to Gas Conversion:

- 1Kg of Cow Dung can generally produce 1.4 Cubic feet (Cft) of gas

Average Gas Requirement per adult:

- 10 Cft of gas per day for 3 times cooking

[30] Details of Briqutte Application in the annex 7

Average Dung Yield per Cow:

- Low Cows: 10-15 Kgs per day or 5 Kgs if it is only night dung
- Bullocks: 15 Kgs per day, or 6-7 Kgs if is only night dung.
- Buffaloes: 15-18 Kgs per day. 6-7 kgs if it is only night dung
- Jersey Cows: 25 Kgs per day (if fed with cow feeds etc)

Average Gas requirement per family:

- 50 to 70 Cft for a family between 5 and 7 members
- 30-40 Cft for a family of 3-4 members

Average Cow Dung required per family:

- 35-50 Kgs of cow dung for a family of 5 and 7 members
- 21-30 Kgs of cow dung for a family of 3-4 members
- Roughly 7Kgs of cow dung to produce gas for cooking 3 meals for an adult per day

With a total animal low yielding cow population of 379,400 in Mandla District, the total non-captive dung per day would be in the region of 1897 tonnes per day, assuming that only 5 kgs of night dung is collected.

Assuming that only 20% of this is available for usage, which is 380 tonnes, it would be sufficient to provide bio-gas to 7,600 large families comprising of 5-7 people every day. It could potentially go up to 15,000-20,000 large families as well, if the quantum of dung available were to be, say, 50% of the total dung collected every day

Further, the current 76,300 buffalo population of Mandla district is 76,300. This would translate to 763,000 Kgs of dung or 763 tonnes of dung. Again, assuming that only 20% of this would be available for bio-gas purposes, which would be 152.6 tonnes, it would be sufficient to provide bio-gas to 3052 large families of 5-7 people every day. It could potentially go up to 7,500 large families as well, if the quantum of dung available were to be, say, 50% of the total dung collected every day.

Table 22: Glimpse of potential bio-gas generation in Mandla[31]

Animal Population in Mandla	Average Dung Collection per day (Only Night Dung)	Dung available: Assumption that only 20% of the total dung yield is surplus for bio-gas plant)	Total Gas Production	Dung Available: Assuming that 50% of dung is available for Bio-Gas Plant	Total Gas Production

[31] Computation based on animal population of Mandla and standard thumb rule estimates of dung collection and conversion rate of dung to gas.

379,400 cows	1897 tonnes	380 tonnes	532,000 Cft (enough for 7500 Families for daily 3 times cooking)	950 tonnes	1330 tonnes Cft or enough to meet the cooking needs of 15000 to 20,000 families
76300 Buffaloes	763 tonnes	152.6 tonnes	213,640 Cft (Enough for meeting daily cooking needs of 3000 families	380 tonnes	534,100 Cft or enough to meet the cooking needs of 7500 families

6.4 Small Hydro Power

Mandla district is amongst the districts identified by the Water Resource Department and the Narmada Valley Development Authority for promoting Small Hydro Power. Two projects (Basania and Rosra) of 35 MW and 20 MW capacity, and a 750 kW capacity project have been identified in the Mandla district.

In addition, the following are some of the sites where pre-feasibility studies for run of the river hydro systems/ Canal based small hydro power have been undertaken and the details are as follows:

Table 23: Feasibility Study done for Run of the River, Small and Micro Hydro Systems[32]

Site	River	Capacity (in kW)	Annual Generation (in Million Units)	Estimated Cost of Generation/unit (Rs)
Malpur	Narmada	5000	14.45	3.30
Patpara	Narmada	3000	9.13	3.49
Lamna	Banjar Nadi	8000	21.76	3.24
Marpha	Haphin Nalla	1000	2.48	4.79
Chhatarpur	Halon Canal	750	2.95	3.61
Gawara	Halon Canal	1250	4.93	3.15
Silgiti	Halon Canal	400	1.57	3.85
Kamara	Halon Canal	450	1.77	3.60
Banchhipani	Halon Canal	100	0.35	4.90
Debatoria	Narmada	250	0.99	3.58
		20,200 kW or 20.20 MW	60.22 Million Units	Average cost = Rs. 3.75

[32] Source: http://www.mprenewable.nic.in/hydro02.pdf, hydro01.pdf, hydro03.pdf

6.5 Energy Efficiency Potential:

The three sectors which have the largest energy conservation and saving potential in Mandla district through energy efficiency applications in the order of priority are:

a) Lighting
b) T & D loss reduction
c) Water Heating
d) Efficient Air-conditioning and room heaters (space Cooling and Heating systems)
e) Agro-based processing units inclusive of rice mills, oil mills etc

The average consumption of electricity[33] for different uses in all category of consumers is as follows:

Table 24: Consumption Patterns (in Lakh kWh)

Consumption Patterns	2008-09	2009-10	2010-11
Lighting, fans and other 5 AMP applications including street lights	512.50	534.50	542.80
Air-Conditioning, Heating Devices and other appliances of 15 AMPs	186	195	198
Pump Sets/Water Works (Non Domestic Types)	153.60	158.60	90.60
Industrial Usage	40.80	42.00	46.80

1. Lighting and Small Electrical Applications:

As can be seen form table 24 above, bulk of the electricity consumption in Mandla is for lighting and single phase consumption. With the exception of a few commercial areas, bulk of the lighting application in Mandla district, inclusive of domestic lighting is largely incandescent bulbs. In the villages that we visited, we found that in most houses, people were using 100 Watt Incandescent bulbs and we were told that this was the general scenario in almost all the villages in Mandla district.

The reason for the domestic sector using incandescent bulbs is largely due to cost considerations and importantly to counter the voltage problem in village supply.

Many of the street lights were also using either incandescent bulbs or halogen lamps.

In our estimate, there is a potential of saving electricity in the lighting and 5AMP category by a modest 15% in the first two years and, in a phased manner, save close to 30% of the electricity consumed.

So, given the current consumption of electricity for the lighting sector at approximately 540 lakh kWh, there is a potential to save 15% of electricity in the first two years of implementing a concentrated lighting efficiency programme, which would potentially bring down the consumption of electricity to 459 Million kWh.

[33] Computed based on data collected from the Madhya Pradesh Poorv Kshetra Vidyut Vitran Co. Ltd. (Mandla)

With a programme of gradually shifting all street lights in to efficient light fittings, the potential to save on a conservative estimate would be 30%.

2. Efficient Air conditioning and Water Heating

The air-conditioning, water heating and other high electricity intense sector current consumes 200 Lakh kWh. Most of the appliances used are not star rated appliances, inclusive of the air-conditioners and heaters installed in the collectorate building.

Table 25: Indicative Consumption Pattern by the District Collectorate (Data for the months of June, August, and December (2011)[34] (In kWh)

	Jun-11	Aug-11	Dec-11
Collector Court Complex	1250	435	289
Collectorate Computer Room	1344	1711	328
Deputy Collector Bar Room	294	115	241
District and Sessions Judge	1463	708	1105
Bar Association Court Complex	254	197	64
Total	4605	3166	2027

As can be seen from the above table, the consumption of electricity in the computer room in summers is very high, which is the result of the air-conditioning system being on full mode and so is the case in the district and sessions judges chambers. The Judges chambers also have a high consumption in winter, due to use of room heaters.

Just taking the example of the Collectorate building, with a change in procurement norms from least cost to least life cycle cost and making it mandatory for the installation of energy efficient – star rated appliances, the potential to save electricity is as high as 30%. Therefore, the consumption in June 2011 which was 4605 kWh, can be potentially reduced to 3200 kWh, a saving of 1400 kWh.

However, for the district as a whole, the saving potential for the first year from this segment is 20%, increasing to 35% by the third year, which translates to a saving of roughly 40 million kWh in the first year of implementing the star labeling programme.

3. Efficient Demand Side Management for Agricultural Pumpsets:

Similarly for the pump sets too, Mandla does not have any demand side management programme, which has been implemented in other districts of Madhya Pradesh. The pumping and water works sector also has the potential to save 30% of electricity from the very first year of implementing a Demand Side and Water Pumping efficiency programme.

4. Industrial Consumption:

The consumption of electricity in the industrial sector right now is negligible, but, certain industries like the agro-processing industries, rice mills, oil mills etc can adopt a combination of electricity and renewable energy applications, which would reduce the use of electricity. The industries in Mandla that could opt for less electricity by co-generation processes are

[34] Source: - Madhya Pradesh Poorv Kshetra Vidyut Vitran Co. Ltd. (Mandla)

the 4 rice mills and the two sugar mills. The All India Radio station could opt for a solar system and so could the railway station. This could potentially bring down the industrial HT load from the current level of 15 lakh units to 5 lakh units per year.

Case Study of M/s. Siddha Baba Rice Mill

Process adopted in the Mill

Paddy is procured from the farmer, then cleaned in a paddy cleaner with the help of air and then it is screened in the vibratory screens to remove heavy particles. This cleaned paddy is then sent for de-shelling or parboiling depending upon the product requirements.

In the process of parboiled rice paddy is soaked in hot water for about 6-8 hours, after which steam is bubbled in to a soak tank for 15 minutes and then water in soaking tank is drained out and paddy (containing 25-30% moisture) is dried by steam generated hot air to bring down moisture level to 12-13%, then it is sent for de-shelling.

The de-shelling of paddy is done in husker cum sheller. The husk is separated from rice by blowing air; husk free rice is separated in separators from un-husked paddy. Rice is then taken to polishing machine. Post polishing, barn is separated from rice by blowing air over the polished rice. The separated rice is screened in the vibratory screen to remove broken rice then packed and marketed.

The annual usage of electricity in the rice mill was 2,64,000 kWh in the year 2010-11. Electricity is used for cleaning, drying, steaming, husking and polishing processes.

The rice mill could use the husk and opt for a co-generation process instead of consuming such huge quantities of electricity.

5. T & D Loss Reduction:

The current Transmission and Distribution loss as per the data of the MP Poorv Khsetra Vidyut Nigam is in the region of 24% per annum. The losses are largely distribution losses, with technical losses in the region of 12%. There is an ample scope to bring down the distribution losses to zero and to also reduce the technical losses marginally. With a proper demand side management programme, the losses can be brought down to 10% in the first year itself.

