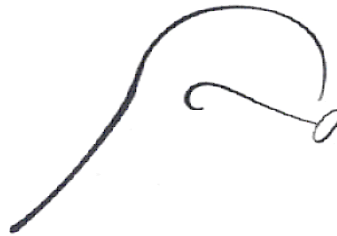


Rural Energy Systems

- The Abandoned Priority



“An ounce of practice is worth more than tons of preaching”.

Energy Supply Systems

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graph TD; A[Energy Supply Systems] --> B[Urban (Industrial & Commercial Activities)]; A --> C[Rural (Household levels)]; B --> D["❖ Important for country's economic development<br/>❖ Largest share of commercial energy consumption (hydro-, thermo-, nuclear-power, or from coal and petroleum products).<br/>❖ Household energy consumption Insignificant compared to Industrial & Commercial Sectors."]; C --> E["❖ Bulk of the energy is consumed at the household<br/>❖ Woodfuel, forms of biomass, biogas, micro-hydro solar and wind power, mostly at a small scale.<br/>❖ Energy is primarily used for cooking food"];
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Urban
(Industrial &
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Rural
(Household levels)

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- ❖ Energy is primarily used for cooking food

Rural Energy systems

- Rural energy systems - an abandoned priority.
- Rural energy is not getting the importance it deserves.
- Upsurge of interest in 1970s triggered by appropriate technology movement and the enthusiasm for the application of science and technology to rural areas.
- However, the emphasis shifted to renewable energy.
- *Rural energy invariably implies renewable energy*, the converse is **not** true.
- Primary focus in the rural energy work was on **cooking**.

Rural Energy Systems

- Population of India – 1.21 billion people (2011 census)
- Rural Population nearly – 70 % (83.3 crore 2011 census). So, Rural Energy needs are important.
- Rural poor do not have the purchasing power to articulate their needs through market demand.
- Attention, therefore, should turn to those sections of the population.
- In world about 2 billion people cook with traditional biomass/ fuelwood and about 1.7 billion people are without electricity.
- Most live in rural areas without access to modern energy carriers. What they need above all *energy services* is for efficient, safe and clean cooking and electric lighting.



Goals of Rural Energy Systems

1. *Must be instruments of sustainable rural development.*
2. Must advance rural economic growth that is economically efficient, need-oriented and equitable, self-reliant and empowering, and environmentally sound.
3. For an energy system to be in the interests of the rural poor, it must qualify from three points of view.
 - It must increase the access of the rural poor to affordable, reliable, safe and high quality energy.
 - It must strengthen their self-reliance and empower them.
 - It must improve the quality of their environment (starting with their immediate environment in their households).



Rural Energy Consumption Pattern

- (1) **Agricultural operations**
 - (2) **Domestic activities** -- gathering fuelwood, fetching water for domestic use particularly drinking, cooking and grazing of livestock
 - (3) **lighting**
 - (4) **Industry** (pottery, flourmill, etc.)
- These activities were achieved with human beings, bullocks, fuelwood, kerosene and electricity as *direct* sources of energy.



Energy Distribution Pattern

- **Human energy** was distributed between **domestic activities** (grazing livestock, cooking, gathering fuelwood, fetching water), agriculture, and industry.
- **Bullock energy** was used wholly for **agriculture** including transport.
- **Fuelwood** was used for **cooking and heating** bath water in the domestic sector & to a small extent in industry.
- **Kerosene** was used predominantly for **lighting**, and to a small extent in industry.
- **Electricity** flowed to **agriculture, lighting, and industry**.

Several Features of Energy Consumption Pattern

1. Overwhelming portion comes from *fuelwood*. conventionally referred *commercial* energy, i.e., kerosene and electricity accounts for a trivial fraction - inanimate energy used in the village.
2. Fuelwood must be viewed as a *non-commercial* source (only a small amount of the total fuelwood requirement was purchased as a commodity, the remainder being gathered at zero private cost).
3. *Animate* sources, viz., human beings and bullocks, represent most of the energy used in agriculture.
4. Village's energy consumption comes from *traditional renewable sources*.
5. However, the environmental soundness of this pattern of dependence on renewable resources was achieved at the exorbitant price of *very low productivity* especially in agriculture.

