Lighting up lives of rural population

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Present situation

- **65% population lives in rural areas.**
- **> 50% (60-65%?) rural population has no electricity. Bihar, Assam, etc. about 90-95% rural households have no electricity.**
- **These households use hurricane lanterns or open flames and large areas do not even get kerosine.**
- **Around 90% of rural areas use ~ 180 million tons of biomass through very inefficient and smoky stoves.**
- **Cooking and lighting energy constitutes 75% of rural energy.**
- **Around 30% of our population earns < Rs.50/day.**
- **Tremendous water shortage and no safe drinking water in rural areas.**
- **Very little food processing. Only 7% value addition.**
- **Rural population aspires to good quality of life.**

Strategy

- **Around 200-250 million rural population have reasonably good purchasing power. Can be agents of change.**
- **Strategies to increase level of living :**
  - **Employment generation**
  - **Wealth creation from land. Will help in attachment to the land.**
- **Can be achieved by use of high technology to produce energy.**
- **Energy is the basis of life. From it flow all other activities of technology, commerce and politics.**
- **Strategy of matching energy to end use.**
- **Agr. country hence energy production via biomass energy.**
- **Need to cap greed for resources.**

Philosophy of rural development

- **Limited energy resources available. Why?**
- **Energy consumption of any country is $E_I + E_{II}$**
- **$E_I = \int E_c dt$ (E_c is instantaneous energy consumption) and goes in infrastructure building.**
- **E_{II} is energy consumption/capita per year.**
- **E_I is not available to DC's because of historical reasons. Mostly were colonized during early 20th century.**
- **It is difficult to reach US or European quality of life even if E_{II} becomes somehow available. March of 1/5th of mankind towards global power can have international repercussions.**
- **Need for an alternative development model which is decentralized and based upon renewable energy.**

Philosophy (contd.)

- **The decentralized alternative model should take into account the aspirations of rural population.**
- **Maxim of *Simple living and high thinking* is a possible driving force. Mahatma Gandhi and Einstein's example. With less energy and few needs they produced a very high quality of thought.**
- **Very difficult to impose in a democratic society. How to reduce the greed is the biggest challenge. Spirituality might help. Indian traditional values need to be encouraged.**
- **Our model is based on high tech development of Taluka so that it becomes food and energy self sufficient and hence sustainable.**
- **Why Taluka?**

Philosophy (contd.)

- **Small villages are sinks for development funds.**
- **Big cities are cracking at seams and are ugly.**
- ***Middle path of Taluka is functional***
- **Hallmark of evolution; size reduction; sustainability; increased efficiency and should be in equilibrium with the surroundings. Societies are Prigogine's DS.**
- **In future it is possible that all societies may be decentralized, high technology and rural based. Gandhiji's dream village?**
- **India is already rural based. Hence a good candidate.**
- **Focus on creating energy technologies based on biomass.**

Biomass Energy

- **India produces > 400 million tons of agricultural residues/yr. Most of it is burnt in fields.**
- **Loss of precious energy besides creating pollution.**
- **Theoretically they can produce ~ 55,000 MW of power.**
- **Increased agriculture will produce more residues. Residue stream for fuel, fodder and fertilizer.**
- **R&D at NARI and in other Institutes has shown that electricity, liquid and gaseous fuels for motive power, transportation and household energy can be produced from biomass.**
- **To produce useful end products at affordable price requires extensive R&D.**
- **Lighting and cooking energy strategy for rural areas.**

Liquid fuel based lighting

- **Light from open flame sources is poor <100 lumens (lm). 100 W bulb~1340 lm**
- **Petromax lanterns provide adequate light (~ 1300 lm) but need improvements in T/L mantles and combustion.**
- **Combustion was improved through the development of Noorie lantern at NARI. Cooking as a by-product. Consumes 50% less kerosine than existing petromax.**
- **Presently mantle efficacy~2-3 lm/W; light bulb~10-15 lm/W and CFL ~ 50-70 lm/W. Need to match mantle efficacy with that of light bulb.**
- **Power plant-to-light efficiency (PPL) point of view liquid fuel lighting will be superior to electric lighting. PPL of CFL is ~ 12-14 lm/W. If T&D losses increase then PPL will further reduce.**

Multifuel Noorie lantern

Liquid fuel lighting (contd.)