6.6 Overall Green Energy Supply Scenario for Mandla

6.6.1 Electricity Supply Scenario through Renewable Energy Sources

Table 27: Sources of Green Electricity, Mandla

Sources	**Conservative Estimate of Potentials (MW)**	**Possible Start year of Generation**	**Approximate Cost of Generation/unit**
Bio-mass	57.4	2013	Rs. 7.50*
Small, Micro, Mini Hydro	20.2	2014	Rs. 3.75
Solar PV (As per the Solar Mission Programme – First Phase	5	2013	Rs. 15.35
Solar Thermal Applications for Grid based generation	2	2015	Rs. 11.26
Energy Efficiency Programme (at 15% saving at current levels of Consumption)	5 MW	2013	Rs. 0.50 **
T & D Loss Reduction (10%) from Current Levels	5 MW	2013	Rs. 0.50***
Total	92.7 MW	2013	Average Cost per kWh = Rs. 5.95

Note:

(*) This is based on approximate cost of generation form bio-mass sources as studied in existing bio-mass plants and factoring in a combination of woody bio-mass (lantana briquette) and soft bio-mass (agriculture residue). See annexure for cost comparisons of other bio-mass plants

(**) This is based on the capital costs of efficiency improvements per kWh. This is taken at the highest cost levels (Source, BEE)

(***) This is based on capital costs of systems upgradation and demand side management, per kWh (Source: Central Electricity Authority)

5.6.2 Other Energy Generation

Table 28: Sources of Green Energy for Mandla district

Source	Potentials
Bio-Gas Plants	25,000 households
Solar Water Heaters	All major hot water consumers in Mandla District

CHAPTER - VII

ESTIMATION OF FUTURE ENERGY DEMAND

7.1 Introduction and Assumptions

The estimation of future demand for electricity is based on the following parameters.

1. Population Growth: The trends of population growth in the past have been factored in to estimate the future growth of population of Mandla. The approximate decadal growth of population was in the region of 15% between 1991 and 2001 and 17% between 2001 and 2011. We have therefore assumed that the decadal population growth will be 17% between 2011 and 2021 and 2021 and 2031. On the basis of this, the annual Population Growth has been assumed at 1.7%

Table 29 Population Estimate (in Millions)

Population	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	1.05	**1.07**	**1.09**	**1.11**	**1.13**	**1.15**	**1.17**	**1.19**	**1.21**	**1.23**

2. Per Capita Increase in Electricity Consumption: The current domestic consumption of electricity in Mandla district is 66 Million Units. Assuming that all households in Mandla district are connected to electricity at a minimum of 1 kWh of electricity, the requirement of electricity for the domestic sector in Mandla would be 76.91 Million Units, based on the calculation of 0.21 Million households as per the 2011 census at 1 kWh per household per day.

However, since the electricity consumption is not equitable, we have factored in an increase based on general usage pattern of electricity in the district and based on an 8% GDP growth and assuming 24 x 7 electricity supply in the entire district.

Table 30: Electricity Consumption in the Domestic Sector (in Million kWh)

Electricity Consumption in Million kWh	2011-12 Current	2012-13 Kick in Phase	2013-14 Take Off	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
	66.00	**76.91**	**117.32**	**127.27**	**137.52**	**148.09**	**158.97**	**170.19**	**181.73**	**193.62**

Therefore the per-capita electricity consumption also increased from 300 kWh in 2011 to 500 kWh in 2012 and increases correspondingly to 700 kWh in 2015 (National average) and touches 1000 kWh by 2020, which is the target of the Government of India.

3. The Energy Consumption growth of 4% has been factored in for the commercial and Industrial sector and correspondingly the demand for the sector is as follows:

Table 31: Electricity Consumption in the Industrial and Commercial Sector (in Million kWh)

Electricity Consumption in Million kWh	2011-12 Current	2012-13 Kick in Phase	2013-14 Take Off	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Industrial	**12.54**	**13.04**	**13.63**	**14.28**	**14.85**	**15.44**	**16.06**	**16.70**	**17.37**	**13.04**
Commercial	**7.20**	**7.49**	**7.82**	**8.20**	**8.52**	**8.87**	**9.22**	**9.59**	**9.97**	**7.49**

4. The Irrigation and Water Works Sector:

With an increase in population and efforts being made to supply piped drinking water to all households and consumers in the district, the amount of water pumping would obviously rise. We have factored in an increase in energy requirement for water supply by 15%, but also taken into account, implementation of energy efficiency measures, which would reduce the energy requirement. Therefore, the projections factor in an increase of 15% of energy requirements for the first 3 years. We have also factored in the requirement for water treatment and water recycling units, which would be required in a climate constrained world. Therefore, the energy requirements for successive 3 years have been increased to 20% and later on taper it to the then current levels.

The assumption for calculating the energy requirement for irrigation pump sets has been taken at 15% increase in the first three years and later on tapering to the then current level.

Table 32: Electricity Consumption for irrigation pump sets and water works (in Million kWh)

Electricity Consumption in Million kWh	2011-12 Current	2012-13 Kick in Phase	2013-14 Take Off	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Water Works	**3.36**	**3.86**	**4.44**	**5.11**	**6.13**	**7.36**	**8.83**	**8.83**	**8.83**	**3.86**
Irrigation Pump Sets	**13.00**	**14.95**	**17.19**	**19.77**	**19.77**	**19.77**	**19.77**	**19.77**	**19.77**	**14.95**

5. Street Lights:

We have factored in street lights in all villages and for all streets of the towns of Mandla District. This would increase the electricity consumption by 20%. However, right now, the street lights are largely incandescent or halogen lamps. If these are converted to CFLs, there is a potential to save 25% of electricity consumption and if it were to be converted to LEDs, there is a saving potential of 40%. We have taken in a mix of both CFLs and LEDs at an 80:20 ration while working on the projected demand for electricity for street lights.

Table 33: Electricity Consumption for Street Lights (in Million kWh)

Electricity Consumption in Million kWh	2011-12 Current	2012-13 Kick in Phase	2013-14 Take Off	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Street Lights	**5.20**	**6.24**	**7.49**	**8.99**	**10.78**	**12.94**	**9.50**	**9.50**	**9.50**	**6.24**

7.2 Demand and Supply Projections for Mandla District

Table 34: Demand and Supply Projections

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Energy Consumption – in MU									
Domestic	**66.00**	**76.91**	**117.32**	**127.27**	**137.52**	**148.09**	**158.97**	**170.19**	**181.73**
Industrial	**12.54**	**13.04**	**13.63**	**14.28**	**14.85**	**15.44**	**16.06**	**16.70**	**17.37**
Commercial	**7.20**	**7.49**	**7.82**	**8.20**	**8.52**	**8.87**	**9.22**	**9.59**	**9.97**
Public Water Works	**3.36**	**3.86**	**4.44**	**5.11**	**6.13**	**7.36**	**8.83**	**8.83**	**8.83**
Irrigation Pump Sets	**13.00**	**14.95**	**17.19**	**19.77**	**19.77**	**19.77**	**19.77**	**19.77**	**19.77**
Street Lights	**5.20**	**6.24**	**7.49**	**8.99**	**10.78**	**12.94**	**9.50**	**9.50**	**9.50**
Total Consumption	**107.30**	**122.49**	**167.89**	**183.62**	**197.57**	**212.47**	**222.35**	**234.57**	**247.17**
T & D Loss	**25%**	**20%**	**15%**	**15%**	**15%**	**15%**	**10%**	**10%**	**10%**
T & D Loss in Million kWh	**26.83**	**24.50**	**25.18**	**27.54**	**29.64**	**31.87**	**22.24**	**23.46**	**24.72**
Total Electricity Requirement for Mandla in Million Units	**134.13**	**146.99**	**193.07**	**211.16**	**227.21**	**244.34**	**244.59**	**258.03**	**271.89**
Peak Load requirement (MW)	**32.50**	**37.71**	**43.50**	**48.50**	**53.20**	**55.55**	**58.75**	**60.20**	**64.50**
Energy Supply in MW									
Bio-Mass	**0**	**5**	**10**	**15**	**20**	**25**	**35**	**45**	**55**
Small Micro, Mini Hydro	**0**	**2**	**2**	**5**	**10**	**10**	**10**	**15**	**15**
Solar PV	**0**	**1**	**1**	**2**	**2**	**4**	**4**	**5**	**5**
Solar Thermal Grid	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**2**	**2**
Energy Efficiency	**0**	**1**	**1**	**5**	**5**	**5**	**8**	**10**	**12**
Loss Reduction	**0**	**1**	**1**	**5**	**5**	**5**	**8**	**10**	**12**
Total Own Generation from RE Sources (in MW)	**0**	**10**	**15**	**32**	**42**	**49**	**65**	**85**	**99**
Supply from Grid (+) or supply to Grid (-)	**32.50**	**+27.71**	**+28.50**	**+16.50**	**+10.20**	**+5.55**	**-7.25**	**-26.80**	**-46**

From the year 2017, Mandla could potentially generate its own surplus green energy, which can be sold to the central grid, while near maximizing its renewable energy potential of 57.4 MW of bio-mass and 20 MW of small, mini and micro hydro. It would have also used its full share of solar energy plants as is envisaged in the 20,000 MW target of the Solar Mission.

7.3 Energy Projections up to 2020

The major sources of energy currently being used for heating, cooking and lighting purposes are Kerosene, Firewood and LPG. Kerosene is primarily used for lighting purposes, while firewood and LPG is used for heating purposes. With 100% electricity needs being met, we believe that Kerosene use in Mandla would decline and in all our costing, this is an assumption being made. As far as firewood is concerned, it is being used in a 30:70 ratio for heating water and meeting cooking needs.

The average firewood consumption in Mandla will be approximately 1250 tonnes a day, or approximately 375,000 tonnes per year, which is equivalent to using trees covering an area of 1500 hectares per year. Of this, the hotel industry consumes 225 tonnes every day or 67,500 tonnes every year, assuming that the hotel industry operates only for 300 days in a year.

With appropriate policies and framework, it is possible to get the entire hotel industry to shift to solar water heaters, the use of firewood would decline by 67,500 tonnes and thereby increase the forest cover by 270 hectares.

