

## **Renewable Energy Capsules; Green Power generation at the doorsteps**

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### **Introduction**

Existence of any organisation is in renovating, modernising and diversifying without compromising its ethics and purpose. NTPC Ltd being the largest power generating company in India must aspire to accomplish its inspiring vision with our mission fueling its road ahead.

Contemplating the current environmental norms and bottlenecks; this is right time for any organisation to demonstrate its inclination towards renewable energy. For sustainable growth, an organisation must endeavour to add renewable energy as a new dimension in its power generation portfolio in the time ahead. To accomplish this mammoth task, a dedicated Engineering and research team must be identified and set on task. The team must explore, excavate and exploit the potential of renewable energy. A dedicated team will bring more life and momentum to any organisations renewable energy ambitions.

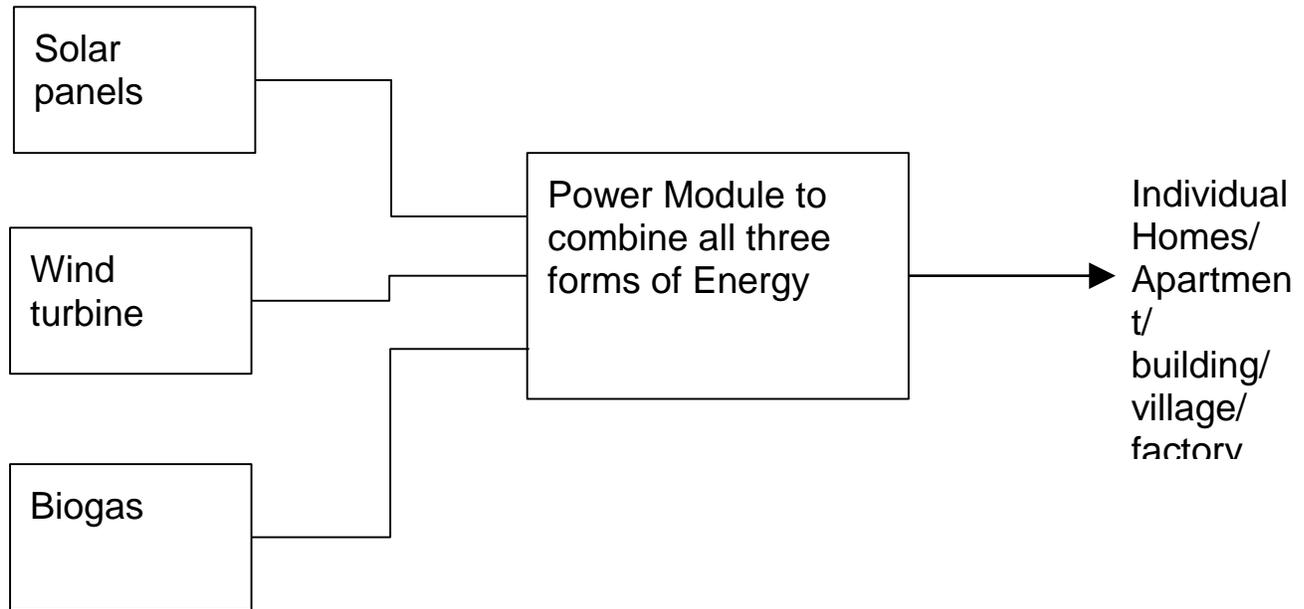
NTPC Ltd is having renewable energy target of 1000 MW by 2017 and is due for revamp. A more ambitious target of 10000 MW by 2020 must be set to make ourselves more sustainable.

Analysing Germany's Renewable Energy fact sheet it is found that, a major chunk, ie 8% of total renewable energy generated in 2014 came from Biomass. In our renewable energy road map too we must include Biomass in addition to Solar and Wind power. To be more specific, biogas, the byproduct of biomass can be considered as an energy generation option.

To bring about a strategic change in power generation technology with an inclination towards green renewable energy a system of **Renewable Energy Capsules** is proposed. The proposed system consists three different and independent system which we can call as renewable modules , which will produce sufficient energy for as per requirements of consumer.