- **Present T/L mantles are 1880's vintage. Made of silk cloth; coated with mixture of 99% ThO_2 and 1% CeO.**
- **R&D required in developing new mixtures which can produce thermoluminescence at lower temperatures (1000-1500 ^{0}C) with higher luminous efficacy. Nanotechnology R&D may provide direction.**
- **R&D required in developing sturdier mantles. Could be ceramic cloth based,carbon-carbon composites etc.**
- **Ultimate liquid fuel lighting will be to copy bioluminescence technology of firefly.**
- **With grid electricity still a distant dream for major portion of rural areas, efficient liquid fuel lighting needs to be encouraged. Future of small distributed energy systems.**

Liquid fuel production

- **Need to develop alternatives to kerosine. Ethanol, non-edible oils, pyrolysis oil, etc.**
- **Ethanol and non-edible oils can be used effectively for cooking and lighting. Need to ensure that liquid fuel production should not compete with food production. Biotechnology will help.**
- **Sweet sorghum - a multiple purpose crop as a solution.**
- **R&D needed for pyrolysis oil development. Can be produced from any dried biomass resource. 3 units in US.**
- **Thermal depolymerization of wet plant and animal waste into light crude. 500-900^{0}C and 40 atm. One unit in US.**
- **Creation of liquid fuels in rural areas from available or new biomass resources will create rural wealth and bring energy security for the country.**

Distributed Electricity based lighting

- **Taluka level energy self-sufficient strategy developed by NARI. All electricity and liquid fuel requirement met from agr. residues. Generation of 30,000 jobs and Rs.100 crore/yr wealth.**
- **Potential for creating Rs. 3 lakh crores/yr and 9 crores jobs.**
- **Was implemented as a national policy by MNES till 2000 AD. About 35 biomass based power projects of 6 MW each set up. New electricity act may spur this development further.**
- **R&D needed in 10-500 kW_e range. Gasifiers, space-age steam engines, stirling engines, biomass gas turbines, low cost PV, etc. Nuclear Power? Concept of microutilities in rural areas.**
- **Thermoelectric elements for cookstoves. 40-50 W power. Need R&D in efficient batteries like ultracapacitors and LED units.**
- **Human powered PMDC generators. Rare earth magnets. Gandhi ji's energy charkha.**

Cooking Energy Technologies

- **Liquid and gaseous fuels can provide clean cooking energy.**
- **Ethanol is excellent fuel for cooking. However R&D is required for stoves development for pyrolysis oil, non-edible oil, etc. Policy needed by GOI for use of ethanol for cooking.**
- **R&D required in high tech biogas reactors. Sophisticated bio-chemical engineering needed in reactor design.**
- **Storage of biogas in hydrates, porous carbon and other organic structures. Need for medium pressure storage.**
- **Scenario of a small utility in rural areas which processes agro-waste into biogas and supplies it in small gas cylinders.**
- **Biomass based industry for cooking and lighting and other rural needs can be of the order of Rs. 3-4 lakh crores/yr and can touch every aspect of rural life.**

What should be done

- **A technology mission on cooking and lighting.**
- **Goals of mission by 2015 (for every rural household)**
  - **50 - 100 lux of light/room.**
  - **User friendly and environmentally clean fuel for cooking.**
- **Strategy for mission**
  - **AICRP on crops for liquid fuels (ICAR).**
  - **AICRP on renewables, gaseous fuel, materials, etc. (CSIR, MNES, Inst., Pvt. sector).**
  - **Create synergy between Govt. labs/institutions, NGOs and corporate sector.**
- **Taluka as a focus of development.**

THANK YOU

- **http://nariphaltan.virtualave.net**
- **http://education.vsnl.com/nimbkar/criticalmass.html**
- **http://nariphaltan.virtualave.net/lantern.htm**
- **http://pune.sancharnet.in/nariphaltan/housenergy.pdf**
- **http://education.vsnl.com/nimbkar/spiritual.html**