There is enough bio-gas supply to ensure that 25,000 households get bio-gas, which will mean a reduction in firewood usage to the tune of 175,000 Kgs every day or 63,875 tonnes of firewood every year. This will, in turn, increase the forest cover by a further 270 hectares.

Mandla has currently 210,000 households and if 25,000 households were to get bio-gas plants and a further 100,000 households get LPG connection, it could potentially reduce the use of firewood from 375,000 tonnes per year to 100,000 tonnes per year.

In view of the above, we project the energy supply needs met households as follows

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Number of Households having bio-gas plants	**0**	**1000**	**2000**	**5000**	**7000**	**10000**	**15000**	**20000**	**25000**
Solar water Heaters (Hotels)	**0**	**5**	**15**	**25**	**50**	**75**	**100**	**130**	**130**
Solar water heater in Households	**0**	**100**	**300**	**500**	**1000**	**1500**	**2000**	**2500**	**3000**
Number of Houses having LPG Connection[35]	**63,000**	**75,000**	**80,000**	**85,000**	**90,000**	**95,000**	**100,000**	**105,000**	**110,000**
Solar water heater in Households	**0**	**100**	**300**	**500**	**1000**	**1500**	**2000**	**2500**	**3000**

[35] We can either have bio-gas plants or bottling plant, due to the limited availability of fresh dung in Mandla district.

CHAPTER- VIII

COSTS, MINDSET AND TECHNO-COMMERCIAL VIABILITY

8.1 Estimated Cost of Green Generation – Costing

Mandla district does not have its own electricity generation, there is a cost implication, primarily in the form of capital costs and also in generating costs, as it currently procures its electricity requirement from the Central Grid.

The general cost of a 1 MW bio-mass plant as per MNRE and State Electricity Regulatory Authority guidelines range from Rs. 3.50 Cr to a maximum of Rs. 4.50 Cr, averaging to Rs. 4 Cr.

For a hydro plant of less than 1 MW, the capital costs are in the region of Rs. 4 Cr per MW.

Table 36: Capital Cost Implications for Renewable Energy implementation in Mandla district

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Bio-Mass (Cumulative)	0	5	10	15	20	25	35	45	55
Capital Cost for Bio-Mass Plant (Rs. In Cr)	0	20.00	20.00	20.00	20.00	20.00	40.00	40.00	40.00
Small Micro, Mini Hydro(Cumulative)	0	2	2	5	10	10	10	15	15
Capital Cost of a Small, Micro Mini Hydro plant (For systems less that 1 MW) Rs. In Cr		8.00	0.00	24.00	40.00	0.00	0.00	40.00	0.00
Solar PV(Cumulative)	0	1	1	2	2	4	4	5	5
Capital cost of Solar PV (Rs. In Cr)		25.00	0.00	25.00	0.00	50.00	0.00	25.00	0.00
Solar Thermal Grid Systems (Cumulative)	0	0	0	0	1	1	1	2	2
Capital cost of Solar Thermal Grid Systems (Rs. In Cr		0.00	0.00	0.00	12.00	0.00	0.00	12.00	0.00
Building of Bio-gas Plants (Rs. In Cr)	0	1.40	1.40	4.20	2.80	4.20	7.00	7.00	7.00
Cost of Solar Water heaters (Rs. In Cr)	0	0.25	0.45	0.60	0.90	1.10	1.10	1.10	1.10
Total Cost Implication (Rs. In Cr		54.65	21.85	73.80	75.70	75.30	48.10	125.10	48.10

Totaling to Rs. 522.60 Crores

With energy efficiency and loss reduction systems and process factored in, the capital cost would be in the region of Rs. 659.60 Cr over a period of 10 years, or Rs. 65.96 Cr per year.

The Generation Costs of renewable energy are as follows:

Sources	**Approximate Cost of Generation/unit**
Bio-mass	Rs. 7.50*
Small, Micro, Mini Hydro	Rs. 3.75

Solar PV (As per the Solar Mission Programme – First Phase	Rs. 15.35[36]
Solar Thermal Applications	Rs. 11.26[37]

8.2 Current Costs of Electricity Supply/purchase to the utility and consumer:

The current costs of electricity supply works to Rs. 3.75 per kWh for the utilities. The cost that a rural consumer pays works to Rs. 1.75 per kWh, while the commercial consumer pays Rs. 5/- per kWh. There is an element of subsidies provided by Government as well as by way of cross-subsidizing with the commercial and industrial consumer paying a higher tariff. On an average a rural consumer pays a subsidized tariff of Rs. 56/- per month in Mandla.

Further, assuming that with a focused and decentralized generation in Mandla district, the consumption of Kerosene would also reduce, the total amount spent on Kerosene per month per household is Rs. 75/-.

The following table looks at costs currently borne by a subsidized rural electricity/energy consumer

Table 37: Current costs of energy to a rural consumer and Government.

Recovery Costs by Utility/Agency Per Month		
Kerosene	Electricity	Total
75.00	56.00	131.00

Therefore, the rural consumer actually pays Rs. 4.36 per unit of electricity per month, as his consumption of kerosene is largely due to unavailability of electricity for lighting purposes.

8.3 The Cost Differentials between Conventional and Non-Conventional Supply

Table 39: Cost differentials between conventional and non-Conventional Supply

Costs for the Utility for supply through conventional energy/kWh	Costs for the Utility through Bio-mass	Costs for the utility for supply of electricity from small hydro system of less than 1 MW	Costs for the utility for supply of solar power
Rs. 5.00	Rs. 7/-	Rs. 3.75	15.35[38]

The costs of supply of electricity as per the demand projection through various sources of generation show that the cost of renewable energy with a basket of fuel sources would actually be more cost effective from 2014-15, while not being dependent on just one source.

[36] MPERC Order (http://www.ireda.gov.in/solar/DATA/Orders/Madhya%20Pradesh/M.P.%20-%20Tariff-Order-Solar-Energy-Based%20july,%202010.pdf)

[37] MPERC Order (http://www.ireda.gov.in/solar/DATA/Orders/Madhya%20Pradesh/M.P.%20-%20Tariff-Order-Solar-Energy-Based%20july,%202010.pdf)

[38] MPERC Order (http://www.ireda.gov.in/solar/DATA/Orders/Madhya%20Pradesh/M.P.%20-%20Tariff-Order-Solar-Energy-Based%20july,%202010.pdf)

Some of the broad assumptions made while computing these are as follows:

a) The cost of conventional electricity was taken at Rs. 5/- per kWh (this is the cost to the utility in a given year, factoring in spikes in generation costs and paying high tariffs in summers to address the supply gap.
b) The conventional costs of electricity has been shown to increase by 10% every year, which has been more or less the trend in the past five years, particularly with the cost of coal going up.
c) The cost of solar PV has been shown to decrease by 5% annually, as has been the trend in the last five years.
d) The cost of solar thermal generation has also shown to decrease by 5% annually, since the capital costs have also come down substantially. The capital costs of Solar Thermal is now pegged at Rs. 12 Cr per MW, while two years back, it was close to Rs. 14. Cr.
e) The cost of hydro generation has been kept constant, though the costs do decline, largely due to depreciation benefits.
f) The cost of bio-mass has been shown to increase at Rs.0.50 per kWh every year, due to price in bio-mass. The price of bio-mass required for every kWh of generation has been in the average range of Rs.0.25/- but with costs of transportation factored in, we have projected an increase of Rs. 0.50 per kWh every year, which is in the approximate region of 7% per annum.

Table 40: Overview of costs to the District Electricity Utility from purchase of electricity from various supply sources

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Total Electricity Requirement for Mandla in Million Units	**134.13**	**146.99**	**193.07**	**211.16**	**227.21**	**244.34**	**244.59**	**258.03**	**271.89**
Conventional BAU Purchase at Rs. 5/- per kWh with incremental rise of 5% per annum (In Million rupees)	**670.65**	**808.45**	**1168.07**	**1404.21**	**1663.18**	**1966.94**	**2164.62**	**2513.21**	**2911.94**
Through Hydro at Rs.3.75 per kWh – Kept constant. (In million rupees)	**502.99**	**551.21**	**724.01**	**791.85**	**852.04**	**916.28**	**917.21**	**967.61**	**1019.59**
Through Solar at Rs. 15.35 with a decrease in price of 5% per annum (In Million Rupees)	2058.90	2143.11	2702.98	2850.66	2896.93	2932.08	2788.33	2812.53	2718.90
Through Solar Thermal Applications at current tariff of Rs. 11.26 pegged to	1510.30	1571.32	1959.66	2037.69	2083.52	2128.201	2022.76	2025.54	2028.30

reduce by 5% per year									
Through Bio-mass at Rs. 7.50 per kWh) with a escalation of costs of Rs.0.50 per kWh per year	1005.98	1175.92	1641.10	1900.44	2158.50	2443.40	2568.20	2650.00	27000.00
As Proposed in the supply Mix in this report	**670.65**	**847.93**	**1185.44**	**1320.33**	**1393.98**	**1575.18**	**1580.22**	**1621.50**	**1631.26**

As can be seen from the above table, if the entire electricity needs of Mandla district was to be met from Hydro, it would perhaps be the cheapest source. But considering that the district does not have such a large small hydro potential, a basket of resources is required.

However, with the suggested energy basket for Mandla district, as per the supply projections, the costs of generation would be the same as conventional power by 2014 and then be lesser than conventional power by 2015.