### **The concept of RENEWABLE ENERGY CAPSULE**

Renewable energy capsule will be combination of three different independent energy generating systems which we may call an energy module; The Solar panel, The Biogas and The Wind turbine. All three will be independent energy producing modules which will be designed and manufactured to be portable. These three systems will be combine to form a common uninterrupted power producing module for any targeted location or consumer. The targeted consumer may be a single house, a village or a factory. The rating of the Renewable Energy Capsule must be to satisfy the customer requirements. A basic system setup is as shown below



Pic1: basic setup of the system proposed.

The concept of energy capsule is formulated as a portable format of energy. The capsule will have the freedom and installed anywhere near the consumer as per their requirement. The system bring home affordable renewable energy with maximum efficiency and minimum losses. As the capsule is made portable it can be shifted to a new location with minimum efforts and can be made available to anyone. As the capsule is ready to use plug and play kind of system, with renewable energy it can be contemplated as affordable energy made available to all.

The consumer or the customer can be a single home, an apartment complex, a shopping complex, a village, a housing colony, a charging station or a small or large scale industry. The capability and the capacity of the capsules will be formulated as per the requirement of the customer. Each capsule will be designed to the serve a particular at a particular location. The design parameters must also take to consideration the requirement that a fault in any renewable energy module will not impact the basic requirements of the consumer. The capsules cater the energy requirements of the Electric Vehicle charging stations.

### Capsule Power requirements a sample calculation

Average per capita consumption per family in Urban India per day will be around 3.5KWh on higher side as 4KWh for a single household.

But for a single household in urban area our challenge is to provide what is now considered as the basic need of theirs.

1 ton five star AC 3.5KW

TV 138W

LED bulbs 10nos 20W

Fan 3 Nos 200W

The total power consumption when all the devices are running will be around 4KW. To define our basic capsule size we consider the peak time energy requirement to 5KW so now the challenge here will be to develop system that could generate and deliver **hassle free 5KW to a house household.**

Why an urban household is considered to a basic sample capsule is because, from this we can extrapolate a apartment complex, a shopping mall or a the requirements of a small village and the basic capsule size can be used in power and cost calculations.

For Example consider an apartment complex with a count of 100 apartments. We will have the challenge of developing a  $100 \times 5\text{KW} = 500\text{KW}$  system to cater the peak load. This will help in cost calculations as well. But here we will go for a single system for the entire complex as that will be more efficient, consumes less space and lucrative. So for an apartment complex of the above mentioned size the Renewable energy capsule size will be 500 KWh.

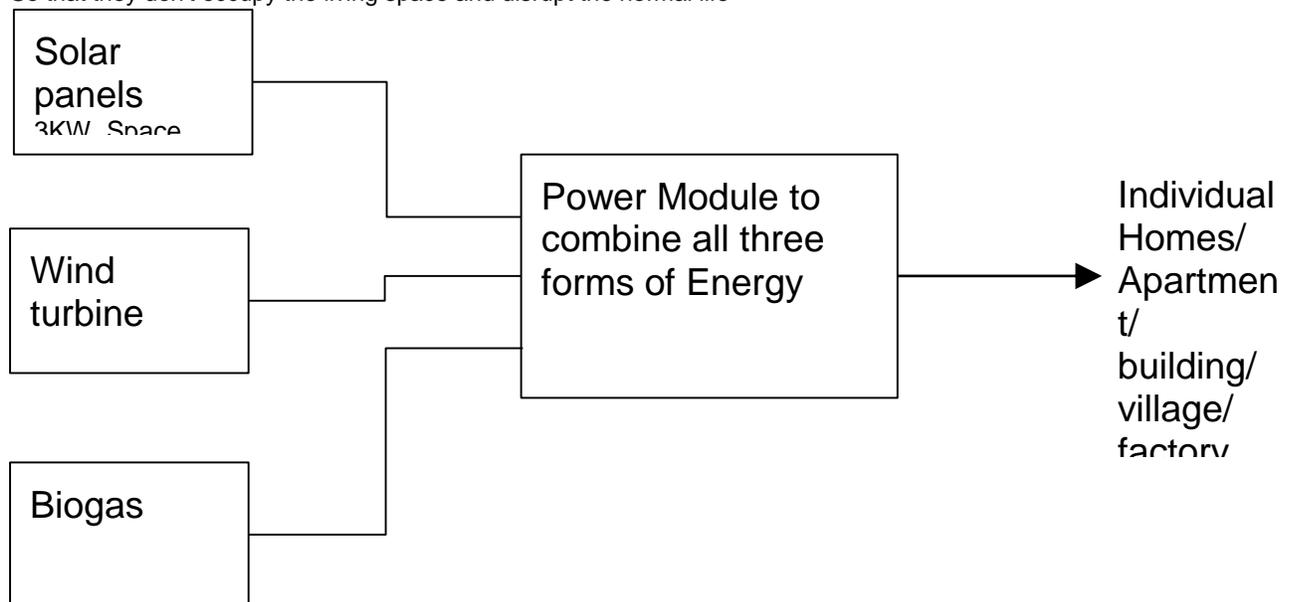
### Renewable energy capsule design for a system size of 5KW.