Contd..

6. And large amounts of human energy are spent on ***fuelwood gathering*** (on the average, several hours per day per family and several kilometres of walking to collect a head load of about 10 kg of fuelwood).
7. ***Fetching water*** for domestic consumption also utilises a great deal of human energy (*an average of 1.5 hr and 1.6 km per day per household*) to achieve an extremely low per capita water consumption of less than 20 litres per day.
8. A great deal of the human energy is spent on ***grazing livestock*** that are a crucial source of supplementary household income.
9. There is a strong gender bias in fuelwood gathering and fetching water both these activities are primarily the traditional burden of women.
10. Only a fraction of the houses in typical “electrified” Indian villages have acquired domestic connections for electric lighting, the remaining houses depend on ***kerosene lamps***. Thus, ***village electrification does not mean home electrification***



Strategies of Rural Energy

- ✓ ***Reduction of arduous human labour*** (especially the labour of women) for domestic activities and agriculture.
- ✓ ***Modernisation of biomass*** as a modern energy source in efficient devices,
- ✓ ***Transformation of cooking*** into a safe, healthy and less unpleasant end-use activity,
- ✓ ***Provision of safe water*** for domestic requirements,
- ✓ ***Electrification of all homes*** (not merely villages),
- ✓ ***Provision of energy for income-generating activities*** in households, farms and village industries.

Technologies Used in Rural energy

- Construction of **biogas plants** to meet the heat energy requirement
- Adoption of efficient **cooking stoves** and **smokeless Chullas**
- Erection of the **gasifiers units** to produce renewable energy to meet the rural electricity demand for various productive activities like irrigation, lighting etc.
- Decentralised generation from biomass and from the intermittent sources of wind and/or small hydel, **solar photovoltaic** and solar-thermal devices. New possibility - micro-turbines.

Energy consumption per capita

- Canada = 17179 kWh
- USA = 13338 kWh
- Australia = 11126 kWh
- Japan = 8076 kWh
- France = 7689 kWh
- Germany = 7030 kWh
- United Kingdom = 6206 kWh
- Russia = 5642 kWh
- Italy = 5644 kWh
- ***India = 631 kWh***

Bangladesh being the lowest : 214.4 kWh

**International Energy Statistics, 2006*

Average power per capita (watts per person)

- Canada = 1910 W
- USA = 1460 W
- Australia = 1244 W
- Japan = 868 W
- France = 851 W
- Germany = 822.22 W
- United Kingdom = 667 W
- Russia = 785 W
- Italy = 603 W
- *India = 50.5 W*

Rural Electrification

- *Rural energy for rural self reliance*
- Rural electrification which was equated with *village* electrification.
- Even *one pole* near a village qualified it as an *electrified village*.
- Agricultural consumers dominated the priority list of electricity end-users - *irrigation pumpsets*.
- Rural electrification was understood as *grid electrification*

Technological Sources and Devices

SOURCE	NEAR TERM	MEDIUM TERM	LONG TERM
Electricity	Biomass-based generation via IC Engines/ Micro-turbines	Biomass-based generation PV/Wind/ Small Hydel/ Solar Thermal	Fuel Cells for baseload power
Fuels	NG/LPG/ Producer Gas/Biogas	Biofuels/ Synthetic DME/LPG	Biofuels

Contd...

TASK	NEAR TERM	MEDIUM TERM	LONG TERM
Cooking	Improved Woodstoves/ Producer Gas/Biogas	LPG/Biogas/ Producer Gas/NG/ DiMethyl Ether (DME) Stoves	Gaseous biofuelled Stoves/Catalytic Burners/ Electric Stoves
Safe Water	Filtered/UV radiated/Treated Water	Safe piped/Centralised/ Decentralised Treated Water	Ultra Safe piped/ treated water
Lighting	Electric Lights	Fluorescent/Compact Fluorescent Lamps	Fluorescent/Compact Fluorescent Lamps
Motive Power	IC Engines/Electric motors	Biofuelled prime movers/Fuel cells/ Micro-turbines/ Improved motors	Biofuelled prime movers Improved motors

Contd..