Table 41: Comparative estimate of Cost to Consumers from a Generation Mix

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Total Electricity Requirement for Mandla in Million Units	**134.13**	**146.99**	**193.07**	**211.16**	**227.21**	**244.34**	**244.59**	**258.03**	**271.89**
Conventional BAU Purchase at Rs. 5/- per kWh with incremental rise of 10% per annum (In Million rupees)	**670.65**	**808.45**	**1168.07**	**1404.21**	**1663.18**	**1966.94**	**2164.62**	**2513.21**	**2911.94**
Per kWh Cost to Consumer/Utility	**5.00**	**5.50**	**6.05**	**6.65**	**7.32**	**8.05**	**8.85**	**9.74**	**10.71**
As Proposed in the supply Mix in this report	**670.65**	**851.03**	**1188.39**	**1324.77**	**1397.31**	**1581.58**	**1598.35**	**1710.1**	**1795.45**
Per kWh Cost to Consumer/Utility	**5.00**	**5.79**	**6.16**	**6.27**	**6.15**	**6.47**	**6.53**	**6.63**	**6.60**
Cost Differential between Conventional and New Mix	**0**	**+0.29**	**+0.11**	**-0.38**	**-1.17**	**-1.58**	**-2.32**	**- 3.11**	**-4.11**

8.4 Where is the Cost coming from/Can Consumers Bear the Cost

As was seen in the previous sub-section, the cost differential between the conventional power and the new mix is very marginal in the first three years, with the cost of phasing in renewable energy will cost the utility only a maximum of 29 paisa. However in the medium run, the costs from renewable energy reduce drastically, with the cost of conventional power increasing and with a decentralized renewable energy solutions, the transmission and distribution losses are substantially reduced.

However, the main costs would come by way of capital costs. With Mandla having no generation capacities exclusive for the district, all new generation set up would have to be set up from scratch.

However, Ministry of New and Renewable Energy through its Solar Mission Programme, Village Energy Security Programme and National Bio-Mass programme have a number of schemes, where 90% of the capital costs are provided. The following are some of the features of the programme.

- Primarily Bio-mass projects and small hydro projects of less than 1 MW
- Targets villages between 25-200 households, with a total of 1000 villages as targets of the programme with a total outlay of Rs. 225 Cr.
- Supports micro-enterprise development
- Government of India provides a 90% capital subsidy; operation and maintenance expense through usage charges, remaining expenses secured by the community, implementing agency or state nodal agency.
- The VESP project guidelines give clear directive to involve communities in the planning and implementation of programme. It mandates the full participation of village community and the constitution of a village energy committee through the Gram sabha which is duly notified as a sub-committee of the Panchayat.
- The VESP also mandates the creation of a Village Energy Fund, under the provisions of the State Panchayati Raj Act, with the beneficiary contribution being used for sustained operation and management of the project. It also mandates that the "user fees" collected would have to deposited in this account and all grants from not only the VESP programme but other related programmes should also be deposited into this account and used for operation and management of the project. It also clearly stipulates that the fund should be managed by the village energy committee.

Therefore, with a good tariff system and if the tariff per kWh is protected and guaranteed, business houses and communities may also be ready to set up decentralized renewable energy units.

8.4.1 Option 1: Fully Managed by the Government:

As stated in the introduction to this chapter, there are a number of Government projects which provide funding and with the involvement of the designated renewable energy development agency of the state, these projects can be implemented.

Further, there are also cases where NTPC and NHPC have taken up projects, particularly bio-mass in the case of NTPC and small, micro and mini hydro in the case of NHPC.

The advantage with the government programmes is that, even in situation of "changing state electricity policy scenario", these projects would potentially run. For instance, if a state government were to announce free electricity supply to all rural connections, as has been the case in many a states in the past, private generation companies will have to get the tariffs from the Government, which usually takes a lot of time and therefore, private sector is reluctant.

8.4.2 Option 2; Public-Private Partnership:

With a "guaranteed tariff policy", there is a possibility of public-private partnership. The public partnership comes by way of Government extending the capital subsidies as is available through the various schemes, but the regular operations are completely with the private sector, which includes, daily operations, organizing supply chain, (particularly for bio-mass), ensuring sustainability of supply chain (raw materials), maintenance and operations, distribution, meter reading and collection of tariffs.

The business model in this case is illustrated with the suggested generation capacity addition for one year.

	2012-13	Capital Cost Subsidy from MNRE	Costs borne by the Developed	Approximate Generation per year	Total Income per year of Generation	Input Costs and other operation costs per year	Net Surplus/Deficit per year
Capital Cost for Bio-Mass Plant (Rs. In Cr)	**20.00**	**6.00**	**14.00**	**21 Million Units[39]**	**Rs.9.45 Cr[40]**	**Rs. 4. Cr**	**(+) Rs 5.45 Cr**
Capital Cost of a Small, Micro Mini Hydro plant (For systems less that 1 MW) Rs. In Cr	**8.00**	**4.00**	**4.00**	**8.76 Million Units[41]**	**Rs. 3.28 Cr[42]**	**Rs. 1 Cr**	**Rs. 2.28 Cr**
Capital cost of Solar PV (Rs. In Cr)	**25.00**	**0.00**	**25.00**	**1.6 Million Units**	**Rs. 2.45 Cr**	**Rs. 0**	**Rs 2.45**

Based on the above approximate costs, it would seem that in the case of Bio-mass, the return on investment would be anywhere between 5-7 years, depending on the cost of maintenance, debt-servicing costs etc. However, these are based on the feed in tariff of Rs. 4.50. However, without any subsidy from the Government, the cost of generation actually works out to Rs. 7.50. That is why, elsewhere in the report, the costs have been taken at Rs. 7.50 a kWh

[39] Calculated on the basis of 5 MW of plant, operated at 20 hours a day for 300 days at a PLF of 70%

[40] Calculated on the basis of Rs. 4.50 per kWh as tariffs, which is the current feed in tariff rate of Bio-mass

[41] Calculated on the basis of 2 MW of total plants, operated 24 hours for 365 days at PLF of 50%

[42] Calculated on the basis of 3.75 per kWh as tariffs, which is the current feed-in-tariff rate for small hydro systems

In the case of hydro, it would again be 4-5 years, again depending on maintenance, water flow source for 365 days.

In the case of solar, it would be roughly 10 years, though, the Central Electricity Regulatory Commission works it to 8-9 years.

However, the caveat is that, the tariffs need to be assured and in the case of bio-mass, the current tariff structure as decided by the Madhya Pradesh Electricity Regulatory Commission is paid to the consumers.

8.5 Programmes/Projects or Schemes that could contribute to the programme:

Programmes / Projects / schemes	Proposed change in direction and scope in objective(s) of the programmes / projects
a) Jawaharlal Nehru National Solar Mission(JNNSM)	Promotion of Solar PV projects on gird or stand alone in de-electrified or energy starved communities through Implementation of SPV based devices like: lanterns, Home lights, street lights, water pumps, power plants, water heaters
b) Small Hydro Project (SHP)	Development of Hydropower projects
c) Biomass Gasifier (BMG)	Promotion of bio-gas, biomass energy
d) National Biogas & Manure Management Programme (NBMMP)	Promotion of bio-gas, biomass energy
e) Remote Village Electrification (RVE)	Electrifying villages/hamlets not covered under RGGVY scheme through solar, Wind and Hydro power projects
f) Wind Energy	Wind Assessment, mapping, implementation of projects
g) Solar City Programme	Effective Implementation of Solar City which can become a model for replication to other town. Reducing grid energy consumption @ 2% per year
h). Electrification of new villages/hamlets /colonies and Village Energy Security Programme	Power supply to the identified villages/hamlets etc.

i) Installation of Pre- Paid Energy Meter and/or Internet billing	Accurate billing, avoid pilferage etc and adopt judicious use of power- Energy Conservation
j)Strengthening / modernization of Transmission and Distribution network.	Reduce T & D Losses
k) Efficiency Improvement Programme of BEE	Labeling of appliances and green building programme
l) National Energy efficiency Mission	Promoting efficiency in the industrial sector

Further, it must be pointed out here that, if the District Administration were to opt for a fully funded scheme, while part funding could come from the Central Government, the state Government also has sufficient schemes where it could use for funding these projects.

8.6 Essential for commercial viability and ability and willingness to pay

The following are crucial to ensure commercial viability and keeping the costs of generation to the least minimum possible.

a) Assured tariffs per kWh and for every unit consumed. This would mean that, even if the Government were to announce free electricity supply to any category of consumers, the costs of consumption needs to be then made good by the Government to the electricity supply company.

b) Assured supply of bio-mass resources. In many cases of bio-mass generation, the cost of generation goes up, primarily due to shortage of bio-mass. We have factored in this and have made a very conservative estimate of bio-mass. However, before a plant is set up, the generation company must make sure to ensure that the bio-mass availability is secured and sustained.

c) The bio-mass energy generator also needs to put in good quality systems with annual maintenance contract in place. Many a times, to reduce the capital costs, generators tend to opt for cheaper systems with no maintenance contract in place. This, many a times tends to increase the number of “no generation days”, which increases the cost of generation

d) The pre-feasibility study made by Madhya Pradesh Renewable Energy Development Agency on small, micro and mini hydro also factors in the water flow and the down time.

e) In terms of ability to pay, even the rural below the poverty line consumers pay roughly Rs. 131/- per month for Kerosene and electricity put together for a total consumption of 30 units, which averages to Rs. 4.36 per kWh. The costs with green energy mix would be at the highest level Rs. 6.50, which is a differential of Rs. 2.14 per kWh and increase the cost to the consumer by Rs. 64/- per month. If the consumer were to get good quality power supply and if the consumer were to shift from incandescent bulb to CFLs, the consumption would also go down and thereby keep his costs to the current levels expenditure.

CHAPTER - IX

PROGRAMME IMPLEMENTATION AND FUNDING

9.1 Introduction

As of any plan, particularly to phase in renewable energy generation for a place which has no electricity generation of its own, may be relatively easy, but requires a plan.

The plan ranges from preparing and adopting plans, with the involvement of various departments but also in organizing funds and importantly aligning itself with current state government projects/programmes and policies and central government projects/programmes and policies.

By and large, most of the proposed programmes for implementation in this plan can be dovetailed with existing programmes of the Central Government and State Government, namely, the National Solar Mission, National Bio-Mass Programme, Remote Village Electrification Programme, the National Energy Efficiency Mission, the National Sustainable Habitat Mission and the programmes of the Bureau of Energy Efficiency.

Further, some programmes can also be dovetailed with the National Rural Employment Guarantee Act, the Rural Development Programme amongst others.

Further, the capital costs for such initiatives would be rather high, but, in a phased implementation plan, the capital costs would also not seem high.

Therefore, the next section has a detailed phase wise implementation plan, which sets the tone for policy and plan formulation to actual implementation.

