Electricity and Water Revolution in Rural Areas

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There are two major crises affecting rural areas of India - lack of electricity and clean drinking water. Shortage of electricity directly hampers rural economic growth while non-availability of clean drinking water does it indirectly by creating tremendous health problems.

Both these problems can be solved simultaneously by village-level power plants running on locally produced renewable fuels like biogas, biodiesel, ethanol and pyrolysis oil. These internal combustion power plants, like diesel gensets, of 500 kW capacity each can supply enough electricity for an average village with a population of 2000-3000 people.

In addition, the high temperature exhaust gases from these plants can easily distill or boil water via a suitably designed unit, which can be attached to the genset. Hence the 500 kW power plant can produce about 150,000 liters of clean drinking water every day. Thus the power plant will produce both electricity and water simultaneously. The raw water could be from any source like river, canal, rainwater harvesting tanks or shallow wells. In producing both electricity and clean water the power plant efficiency will jump from existing 35% to around 65% thereby making the whole system extremely efficient. Most of the energy of these gensets is lost in exhaust gases and in cooling the engine. This energy can easily be utilized for distillation or water boiling.

The plant can be owned by a microutility company whose shares will be owned by all the villagers. It can therefore be managed professionally and hence will not have the pitfalls of a cooperative society, which very rapidly degenerates, into political chaos.

Another interesting feature of this microutility could be that it will lease the village level transmission lines and infrastructure from the local State Electricity Boards (SEBs) at "social cost". This can be based on the cost of electricity that most of the SEBs charge farmers presently. The village thus could be isolated from the SEB network and appropriate meters installed so that SEB electricity could be metered. During the maintenance schedule of microutility it could draw upon the SEB's electricity. With the new electricity Act (2003) it is possible for microutilities to do so. Thus the microutility will sell electricity and clean drinking water to the villages. For agriculture and other non-drinking purposes the villages can take water from any other source.

The renewable fuel for running these gensets can be biogas, biodiesel, ethanol or pyrolysis oil.

Biogas, which is, produced either from cowdung or any biomass has been used for almost 100 years in India as a cooking fuel. However it can easily be used to run diesel gensets. It is envisaged that the microutility will buy the biomass residues from the villages and use them in a sophisticated digester to produce biogas efficiently. Some development is still needed in engineering the digesters so that they can run very efficiently and on varied biomass. Biogas production from these digesters improves drastically if the temperature, pH and other variables are maintained properly. This requires sophisticated controls, which a microutility can easily install.

Biodiesel is another fuel, which can be used in the diesel gensets directly. It is produced from non-edible oils like Karanja, Neem or Jatropha. There is a national technology mission on biodiesel and large-scale plantations of some of these crops are planned. However for it to become a viable alternative to diesel it is necessary that the present crop yields are increased manifold, so that farmers get excellent remunerations from growing them. At present, in the absence of any large-scale plantations this is still a paper exercise showing overblown economic benefits. Hence there is a need to have a national program for breeding and selecting high yielding varieties of non-edible oilseed-bearing crops.

Ethanol traditionally has been produced from sugary crops like sugarcane. In India it is mostly produced from molasses, which is a by-product of sugar industry. However, with 5% ethanol mix in petrol promoted by Government of India for automotive uses, the present ethanol production needs to be increased manifold. There is therefore a need to use other crops which require less inputs than sugarcane and are short duration crops.

Sweet sorghum is such a crop. It is a multipurpose crop, which produces grain, sweet juice from its stem and the bagasse is excellent as cattle feed. Besides it uses almost 50% less water than sugarcane and is a 4-month crop so farmers can grow two crops/year on the same land. Nimbkar Agricultural Research Institute (NARI) has pioneered the development of sweet sorghum in India since 1970s. NARI has produced a high yielding sweet sorghum hybrid 'Madhura' which has the same package of practice as regular sorghum. Thus "Madhura" planted on the same area where grain or fodder sorghum is grown presently in the country can yield simultaneously about 2000 million liters of ethanol and 10 million tons of grain every year.

Similarly spoiled grain which cannot be used for human or cattle consumption can also be used for ethanol production via the starch hydrolysis route. Recently US and European scientists have reported a breakthrough in technology for using any agricultural residues for ethanol production. This can help increase further the ethanol production from

biomass. Ethanol fuel of 85% and above concentration can be used in any spark ignition engine and hence these gensets can run on ethanol produced easily from existing distilleries. Thus there is no need to produce costly 100% anhydrous ethanol which is required for mixing in petrol. This can help reduce the cost of electricity from these utilities.

Pyrolysis oil is similar to diesel and can be used in the diesel gensets directly. It is produced by rapid combustion of dry agricultural residues. India produces more than 400 million tons of agricultural residues every year. Thus there is a potential of producing from these residues pyrolysis oil equivalent to 86 million tons of diesel every year. This is nearly 60% of total oil demand of the country. This oil has been successfully tested in 5 MW diesel gensets in Europe. Small-scale pyrolysis oil production units in rural areas can be run quite effectively.

It is estimated that renewable liquid and gaseous fuel production and usage in rural areas could be Rs. 20-30,000-crore/year industry ($4.5-6.5 billion) and can bring substantial wealth to these areas. Besides it will bring energy and water self-sufficiency to villages.

For these plants to be introduced on large scale in villages it is necessary to set up a **National mission on electricity and water production** for rural areas. This mission may provide grants for developing such plants, help in setting up the microutilities by providing them financial help and should encourage the government, corporate sector and NGO partnership in this vital area.

Development of dual-purpose power plants may also help in disaster relief management. During most of the disasters like earthquake and Tsunami type flooding, electricity and clean drinking water are in short supply. These power plants of 250-500 kW capacities can easily be truck mounted and can be sent to the disaster areas. Their large-scale usage in rural areas will allow the availability of such plants for disaster relief on a short notice.

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