TASK	NEAR TERM	MEDIUM TERM	LONG TERM
Appliances	Electric appliances	Efficient appliances	Super-efficient appliances
Process Heat	Electric Furnaces/ Producer Gas/ Cogeneration/NG- fueled/ Solar Thermal	Induction Furnaces Biomass-fuelled Solar Thermal	Biofuels/ Solar
Transport	Petroleum/NG-fuelled Vehicles	Biomass-fuelled vehicles	Fuel-cell driven vehicles

Characteristics of Rural Energy Systems

- Supply sources
- Energy mix patterns
- Problems & Potentials for development

Characteristics is vary from place to place, depends on numerous factors such as :

- Availability
 - Accessibility
 - Affordability
 - Alternatives
 - income level
 - socio-cultural practices
 - climate, etc.
- Difficult to generalize purely in terms of explaining only one of the different traditional energy sources that are commonly used in rural areas.

Energy Poverty-facts & figures

- World: 2 billion without access to electricity
- Rural India: 400 million (57% of population)
- Target 100% electrification by 2012



Solar Resource in India

- 5 trillion kWh/year theoretical potential
- Sunny areas
 - Most of the country receives more than 4kWh/m^2 /day
 - More than 300 sunny days in the most part of the country
- Potential being mapped by IMD, and few other institutes.
- IMD, MNRE has published solar energy resource handbook

Government initiatives

- **GBI** (Generation Based incentives) for Solar power projects (2008).
- Solar Mission under National Action Plan for Climate Change.
- GBIs and incentive schemes from state governments.

Village Electrification

Earlier definition:

A village is classified as electrified if electricity is being used within its revenue area for any purpose what so-ever.

New definition:

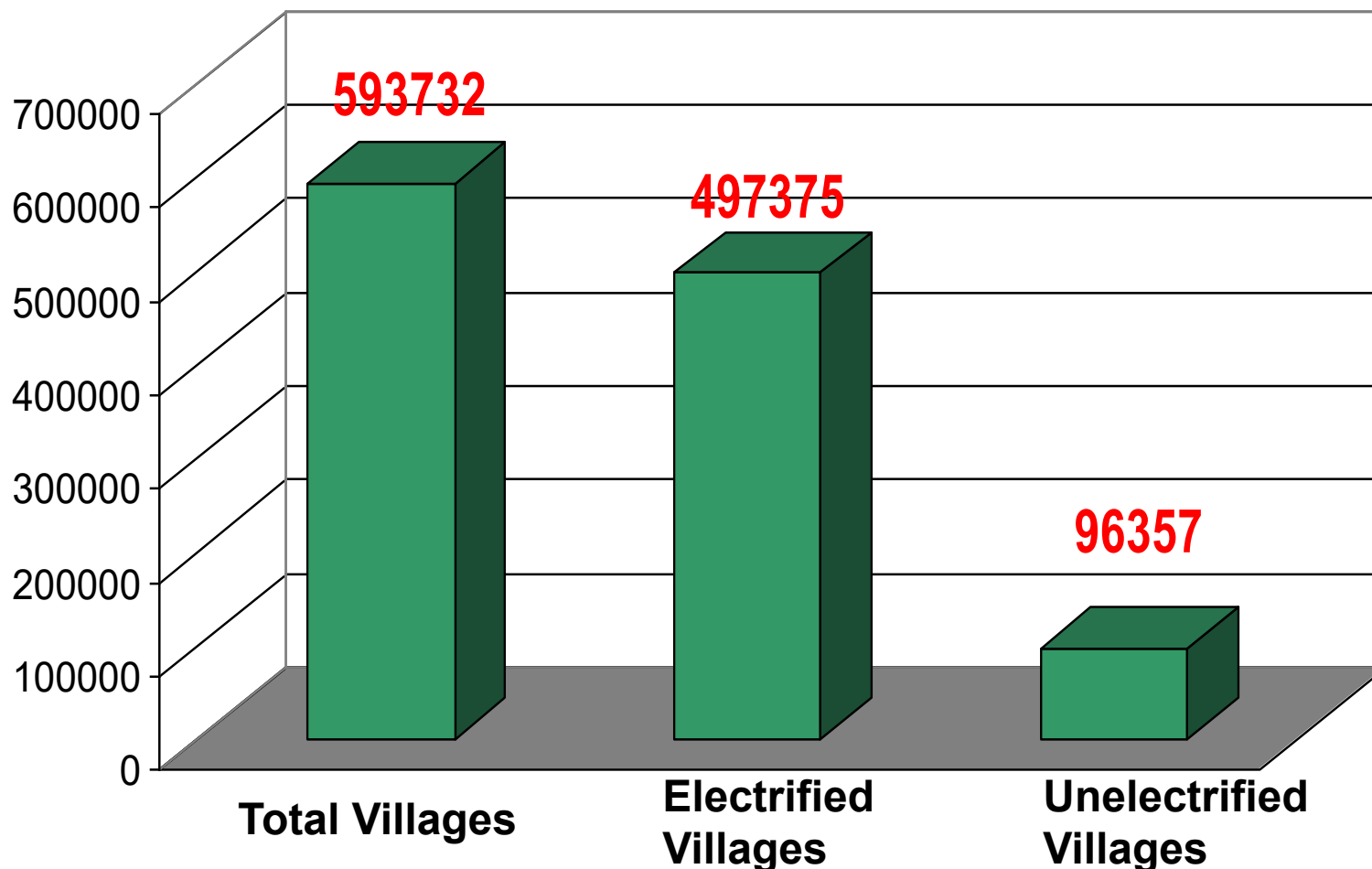
- ❖ The basic infrastructure such as distribution transformer and or distribution lines is made available in the inhabited locality within the revenue boundary of the village including at least one hamlet/Dalit Basti as applicable.
- ❖ Any of the public places like Schools, Panchayat Office, Health Centres, Dispensaries, Community centers etc. avail power supply on demand.
- ❖ The number of household electrified should be minimum 10%.