9.2 Action Plan for Implementing the Strategies:

Policy Measures		
(2012-2013)	**2014-2017**	**2017-2020**
a. Acceptance of this plan and setting up of a coordinating committee comprising of District Collector and key officials of Mandla to proceed further to develop a framework for implementation	a. An Order to all hotels to phase out using firewood water boilers to solar water heater with a 2 year framework b. Legal framework for ensuring all government hotels to install solar water heaters	a. Mandatory phase out of all 3 star and below rated appliances from the Market
b. Prioritizing implementation and developing a strategy for implementation	b. Mandatory Norms for all Government and public building, hotels, schools and other institutions to install	b. Legislative framework for “Green Village” implementation through Panchayats

	energy efficient lighting	
c.Identifying key sources of financing from GoI Projects and other sources and preparing DPRs	c. One stop kiosk in all area of Mandla for payment of electricity bills electronically – ECS facility, which would also include post offices	c. Increasing coverage of DSM Programme to all villages in Mandla district
d. Call for tenders for "pre-paid electricity meters" in Mandla district	d. Increasing coverage of DSM Programme to all tehsils in Mandla district	d. Full Implementation of Panchayat Level DSM Programmes
e.Initiation of Demand Side Management Programme (DSM) in Mandla district with priority on "efficient irrigation pump sets". awareness of Municipal Level DSM Programmes	e. Awareness of Panchayat Level DSM Programmes	
Actions Proposed		
Short Term	Medium Term	Long Term
A T & C Loss Reduction		
a. Target of reducing A T & C Loss from the current level of 25% to 20%	a. Target of reducing a t & c Loss from 20% to 15%	a. Target of reducing a t & c Loss from the 15% to 10%
Municipal Level Programmes		
a. Detailed Mapping and auditing of all Government buildings, AIR, Railways stations etc… conforming to the Energy Conservation Act for Mandla	a. Detailed Mapping and auditing of all Government buildings conforming to the Energy Conservation Act for efficiency potentials in all Government buildings in all tehsil head quarters of Mandla district	a. Detailed Mapping and auditing of all Government buildings conforming to the Energy Conservation Act for efficiency potentials in all Government buildings in the entire length and breadth of Mandla
b. Implementing of finding of the audit to make the buildings energy efficient compliance in accordance with the Energy Conservation Act in Mandla	b. Implementing of finding of the audit to make the buildings energy efficient compliance in all other Government buildings and government buildings in all district headquarters accordance with the Energy Conservation Act	b. Implementing of finding of the audit to make the buildings energy efficient compliance in all Government buildings in the entire length and breadth of Mandla

c Detailed Mapping and auditing of Street lights for conversion in to CFL/LED lighting on iconic and key roads of Mandla and in and around Kanha National parks	c. Detailed Mapping and auditing of Street lights for conversion in to LED lighting on all roads tehsil head quarters	c. Detailed Mapping and auditing of Street lights for conversion in to LED lighting on all major roads of all villages of Mandla
d. Initiating the conversion of Street lights in to CFL/LED lighting on iconic and key roads of Mandla town, in and around National Parks and other tourist locations	d. Initiating the conversion of Street lights in to LED lighting on all major roads of Tehsil Head quarters	d. Initiating the conversion of Street lights in to LED lighting in all villages of Mandla
Increasing Generation Capacities with Renewable Energy		
a. Increasing coverage of bio-gas programme from the current level of a few to household plants to at least 2500 household plants per year = 12,500	a. Increasing coverage of bio-gas programme from 2500 households to 5000 households per year = 25,000 households	a. Increasing and ensuring full coverage of bio-gas programme exploiting full potential of bio-gas
b. Completion of GIS mapping of all streams, and rivers for assessing small hydro potentials and commissioning of 6 MW of mini, micro and small hydro projects	b. Increasing the number of Small Hydro projects based on the results of the GIS mapping and commissioning of Small, Mini and Micro Hydro projects totaling to 50 MW	b. Further Increasing the number of Small Hydro projects based on the results of the GIS mapping
c. Ensure both grid and off-grid renewable energy projects implemented by the Department of Renewable Energy totaling to 39 MW	c. Ensure both grid and off-grid renewable energy projects implemented by the Department of Renewable Energy with the total cumulative installed generation capacity of 111 MW	c. Ensure both grid and off-grid renewable energy projects implemented by the Department of Renewable Energy with the total cumulative installed generation capacity of 111 MW
d. The Department of Power proposes to tap the micro, mini and small hydro potential in the state totaling to 15 MW	d. The Department of Power proposes to tap the micro, mini and small hydro potential in the state totaling to 95 MW (Cumulative)	d. The Department of Power proposes to tap the micro, mini and small hydro potential in the state totaling to 197 MW (Cumulative)
e. NEPeD proposes to set up community pico hydro projects totaling to 2 MW	e. NEPeD proposes to set up community pico hydro projects totaling to 5 MW (Cumulative)	e. NEPeD proposes to set up community pico hydro projects totaling to 10 MW (Cumulative)
f. Solar water heater coverage of 1000 metre square per year with	f. Solar water heater coverage of 3000 metre	f. Solar water heater coverage of 3000 metre

100 litres system	square per year with 100 litres system	square per year with 100 litres system
Increasing Generation Capacities		
a. Preparations of DPR for all Micro,Mini and Small Hydro for which pre-feasibility studies have been undertaken and awarding projects.	a. Commissioning hydro projects to start generation	a. Increasing generation capacities and fine-tuning business models based on lessons from functioning projects
b.Invite tenders for bio-mass generation based on VESP/Bio-mass Programme of MNRE guidelines and awarding them	b. Commissioning projects to start generation	b. Increasing generation capacities and fine-tuning business models based on lessons from functioning projects
c.Conduct a techno-economic and commercial viability of Lantana Briqueting inclusive of exploring market avenues – a joint initiative of MPSEB, Forest Department, Rural Development department (also exploring livelihood options for communities)	c. Commissioning projects to start generation	c. Increasing generation capacities and fine-tuning business models based on lessons from functioning projects
Invite tenders for Solar Grid Connected PV system – in the next call for such by MNRE		
Fiscal Policy		
a. Explore possibility of tax incentives to all hotels for incorporating Green building norms voluntarily (Needs to be a State Norm) But Mandla can be the showcase, due to Kanha National Park		
b. Reduce license fees for hotels and home stays incorporating energy efficient practices and installing solar water heaters		
c. Give monthly rebate on electricity bills for installation of every 100 litres of solar water heater in every building of say Rs. 50/- per month for every 100 litres of solar water installation		

(Rs.. Rs. 600/- per annum)		
Building Norms		
a. Drafting new building bye-laws incorporating principles of Energy Conservation and building code, particularly for hotels and resorts	b. Implementing new building bye-laws incorporating principles of Energy Conservation and building code	c. Strict enforcement of building bye-laws incorporating principles of Energy Conservation and building code
Inter-department Pilot Projects		
With the Department of Agriculture and Horticulture Department: Setting up a chain of cold storage using solar based chilling systems to ensure storage of agriculture and horticulture produce for better marketability of produce Setting up small agro-based units to process fruits and vegetables grown in Mandla for wider market access with energy from stand alone renewable energy applications (Small canning unit, de-hydration unit, juicing units….)		
With the Department of Animal Husbandry: Setting up a chain of cold storage using solar based chilling systems to ensure storage of milk and setting up milk cooperatives (there is a shortage of milk in many of the districts and hence there is rampant use of milk powder)		

9.3 Budgetary Estimates:

An indicative budgetary estimate for converting Mandla district into a Green Energy District comes up with a total cost of Rs. 659.60 Cr over a period of 10 years, with an annual budgetary outlay of Rs. 65.96 Cr.

However, as indicated in section 8.4, most of these projects can be implemented under existing programmes and projects of the State Government and the Central Government.
For instance, in the Rural Electrification Programme for decentralized renewable energy, there is a budgetary outlay of Rs. 540 Cr, with an annual allocation of Rs. 108 Cr. The Remote Village Electrification Programme of the Ministry of New and Renewable Energy has an annual budgetary allocation of Rs. 95 Cr. The Solar Mission for off-grid projects has a budgetary allocation of Rs. 224 Cr. (The Full list in annex 5).

So, in short, the budgetary estimates for Mandla district are doable from just the Government allocations.

Table 42: Budgetary estimates of Capital Cost of Implementing Green Energy (Rs. In Crores)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Capital Cost for Bio-Mass Plant (Rs. In Cr)	**0.00**	**20.00**	**20.00**	**20.00**	**20.00**	**20.00**	**40.00**	**40.00**	**40.00**
Capital Cost of a Small, Micro Mini Hydro plant (For systems less that 1 MW) Rs. In Cr	**0.00**	**8.00**	**0.00**	**24.00**	**40.00**	**0.00**	**0.00**	**40.00**	**0.00**
Capital cost of Solar PV (Rs. In Cr)	**0.00**	**25.00**	**0.00**	**25.00**	**0.00**	**50.00**	**0.00**	**25.00**	**0.00**
Capital cost of Solar Thermal Applications (Rs. In Cr	**0.00**	**0.00**	**0.00**	**0.00**	**12.00**	**0.00**	**0.00**	**12.00**	**0.00**
Capital Cost of building bio-gas plants	**0.00**	**1.40**	**1.40**	**4.20**	**2.80**	**4.20**	**7.00**	**7.00**	**7.00**
Cost of Solar Water Heaters (Rs. In Cr)	**0.00**	**0.25**	**0.45**	**0.60**	**0.90**	**1.10**	**1.10**	**1.10**	**1.10**
Implementing Energy Efficiency Programme	**0.00**	**3.00**	**3.00**	**3.00**	**3.00**	**5.00**	**5.00**	**5.00**	**6.00**
Implementing Loss Reduction Programme	**0.00**	**2.00**	**5.00**	**10.00**	**12.00**	**15.00**	**18.00**	**20.00**	**22.00**
Total Cost Implication (Rs. In Cr		**59.65**	**29.85**	**86.80**	**90.70**	**95.30**	**71.10**	**150.10**	**76.10**
Total Cost of Greening Mandla's Energy Supply, maximising on T & D Loss reduction Efficiency and RE Potential will cost Rs. 659.60 over a period of 10 years or Rs. 65.90 Cr per year									

However, if the model were to be on a public-private partnership, the budgetary outflow from the Government would reduce substantially. The reason is that, 70% of the cost of setting up bio-mass plant will have to borne by the private sector, similarly, 50% of the cost of setting up micro-hydro will be borne by the private sector, the costs of solar PV will be entirely borne by the private investor and for bio-gas and solar power plants, only 30% of the costs would be borne by the Government, while the rest will have to be borne by the individuals.