As mentioned earlier the system will have solar panels, biogas to electricity module and a wind turbine module. The system must be such that the solar and the biomass must be able to deliver around 60% the peak load, say for a household with peak load of 5KW both the systems individually must be able to cater around 3KW. This is due the concern over availability of wind energy. The system must be designed to function both online and offline mode. Online with load being directly given by the modules, offline when load is shared by the battery system installed. Here to a priority to be set for load sharing by different capsules based on the cleanest form of energy. Solar and wind being the cleaner forms of energy than biogas. When both Solar and Wind energy are enough to cater the load at any given point of time. Those modules must be given priority. Biogas must be used as a reserve energy. Which can be made to share the peak load when both solar and wind cannot cater the energy requirements. Biogas can also keep the batteries fully charged to cater the sudden surge in demand.

#### A solar Portable Module

As mentioned earlier of a 5KW requirement, solar energy panels must be able to deliver around 3KW of the peak load. And the space required for the panels on roof top would be 21sq m approx; In India average bedroom size will be around 9.5sq m.

The storage batteries can occupy the space below the panels. So that they don't occupy the living space and disrupt the normal life

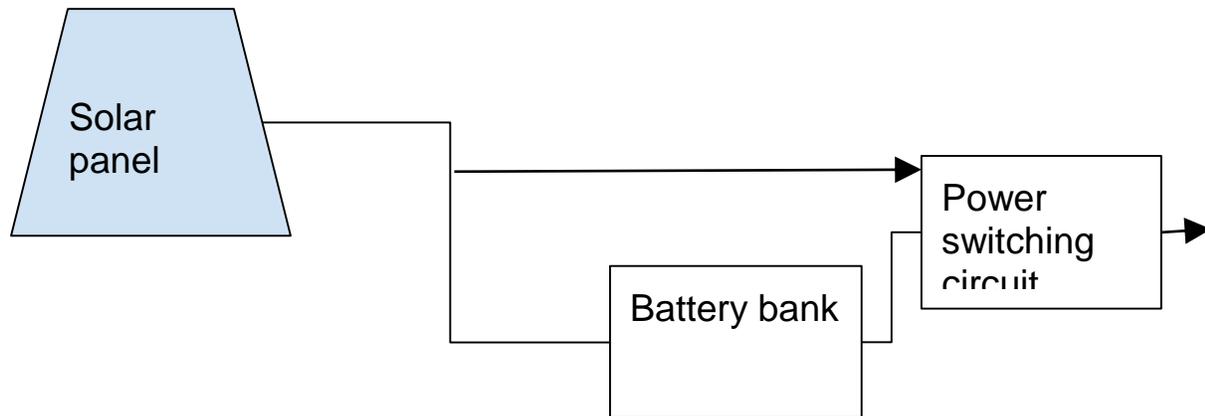


Pic2 : Solar panel requirements and cost calculation incorporated

Solar panels can even be installed as window panels or on glass doors to maximise the solar energy production. Such innovative methods of solar panel installation can also be explored for further improving the efficiency of the system. Moreover the solar panel per unit cost as well as the area per unit production spiralling down which will have a positive impact on the renewable energy industry