Electrification of Households

Overall electrification in the country	No. Households	Percentage
Total no. of Households	138.27 million	
Households electrified	60.18 million	43.5%
Households yet to be electrified	78.09 million	56.5%

Status of Village Electrification

As on 31.10.2009



Rural Energy Supply

❑ Biomass

- Primary source of cooking energy in $> 80\%$ rural households

❑ Electricity

- All India average shortage $\sim 11.6 \%$
- Peak Load supply shortage $\sim 15 \%$
- Base Load supply shortage $\sim 9 \%$

❑ Poor electrification status

- 78 million households (44%) in the country do not have access to electricity.
- Electricity supply situation is generally poor in even electrified villages

STATEWISE GROSS ANNUAL PER CAPITA CONSUMPTION OF ELECTRICITY

	States	kWh
1	Haryana	1090.39
2	Himachal Pradesh	765.86
3	Jammu & Kashmir	711.01
4	Punjab	1436.79
5	Rajasthan	572.20
6	Uttar Pradesh	311.82
7	Uttarakhand	654.84
8	Chandigarh	1553.96
9	Delhi	1766.94
10	Gujarat	1283.77
11	Madhya Pradesh	580.34
12	Chhattisgarh	685.81
13	Maharashtra	934.43
14	Goa	1970.08
15	Daman & Diu	8300.12
16	D. & N Haveli	11567.67

Contd..

17	Andhra Pradesh	723.10
18	Karnataka	720.43
19	Kerala	424.13
20	Tamil Nadu	976.81
21	Lakshadweep	368.29
22	<i>Pondicherry</i>	<i>2509.25</i>
23	<i>Bihar</i>	<i>85.86</i>
24	Jharkhand	548.74
25	Orissa	633.93
26	West Bengal	380.61
27	A.& N. Islands	407.77
28	Sikkim	429.81
29	Assam	170.65
30	Manipur	215.21
31	Nagaland	179.34
32	Meghalaya	517.54
33	Tripura	190.62
34	Arunachal Pradesh	297.66
35	Mizoram	250.15

Cooking Energy

- Research, development and dissemination were devoted to stoves, particularly fuelwood stoves –
A Partial Success
- 75% of rural households depend on firewood for cooking, 10% on dungcake and about 5% on LPG.
- 22% of urban households depend on firewood for cooking, another 22% on kerosene and about 44% on LPG.