The following table indicates the financial outgo from the Government for greening Mandla, if it were to opt for a Public-Private model.

Table 43: Capital Cost out from the Government for Green Energy in Mandla (Rs. In Crores)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Capital Cost for Bio-Mass Plant (Rs. In Cr)	**0.00**	**6.00**	**6.00**	**6.00**	**6.00**	**6.00**	**12.00**	**12.00**	**12.00**
Capital Cost of a Small, Micro Mini Hydro plant (For systems less that 1 MW) Rs. In Cr	**0.00**	**4.00**	**0.00**	**12.00**	**20.00**	**0.00**	**0.00**	**20.00**	**0.00**
Capital cost of Solar PV (Rs. In Cr)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital cost of Solar Thermal Applications (Rs. In Cr	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Capital Cost of building bio-gas plants	**0.00**	**0.42**	**0.42**	**1.26**	**0.84**	**1.26**	**2.10**	**2.10**	**2.10**
Cost of Solar Water Heaters (Rs. In Cr)	**0.00**	**0.07**	**0.13**	**0.18**	**0.27**	**0.33**	**0.33**	**0.33**	**0.33**
Implementing Energy Efficiency Programme	**0.00**	**3.00**	**3.00**	**3.00**	**3.00**	**5.00**	**5.00**	**5.00**	**6.00**
Implementing Loss Reduction Programme	**0.00**	**2.00**	**5.00**	**10.00**	**12.00**	**15.00**	**18.00**	**20.00**	**22.00**
Total Cost Implication (Rs. In Cr		**15.49**	**14.55**	**32.44**	**42.11**	**27.59**	**37.43**	**59.43**	**42.43**
Total Cost of Greening Mandla's Energy Supply, maximising on T & D Loss reduction Efficiency and RE Potential will cost the Government Rs. 271.41 over a period of 10 years or Rs. 27.41 Cr per year, with majority of the costs going for efficiency and loss reduction programme.									

CHAPTER – X

GHG Emission Trajectory for Mandla District

10.1 Current GHG Emission Profile of Mandla District – a back of the envelope calculation

The estimate for GHG emission is primarily a back of the envelope calculation, focused on energy consumption for lighting and heating and does not include transport emissions.

The key sources of GHG emissions for the heating and lighting sector in Mandla are primarily

- Conventional Electricity (here the calculation is based on supplies being from coal)
- Kerosene for lighting and a limited quantity for pumpsets and heating/cooking
- Firewood and traditional bio-mass
- LPG for cooking and heating
- Diesel for pumpsets

For conventional electricity, while we believe that the main source of electricity for Mandla district is largely from hydro projects, as is mentioned in section 4.1 of this report, due to lack of concrete and firmed up information on this, we have factored in that the electricity to Mandla could be from coal sources.

The estimated current usage of fossil fuel based sources of energy are as follows:

Conventional Electricity Supply: 35 MW
Traditional bio-mass: 375,000 tonnes per year
Kerosene: 8000 Kilo Litres per year
Diesel: 1200 Kilo litres of diesel per year.
Domestic LPG: 10,224 tonnes of Gas per annum.
Commerical LPG: 380 tonnes of Gas per annum.

In View of this the GHG emission from the usage of above is as below:

Sources of Energy	GHG emissions per unit	Current Consumption	Total Estimated Carbon Emission (in tonnes)
Conventional Electricity Supply	0.82 Kg per kWh	1073 Lakh kWh	8,800
Kerosene	2.93 Kg per Litre	8000 Kilo Litres	2,344
Diesel	2.93 Kg per Litre	1200 Kilo Litres	351.60
LPG	2.91 Kg per Kg of LPG	10,624 tonnes	3,915
Traditional bio-mass	0.25 Kg Per tonnes	375,000 tonnes	93.75
Total Emissions			**15,504.35**

The All India Emission as on 2010 was 10,07,980 tonnes and in comparison, the emission of Mandla district was 15,00 tonnes.

10.2 Estimate of Projected GHG emission reduction – BAU vs. Proposed plan

In the Proposed plan, the entire electricity will be from Renewable Energy Sources from 2013, which will mean the carbon emission from the electricity sector will be zero. We are also hoping that with the implementation of this plan, the usage of Kerosene for lighting purpose will also come to zero, which will mean a zero emission from Kerosene from 2014.

With bio-gas replacing firewood, the emission from firewood would also reduce, though the penetration of LPG would increase considerably.

Therefore, the projected emissions post 2014, if the plan is fully implemented is likely to be as follows:

Sources of Energy	GHG emissions per unit	Current Consumption	Total Estimated Carbon Emission (in tonnes)
Conventional Electricity Supply	0.82 Kg per kWh	0	0
Kerosene	2.93 Kg per Litre	0	0
Diesel	2.93 Kg per Litre	1200 Kilo Litres	351.60
LPG	2.91 Kg per Kg of LPG	30,500 tonnes	5965.50
Traditional bio-mass	0.25 Kg Per tonnes	100,000 tonnes	25.00
Total Emissions			**6342.10**

Therefore, the emission reduction by 2014, will be down by 9,162.21 tonnes, which is 40% of the emission in a Business as Usual Scenario.

Annex 1

Assumptions

This report and modeling exercise has been done factoring in a number of assumptions and calculation methodologies. The following are the detailed assumptions/methodologies adopted in the exercise.

1) Demand Projections: The demand projections for electricity and energy are based on past consumption trends, projected growth rate for the district, projected increase in per-capita income, projected population growth rate (again based on decadal trends of growth of population), ensuring energy access for all households and importantly, factoring in energy efficiency potentials in a phased manner amongst others.

2) The Renewable Energy and Energy Efficiency potentials are based on thumb rule estimation which is scientifically and universally accepted. Some of the calculations are given in the subsequent annex of this report.

3) The cost and pricing assumptions are based on the prevailing market prices, factoring in price fluctuation trends of the past and projected prices. Some of the detailed cost assumptions are as below:

    a. The cost of conventional electricity was taken at Rs. 5/- per kWh (this is the cost to the utility in a given year, factoring in spikes in generation costs and paying high tariffs in summers to address the supply gap. This is the cost to the consumer and not the cost to the utilities.
    b. The conventional costs of electricity has been shown to increase by 10% every year, which has been more or less the trend in the past five years, particularly with the cost of coal going up.
    c. The cost of solar PV has been shown to decrease by 5% annually, as has been the trend in the last five years.
    d. The cost of solar thermal generation has also shown to decrease by 5% annually, since the capital costs have also come down substantially. The capital costs of Solar Thermal is now pegged at Rs. 12 Cr per MW, while two years back, it was close to Rs. 14. Cr.
    e. The cost of hydro generation has been kept constant, though the costs do decline, largely due to depreciation benefits.
    f. The cost of bio-mass has been shown to increase at Rs.0.50 per kWh every year, due to price in bio-mass. The price of bio-mass required for every kWh of generation has been in the average range of Rs.0.25/- but with costs of transportation factored in, we have projected an increase of Rs. 0.50 per kWh every year, which is in the approximate region of 7% per annum.

4) Energy efficiency potentials have been factored in based on estimates done by the Bureau of Energy efficiency for the various sectors.

5) Some projections such as demand for street light, public water works etc have been on the basis of thumb rule and importantly based on current policies of the Central and State Governments, particularly factoring in efficiency measures.

6) All projections are based on existing policy and regulatory framework and programmes, assuming full implementation of the existing framework.

7) The base line used for the estimation and modeling are on data and statistics provided by the various departments and all the data/information are attributed to sources. As far as possible, our endeavor was to base our modeling on the most recent data/information authenticated by the Government or found in Government documents. Therefore, while we may have found more recent data or analysis in studies done by non-Governmental sources, we tried to avoid them, unless, the source/s for the data was clearly mentioned in those non-governmental reports.

8) As far as the sample size of villages was concerned, the approach followed in identifying the villages and arriving at the sample size was based on a stratified random sampling approach. The identified parameters for the stratified random sampling approach were (a) Electrified/Non-Electrified (b) Tribal and Non-tribal villages (c) Villages within the forest periphery (d) Villages with history of Protest. Based on these parameters, we classified the villages and thereby chose the 5 villages for the exercise.

   Since, the report was mandated to be a macro report covering the entire district, we did not opt for the 10% Sample size of villages in the district.

9) The approach taken by this report is macro analysis, while trying to integrate the various elements of green energy development. Therefore, this report does not dwell into detailed elements of each sector.

10) The report also does not factor in elements which are not certain. For instance, while we did look at Clean Development Mechanism (CDM) Funds as a potential funding stream for Greening Mandla, considering that the future of CDM is uncertain, the current carbon market prices are extremely low, assuming that the various green energy projects of Mandla might be a combination of a number of projects, rather than bundling of all the projects as one activity, we have not factored in CDM as a potential revenue stream. Similarly, we have also not factored in potential technologies such as Geo-Thermal Energy, which perhaps Mandla district does have some potential.