Fact file; Pic3: A skyscraper covered in solar panels, An office tower on Miller Street in Manchester, England is completely covered in solar panels, used to offset the energy usage for the insurance company inside. The tower was first constructed in **1962**, but it was first covered with a mosaic tile facade. These small tiles became a problem for the building and continued to fall off the face for 40 years until a major renovation was undertaken. It was during this renovation that the building's owners, CIS, consulted with the solar panel company, Solarcentury, to cover the entire

building in **575.5 kW** of total solar panels. Completed in 2004, the CIS tower became Europe's largest vertical array of solar panels, and a vertical solar project of this scale has never been repeated since.



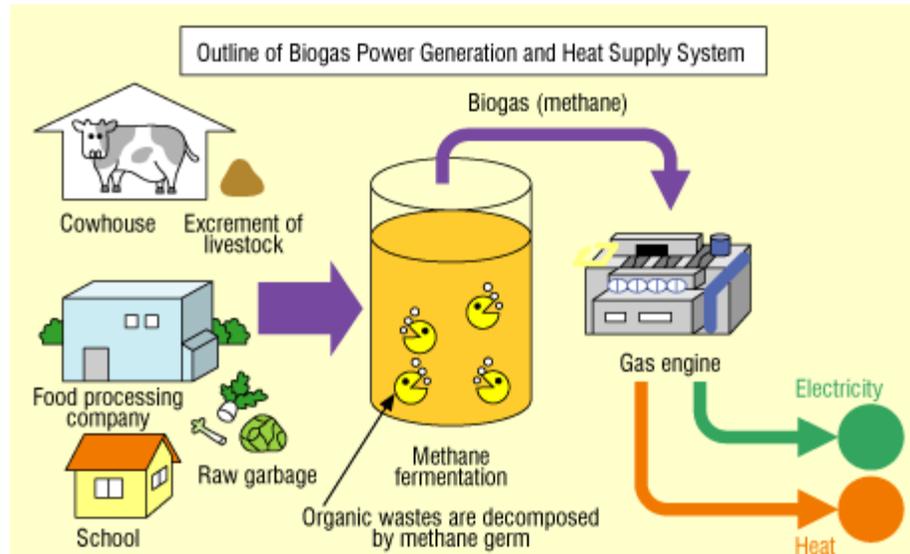
Pic4: solar panel module basic design

### **Biogas Basic Module**

Biogas Power Module will consists of a Synthetic Tank to collect and bio wastes and produce gas. Then a power generator which uses the gas to produce the electricity.

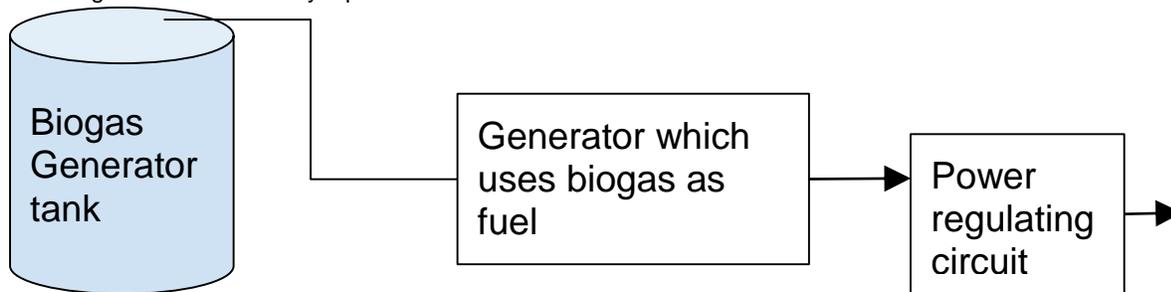
Fact File

The model biogas plant that uses wet waste to generate biogas/electricity on the University of Agricultural Sciences-Bangalore campus has been functioning well. The raw material for power generation comprises cow dung from around 175 cattle at the university apart from leftovers at the students' hostels. The plant requires 4.5 to 5 tonnes of organic waste a day for its operation. The total cost of the 20-kW plant is about Rs. 40 lakh.