Lighting Energy

- ❖
- ❖ 50% of rural households depend on kerosene and another 48% on electricity
- ❖ 89% of urban households depend on electricity and another 10% on kerosene.
- ❖ Unelectrified households very high in Bihar, Jharkhand, Orissa, UP, NE, West Bengal, Chattisgarh and Rajasthan.

Initiatives from GOI

- Under the Electricity Act, 2003 there is no requirement of license for standalone generation and distribution of power in rural areas.
- **Rural Electricity Supply Technology (REST) Mission** was set up in September '02. The base objective of formation of REST mission is to accelerate electrification of all villages and households progressively by year 2012 through local renewable energy sources and decentralized technologies, including through the conventional grid connection.
- The Mission is also to identify technologies that could be used in providing affordable and reliable power supply to rural areas and effect implementation through distributed generation schemes using-
 - ✓ Available technology options
 - ✓ Innovative financing
 - ✓ Grass root Institutional arrangements

Initiatives contd...

Rajiv Gandhi Grameen Vidhyutikaran Yojana (RGGVY)-Ministry of Power

- **Major national effort to universalize access to electricity – 57% of rural households were without access in 2001.**
- **Launched in 2005. Targets :**
 - **1,00,000 un-electrified villages.**
 - **78 million rural households in un-electrified and electrified villages.**
- **Provides 90% capital subsidy. 100% capital subsidy for electrification of Below-Poverty-Line (BPL) rural households.**
- **44,000 villages electrified. Another 22,000 villages covered under intensive electrification. About 2 million connections given.**
- **USD 1.5 billion invested. Another USD 6.75 billion provided.**
- **National programme for Franchisee development launched.**

Initiatives contd..

Rajiv Gandhi Grameen Vidhyutikaran Yojana (RGGVY)- Ministry of Power (contd.)

- Franchisees in place in 14 states, covering 63,000 + villages.
- Generated employment for villagers and improved consumer services.
- Resulted in significant improvement in revenue collection- in some cases more than 100% .

Initiatives

INTEGRATED RURAL ENERGY PROGRAMME (IREP) - Ministry of New & Renewable Energy

- ❖ IREP aims at promotion of an optimum mix of both conventional and non-conventional energy sources in selected Blocks in the country.
- ❖ Central Sector Component - Provides grants for support staff in the IREP project cells at the State and Block levels, training of the staff and extension work.
- ❖ State Sector outlays - Utilised for the implementation of IREP Block Energy Plans

Initiatives

EXISTING RURAL ENERGY PROGRAMMES

- National Biogas & Manure Management Programme
- Solar Thermal Applications in Rural Areas
- Solar Photovoltaic Programme for rural areas
- Biomass Gasifier Programme for Power Generation for Meeting unmet demand in electrified villages
- Biogas based distributed power generation programme
- Village Energy Security Programme
- Remote Village Electrification Programme
- Fuel Wood Programme
- Kerosene/ Diesel

What we have done so far for achieving Rural Energy Security in India?

Renewable energy source →	Potential	Installed capacity as on 31.03.2008
Family Type Biogas Plants	12 million	4.2 million (Functionality of the biogas plants is about 95.80%)
Solar PV		1.3 million systems (domestic & Street lighting and telecommunication etc)
Remote Village Electrification		4500 villages/hamlets (Mostly solar lighting systems)

Government Plans (2007-2012)

Renewable energy source	Proposed Targets
Renewable Power Stand Alone Systems (Solar, wind, small hydro biomass etc)	1,000 MW
Family Type Biogas Plants	2 million plants
Remote Village Electrification	10,000 villages

Rural Energy Challenges



- ❑ Access to electricity and the services it provides (illumination, mechanical power, cooling) is extremely limited
- ❑ Majority of heat energy needs come from traditional biomass (cooking, heating, agricultural processing) such as wood, agricultural residues, charcoal and dung
- ❑ Family energy needs met largely by women and girls
- ❑ Fuel and water collection limit girls participation in school, impact literacy, fertility and economic options
- ❑ Low levels of public services (education, health, etc) impacted by lack of energy
- ❑ Rural jobs and agricultural value added limited by lack of energy

Thank You