Annex 2

Method of Estimating Crop residue production and bio-mass generation

Crop	Production (Tonnes/Year)	Residue Type	Residue to Product Ratio	Theoretical residue production (Tonne/Year)	Total Residue Product	Bio-mass Generation (In MW) (efficiency factor taken as 0.8
Paddy	100	Paddy Straw	1.80	180	207	1.65
		Paddy Husk	0.27	27		
Maize	100	Maize Stalk	2.10	210	285	2.28
		Maize Cob	0.48	48		
		Maize Husk	0.27	27		
Wheat	100	Wheat Straw	1.46	146	146	1.17
Millet (Minor and Major)	100	Millet Straw	1.55	155	155	1.24
Mustard	100	Mustard Stick	2.50	250	250	2.00

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Methods of Estimating Woody Bio-Mass

Forest Area : 100 Hectares

Average Productivity of Forest is generally 130 Metric Tonnes considering rotation age as 50 years with density of 0.6 metric tones

Growing stock = Forest area x Productivity x density = 100 x 130 x 0.6 = 7800 tonnes

Annual Sustainable Yield: multiply the growing stock x 2 and divide it by rotation period = 7800 tonnes x 2 / 50 = 312 tonnes per year. Factoring a collection efficiency of 0.89, the extractable bio-mass will be 250 tonnes per year

Annex 3

Bio-Gas Calculation

Cow Dung to Gas Conversion:

- 1Kg of Cow Dung can generally produce 1.4 Cubic feet (Cft) of gas

Average Gas Requirement per adult:

- 10 Cft of gas per day for 3 times cooking

Average Dung Yield per Cow:

- Low Cows: 10-15 Kgs per day or 5 Kgs if it is only night dung
- Bullocks: 15 Kgs per day, or 6-7 Kgs if is only night dung.
- Buffaloes: 15-18 Kgs per day. 6-7 kgs if it is only night dung
- Jersey Cows: 25 Kgs per day (if fed with cow feeds etc)

Average Gas requirement per family:

- 50 to 70 Cft for a family between 5 and 7 members
- 30-40 Cft for a family of 3-4 members

Average Cow Dung required per family:

- 35-50 Kgs of cow dung for a family of 5 and 7 members
- 21-30 Kgs of cow dung for a family of 3-4 members
- Roughly 7Kgs of cow dung to produce gas for cooking 3 meals for an adult per day

Annex 4

Energy Efficiency Potential calculation

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Total Electricity Requirement for Mandla in Million Units	**134.13**	**146.99**	**193.07**	**211.16**	**227.21**	**244.34**	**244.59**	**258.03**	**271.89**
Total Saving Potential through efficiency measures	**3%**	**3%**	**3%**	**15%**	**15%**	**15%**	**18%`**	**20%**	**25%**
Reduction in Million Units	4.02	4.41	5.79	31.67	34.08	36.65	44.3	51.61	67.97
Reduction in MW terms (rounded off)	**0**	**1**	**1**	**5**	**5**	**5**	**8**	**10**	**12**

Annex 5

Average Cost of Generation from Bio-mass plants

Village	No. of Households	Estimated connected load kW	Load factor in %	Capacity Utilization Factor in %	LUCE as per TERI report at existing operating conditions in Rs /kWh
Dicholi	85	7.8	78	10	**8.88**
Bhalupani	50	2 kW domestic + 4 kW commercial	60	14	**6.49**
Rapta	56	7	70	12	**7.59**
Mokhyachapada	52	4	53	9	**21.00**
Kanjala	90	6	80	13	**21.00**
Mahisiakada	85	6	60	10	**8.68**
Mankidiatala	84	7	70	12	**9.15**
Siunni	141	8	80	13	**8.13**
Kudrichigar	75	5.4	54	9	**9.54**
Jambupani	107	7.2	72	12	**7.40**
Ranidehra	128	2.68	54	7	**21.00**

Annex 6

Budgetary allocations for all Decentralised Rural Electrification Programmes/projects in India (2012-12):

Name of the Programme	Budgetary Allocation for 2011-12	Implementing Ministry
DDGF Programme under RGGVY	Rs. 108 Cr (Rs. 540 Cr for the 11th Plan Period)[43]	MoP
The Remote Village Electrification Programme	Rs. 95 Cr[44]	MNRE
Solar Mission – Off Grid Projects	Rs. 224 Cr[45]	MNRE
Bio-mass Gasifier based Programme	Rs. 6 Cr [46]	MNRE
VESP	Rs. 5.38 Cr	MNRE
Total	**438.38 Cr**	

[43] Rggvy.gov.in

[44] http://www.mnre.gov.in/adm-approvals/rve-adm-2011-12.pdf

[45] http://www.mnre.gov.in/adm-approvals/aa-jnnsm-2010-11.pdf

[46] http://www.mnre.gov.in/adm-approvals/biomassgasifier-2010-11.pdf

Annex 7

Village Survey and Mapping Details

Patpara Village (visited 24th January, 2012)

Patpara is a small electrified village with 35 households. All houses in the village are either metered or have single point connections under RGGVY, with the exception of 5 households near the gate of the Kanha National Park. Single point consumers pay a flat rate of Rs. 56/- every month. During the discussions the villagers shared that metered households have a two-month billing cycle, although there are anomalies in billing with some households getting inflated bills. Due to long duration power cuts at night, villagers use kerosene oil lamps for their lighting needs. At an average each family consumes about 2 to 3 liters of kerosene oil every month for lighting purposes and hence the average monthly expenditure on energy comes to approximately Rs. 120/-.

For cooking needs the households burn firewood collected from the forest. They also use Lantana for the purpose but largely depend upon firewood. Most of the women in the village are responsible for collecting the firewood, and the chore takes up the entire day. This limits their involvement with NREGA resulting in foregoing of the wages.

Patpara has a relatively higher water table (as compared to villages in the area); however in the absence of any irrigation pumps (electric or diesel) they are unable to irrigate the land. Villagers practice single cropping and depend only on paddy cultivation during the rainy season. Entire crop residue is either consumed in stall feeding of cattle or the remaining is spread in fields as waste.

Cattle wealth is also very low due to poor productivity of the cattle. They are mainly used for producing cow dung that is used as manure in fields. Ever since an organization named Foundation for Economic Security (FES) has started intervention on livelihood issues, the village is getting some buffaloes. This could possibly increase the bio mass availability in the village.

Villagers look forward to better irrigation facilities in this low rain area so that they may take up double cropping and sow some pulses along with wheat in the Rabi season. They all agreed that they can pay up to Rs. 130/- per month for electricity, provided they get energy that can light their houses and irrigate their fields.

Chhapri Village (visited 24th January, 2012)

Village Chhapri (Panchayat - Mocha) located in Bichhiya Block is a large village with 169 households. The village is divided into 9 household pockets or mohallas. The social composition of the village is mixed, with the tribal Gond community and OBC groups forming the village population.

Almost all the houses are large kutchcha houses with a huge backyard, used as a kitchen garden for growing vegetables. Level of ground water is high and thus the village has good number of water sources like wells and ponds.

Almost all the households have electricity connections. Houses having single point connections pay a flat rate of Rs. 56/- (40W load), whereas the metered consumers pay amounts ranging from Rs. 120-Rs. 350/-. There are fixed timings for electricity supply – 6pm till 6 am and 10 am to 3 pm. Earlier the households were lighting kerosene lamps and consuming more than 5 litres of oil per household per month, now with the advent of electricity the requirement has come down to approximately 2 liters per household per month. The cost of purchasing kerosene oil from a Fair Price Shop has reduced significantly from Rs. 75/- per month to about Rs. 30/- (with a liter of kerosene priced at Rs 15/-). Incandescent bulbs of 40 watts are used for lighting and when it goes out of function they replace it with a Zero watt bulb.

To meet their cooking needs the households are largely using firewood that they collect from forests. Households also collect wildly growing Lantana weed from forests and use as cooking fuel. Collecting fuel wood consumes large part of the day and prevents villagers from going to work. 2 households in this village also reported use of LPG. They stated that the costs of the connection and cylinder combined were approximately Rs. 2000/- although there was some government subsidy involved, the amount of which they could not recall.

The Forest department once provided Bio Gas plants to 10 families in Chhapri at the cost of Rs. 14,000/- (with 10,000/- being government subsidy). However at present only two or three such plants are working. The reason being insufficient availability of biomass to run the plant. On an average night dung of cattle comes to about 25 kgs which is not sufficient for running of a biogas plant. Hence households are not able to maintain its functioning. Some plants also reported leakage and diffusion of gas in open air. Some families registered complaints with the forest department to rectify the flaws however it is reportedly lying unattended.

Discussions with the villagers revealed that they have knowledge about benefits of biogas and solar electricity but financial constraint in getting them individually proves a hindrance. Though getting firewood for fuel consumes almost an entire day, it does not cost anything except the notional cost which is not calculated by them.

Agriculture is the primary source of livelihood, however the soil quality is not very good and a huge spread of land is Burra land with red soil which is used only for growing a local variety of paddy during monsoons. The land lies fallow in the remaining part of the year.

Almost all households keep cattle in the village and this largely includes cows and ox. The purpose of keeping cattle wealth is largely to get manure for fields since the cattle do not produce sufficient milk for consumption or selling. On an average 4-5 cows in a household collectively produce about one liter of milk every day. Cattle are left for grazing in nearby forest area during the day while stall feeding is done at night. Crop residue and agri-waste produced during harvest is stored and used as cattle feed.

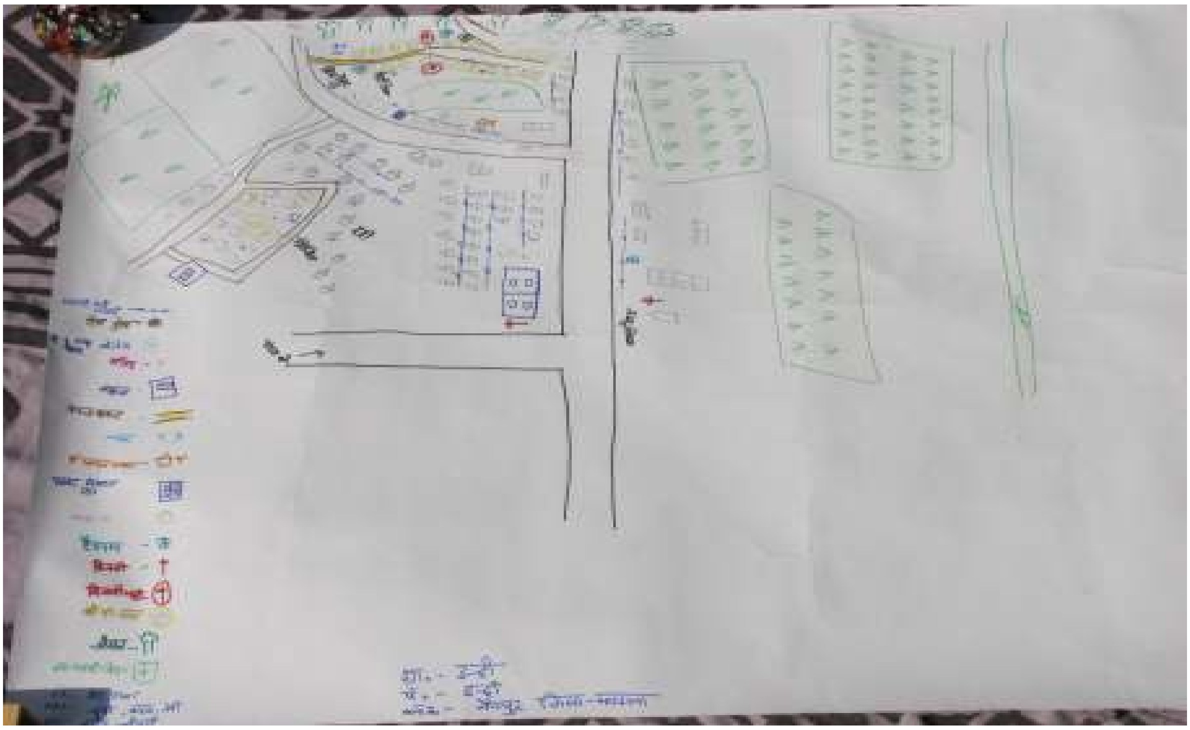
Indri Village (visited 25th January, 2012)-