Pic5; Biogas power generation system

Our basic module will have a tank capable of producing Biogas  
Then a generator followed by a power circuit

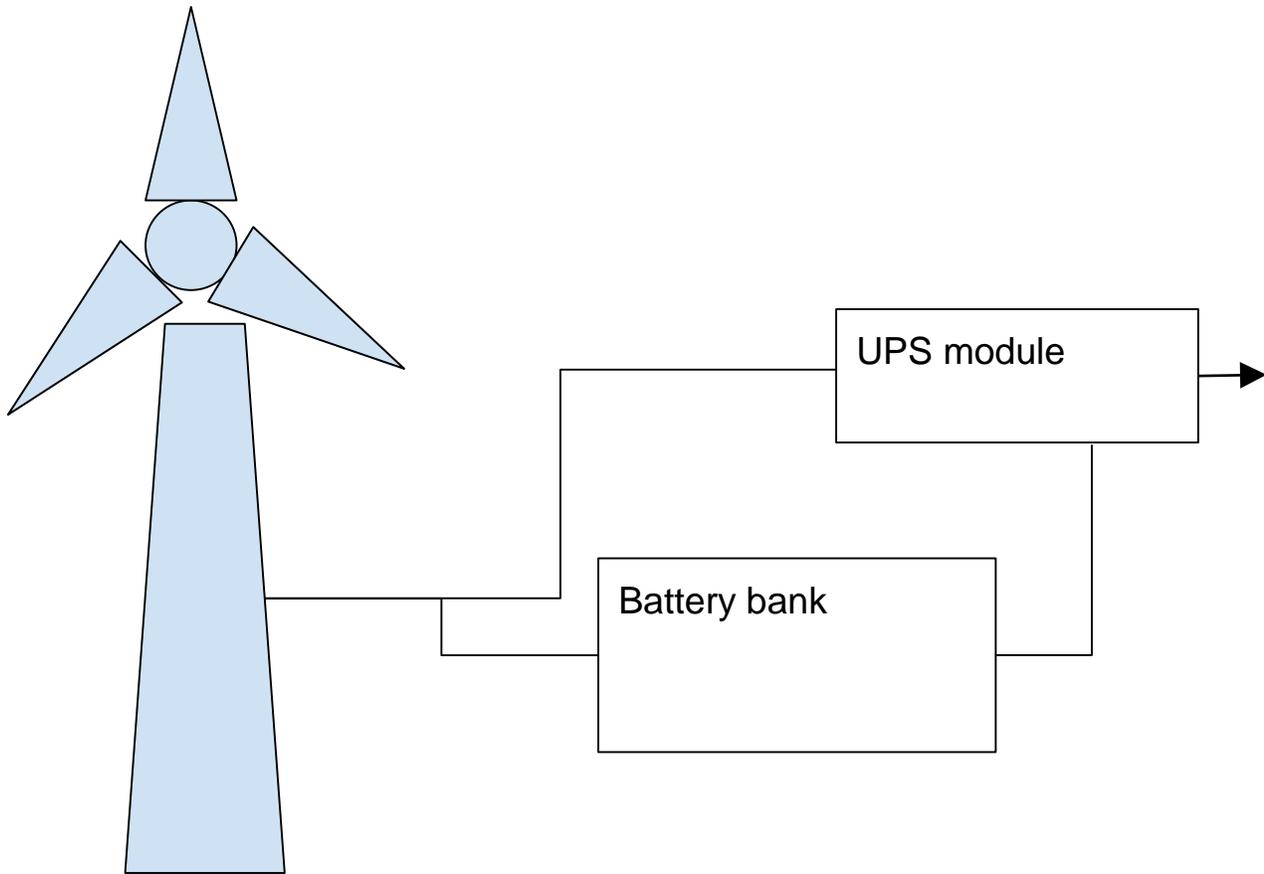


### Cost calculations for Biomass Module

A 3.5KVA biomass generator will cost around 3 lakhs approx  
The tank and biogas setup we can calculate to be around 3 lakh  
Total setup cost will be approx 6 lakhs

### Wind turbine Module

Considering the size and availability of wind in all locations we install our modules, we reduce the wind turbine energy delivery requirements.  
We consider it as just 20% of the requirement.  
We go for a 1KW energy generating system.



