Green Rameswaram - Smart Micro Grid

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The importance and benefits of DC appliances have been clearly brought out in the past articles. Energy efficiency is a low hanging fruit and this has to be deployed in a big way and both state and central governments have to give a major thrust for this along with encouragement of renewable energy in a big way. The idea can be successfully exploited inn roof top solar systems and other forms of green energy such as Micro Wind, PICO Hydel and Bio mass/gas generation systems. Depending on the local availability of resources many of these forms of renewable energy can be brought together using a smart micro grid system for individual buildings. The following graphics explains this concept in a pictorial manner.

In the above schematic different forms of renewable energy sources are coupled together in a smart micro grid. iGrid takes inputs from several of them like Solar Panels, Rooftop Micro Wind, PICO Hydel, Biogas generation system and the electricity grid. One can also have a battery for backup of critical loads when all these sources of energy are not available. The size and kWh capacity of the battery will depend on the loads that are to be backed up and the backup time. Like a regular grid, the micro grid takes in power from all or many of such generation systems. The main difference is that all these sources of energy are localised. Depending on the site conditions and terrain all or only some of the sources may be tapped. Except the main utility grid, all the other sources are equipped to deliver DC, including the battery.Different generation systems will now be briefly described in the following paragraphs.

Micro Wind System:

Unlike the big wind turbines that are deployed in the field, the micro wind turbine is for a few kW or power. These turbines are invariably axial types and are very efficient in high wind speed areas. However the micro system is generally of vertical turbine type. This can capture lower velocity winds also and does not take much foot print area. They can easily be mounted on the pillars of a building. There is generally no gearbox and Nacelle and the generator is mounted at the bottom of the structure housing the turbine. This enables lesser space and also easy maintenance. The generator can be of induction or synchronous type. In the latter case it is brushless variety.

PICO Hydel:

These are run of the river systems without the need for any major construction or dams. A pipeline carries the water from a running stream to the turbine and the same is let out back into the downstream side. These are generally deployed in mountainous terrains having a natural head and/or voluminous flow. Pelton turbines are used in places where a natural head is available. Kaplan or Cross Flow type turbines can be used in sites where the flow is good but the head differential is low. In fact such turbines can be used in plains as well and also at the outlet of check dams in rivers and big lakes. Again the generator can be of simple induction type or high performance brushless alternator type.

Bio-Gas Systems:

Disposal of solid waste is engaging the attention of town planners and environmentalists these days. In fact it is not a waste and can be converted to gas and hence energy very profitably. Many European towns and cities run piped gas or electrical distribution system for localities nearby such stations. After due segregation of metals and plastics the organic waste can be converted to gas. The removal of Carbon dioxide makes the output quite rich in methane. This can be used for heating, lighting and also for running of vehicles. It can also be used to run regular petrol start - kerosene run engines that are available in the market. Generators can be coupled to the engine to get electricity.

Smart Micro Grid:

All the above generating systems can be connected to the micro grid along with the utility AC lines. No conversion takes place within the micro grid, which only enables the appliances to run from either renewable or AC mains depending on the availability of power from the various sources. The iGrid is continuously monitoring the power generated from the different renewable sources on one hand and the load demand on the other side. Generally the following four scenarios occur:

1. When the power generated from the renewable sources is adequate to meet all the loads, the appliances are run from the renewable energy sources.

2. When the power availability from the renewables is lower than the load demand, all the available power from renewables are used and the balance is drawn from the AC grid.

3. When there is no power from renewable sources, either in the night or depending on the season, all the appliances are run from AC grid.

4. When the power available from renewable sources is in excess (more than demand) this can be fed back to the AC grid through a grid tied inverter. This is now permitted by several state electricity boards.