Indri village located in Nainpur block is a large village comprising of 300 households, and spread across 3 tolas namely Chhindi Tola, Tekari Tola and Baheri Tola. This is a village inhabited by tribal families (Gonds and Pradhans) and OBCs (Yadav, Vishwakarma, Bhanware etc.) Many of the roadside houses are pucca while remaining are kuchha. This is an electrified village with some houses having metered connections. Electricity supply is available only for a few hours in the afternoon and from evening till night. In the morning hours there is usually no electricity. All the households are using 60 W incandescent bulbs and pay between Rs. 200/- – Rs. 800/- for electricity depending upon their usage. Indri village has about 50 borewells with water pump sets of 2/3/5 horsepower. Water level here is approx. 200 ft. About 50 acres of land is irrigated in the village.

Households do not have large fertile land holdings as large patches of land are red soiled Burra land that are used only for cultivating local variety of paddy called Kodu Kutki. The land largely produces only one crop i.e. paddy in monsoon season and remaining part of the year it is largely left uncultivated. As far as cattle rearing are concerned, households are not keeping more than 4 or 5 cattle. Unlike other villages visited during the study, Indri has larger number of buffaloes as villagers felt that cows were not as milk producing as buffaloes. The cattle are left for grazing in nearby jungle in the day time and stall fed in the night. The night dung is collected and used as manure in the fields.

Indri is a WWF intervention village and their concentration is more on Chhindi tola, a small hamlet within Indri village with 22 households. WWF is promoting implements run on renewable energy like – Solar Lanterns, Biogas plants and smokeless stoves. Thus the village has 18 smokeless stoves. WWF is also promoting sustainable agriculture practice in the low water fields.

NREGA work is partially providing livelihood to most of the households, however the availability of work is not as per the demand. Women spent their days searching for firewood in jungle and in the season of Mahua and Tendu they collect the fruits and leaves.



Indravan Village (visited 26th January, 2012)-
Located in Bicchiya block Indravan is a small village of about 130 households. The households located on the roadside are pucca and have one or two petty shops, etc. However inside the village, the houses are kutcha. The village is divided into 5 mohallas and except one family all households are registered under the BPL category. The village is electrified and each household has unmetered single point connection. However, for the past 6 months there has been no electricity supply in the village. Therefore people are using 5 litres or more of kerosene to light oil lamps in order to meet their lighting requirements.
For fuel purposes, the villagers are dependent upon wood from the jungle. The other NTFP, (Non-Timber Forest Produce) used for livelihood purpose, is collecting Mahua and Tendu leaves in the season. Lantana grows wildly in and around the village which is also used by villagers as fuel wood.
Some biogas plants were also installed in the village with help from the forest department, but apart from 2-3, remaining plants have shut down largely due to non-availability of sufficient biomass.
As far as agriculture practice is concerned, barring one family of Gond tribe all households own some land. The village has about 750 acres of land for agriculture but out of this a large amount of the land is Burra land which remains fallow except during the rainy season when villagers grow a local variety of paddy.
The villagers practice single crop farming as there is water scarcity during winters and no Rabi crop is cultivable. Villagers have no source of ground water extraction as there are no pump sets in the village. The reason is both unaffordability and no provision of electricity. Even when there was electricity supply available, regular power cuts were happening during the day.
Cattle rearing is done by all households and on an average, each household keeps up to 4 cattle (mainly cow), the milk produce is very low. Stall feeding is done during the night, and during the day cattle are left for grazing in the jungle. Cattle dung is largely used to produce manure for fields. With efforts of an NGO in the village about 85 household level vermicompost pits have been made that produce organic vermicompost for agricultural use.

Atariya Village (visited 26th January, 2012)

Atariya is a very small village with 3 mohallas and a total of 57 households. The village rests on highlands neighboring the Kanha National Park. This is a tribal dominated village of the Gond community. This is a backward village with very low agriculture productivity. Single crop rain fed agriculture is practiced by the village since there is water scarcity in this part of Mandla. The terrain is rocky and water table is inaccessible. Besides black soil it also has huge acreage of red soil. Paddy is cultivated in the rainy season in fields with black soil while a local rice like grain called Kodu kotuki is grown in red soil patches. There is no crop in winters due to scarcity of water. For further livelihood the tribals are dependent on Non Timber Forest Produce. They collect Mahua post monsoon season and sell the dried seeds. Villagers also pluck Tendu Patta in summer season. Besides these two produce from forests, not much is obtained for selling.

Out of the three, only one tola of village has electricity while the remaining two are still in the dark. Mere poles were found affixed but they had no wires. Villagers informed that some officials from the electricity department came and dropped the poles in the village about 6 months ago and instructed the villagers to fix them and wait for further action. Villagers erected the poles as per their skill and now are waiting for the wires and electricity to reach them. Electricity connections provided in one of the tolas are single point flat rate connections, however the power supply is very erratic. Villagers buy kerosene oil to light lamps and each household consumes more than 5 liters of oil every month. They get their kerosene quota of 5 liters per month from PDS shop and also buy surplus from open market because of shortage of electricity supply and connections. The situation of cattle wealth is also very poor. Earlier all households maintained more than 4-5 cattle, but ever since the forest has reserved large chunks of land as core area and banned grazing of cattle, many households reduced the cattle number. Cattle are sent for grazing in neighbouring buffer zone while stall feeding is done at night. Even in summers when forests go dry, stall feeding is the only option. Villagers use crop residue as fodder for stall feeding hence the entire stock of feed is exhausted by the animals. Cattle are of very low quality breed that do not produce milk in sufficient amount. It does not suffice the household need and therefore, cattle rearing is not done in large quantity. More than milk produce, cattle are maintained for their dung which is largely used as manure in field and sometimes as fuel source too.

To reduce the burden of cattle grazing in forests the Forest department once installed Bio Gas plant in a few households, however in the absence of adequate availability of biomass especially cattle dung the plants do not work. Moreover with more and more households reducing the cattle wealth, availability of dung for the biogas plants is also diminishing.
The village has one primary school where about 50 children study. There is no other resource in this village. NREGA cards have been given to almost all households but not much work has been provided to villagers. Villagers did not seem very enthusiastic about the scheme as well. Overall, the situation of availability of cattle dung biomass, crop residue and other organic waste is very low in Atariya village. With unproductive agriculture land holdings, single crop, low cattle population and ignorance and resourcelessness, the village seems to form a very weak case of being converted into a 100% green energy fed village self sufficient in energy needs.

Annex 8

List of Briquet units in Operation and their status

ANNEXURE-I

Capacity Utilisation and Constraints in Production

Description of plant	Capacity installation	Plant supplied by	Utilisation	Financed by	Remarks
A. GOOD OPERATING PLANT					
Anand Khandsari	3000 kg/hr	SSC/New Life	85%	Self	Production low during rainy season
Nitin Biocoal	1000 kg/hr	SSC/New Life	80%	Self	Power disturbance
Gayatri Biocoal	1000 kg/hr	SSC/New Life	70%	IREDA	Power restriction
Devi Renewable	1500 kg/hr	Ameteep	70%	IREDA	Power restriction
Punjabi Agro	1250 kg/hr	SSC/Hi-Tech	70%	Commer. bank	New plant
Vikram Agro	750 kg/hr	SSC/New Life	70%	Commer. bank	New Plant
Hariom	1250 kg/hr	SSC/Hi-Tech	80%	MSFC	New plant
B. AVERAGE OPERATING PLANT					
Witco	500 kg/hr	SSC	60%	IREDA	Utilisation low due to break down
Vijay Industries	1250 kg/hr	SSC/New Life	65%	Self	Power restriction
Jindal Briquette	500 kg/hr	SSC/Triad	65%	Self	Material mix
Darshan Singh	--	Local	65%	GSFC	--
Nemi Briquette	--	SSC/New Life	60%	GSFC	Low motivation
C. PLANT OPERATING BELOW AVERAGE (LESS THAN 50%)					
Mohta Agro	3000 kg/hr	Imported Alternate		UPFC	Problem in marketing
Indoden	7000 kg/hr	ISGEC-2 press Alternate-2 press		IREDA	Problem in marketing
Agri Carb	2500 kg/hr	Alternate-1 press SSC-1 press		IREDA	Defective pre-processing equipment
Majha Energy	1600 kg/hr	SSC/New Life		PFC	Shortage of raw material
Punjab Hydro Carbon	1000 kg/hr	SSC/New Life		PFC	Shortage of raw material
Gurukripa	1000 kg/hr	SSC/New Life		IREDA	Shortage of raw material
PAB Fuels	1000 kg/hr	SSC/Triad		IREDA	Shortage of raw material
Abohar Biocoal	1000 kg/hr	SSC/New Life		IREDA	Shortage of raw material

Source: http://wgbis.ces.iisc.ernet.in/energy/HC270799/RWEDP/acrobat/rm23.pdf