### Cost calculations

Wind turbines cost around 60000INR per KW  
We calculate the total setup cost to be around 1 lakh  
A typical 1KV wind turbine specifications

### Fact File

#### Example of a small wind turbine Technical specification

Star-up speed 2(m/s)

Rated speed(m/s) 12(m/s)

Cut-in speed 2.5(m/s)

Rated voltage 24V/48V(DCV)

Rated output 1000(W)

Peak power 1200(W)

Rotor diameter 1.8(m)

Blades 5(pcs)

Survival wind speed 60(m/s)

Weight 31(kg)

Heavy wind protection Dump load and with electromagnetic breaking

Max motor exothermic Rated load 85 centigrade

work temperature -20 centigrade to 40 centigrade

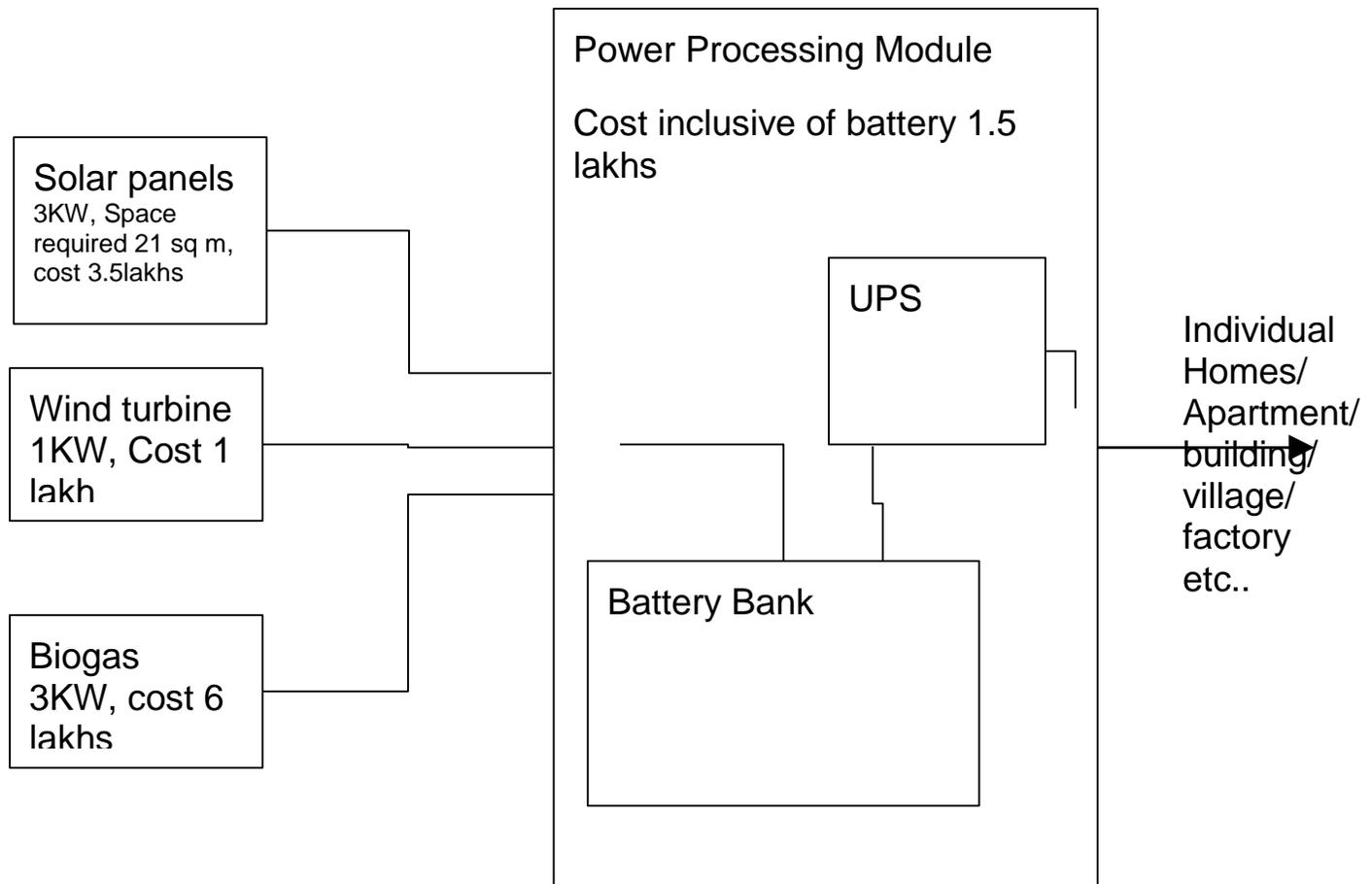
Certification CE ISO9001

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Guangzhou Sunning Wind Power Generator Limited Company

**Combining all three modules to form a Renewable energy capsule**

Now let's find out how an combined system may look like.



### Total cost of Installation as per our rate calculations

Solar Module for 3KW system will cost around 3.5Lakhs

Biogas Module will cost for 3KW system will be 6 Lakhs

Wind turbine Module for a 1KW system will cost 1 lakhs

The total cost of installation of entire system for a power rating of 5KW will be around 12lakhs

Cruze 5.2 KVA is a powerful Inverter that runs Air Conditioner up to 2 ton in hot summer. The Combo runs almost everything that we keep in our home and office Such as multiple lights, Fans, Computers, CC TV Cameras with DVR, Water pump etc. and is safe for running sensitive appliances like computer, Double door refrigerator, Washing Machine etc. with a back up time up to 4-5 hours. The Combo provides Power back to large homes Such as 4-5 BHK and office for long hours when power cut is frequent. The minimum change over time, super fast charting and Pure sine wave Output makes it highly suitable power back up solution Combo.

### Basic Services We need to provide to customers

1. Design and Installation of systems as per the customer requirements
2. Maintenance and repair of the installed system.

### Advantages of Renewable energy capsules

1. Renewable energy without much impact to the environment, a clean energy solution to tackle pollution.
2. Direct to home energy, energy is being produced at the point of consumption so negligible T&D losses.

(In 2017 ,Our total T&D losses account for 23% of total generation)

3. Every household/consumer has the freedom to raise their individual power consumption capacity independently as per energy their requirements.
4. Can be shifted/transported with ease and Can serve remote locations. A capsule can create power hub in any location.
5. A renewable energy capsule Can support and serve Electric vehicle charging stations.
6. Can support support power requirements small and medium industrial establishments, the renewable energy capsules can serve reliable and independent power to industries.
7. Capsules are designed with portable modules so can be replaced or relocated with less or minimum effort.
8. Three independent modules installed, so greater redundancy and availability. In case of fault in any module the other modules can serve the basic requirements of the consumer.
9. Can boost the small scale industry and in house manufacturing industry.
10. The Green Energy production at the doorsteps; every citizen is made accountable and responsible for power they produce and consume.

### **Challenges Ahead Renewable Energy Capsules**

1. Procurement or manufacturing of efficient solar panels.
2. Reliable and efficient storage of Electrical energy is still a challenge
3. Design and deployment of Efficient and less maintenance batteries and other electrical equipments involved
4. Portable design may be maintenance intensive, the system may pose challenges in deployment of skilled manpower across the country.

### **Conclusion**

The idea of energy capsule is formulated for providing affordable and self sustainable renewable energy to general public as a whole. Every consumer is made responsible for their carbon footprints ie energy they produce and consume. Moreover quality and independent power is being produced and the point of consumption, Where any consumer has the freedom to decide how much energy they must produce. However, the there are several challenges ahead of disposal of such a system in mass scale. But if we are able to surpass the challenges ahead it poses then its a win win situation for the customers and the service providers.

### **References**

[http://www.cea.nic.in/reports/monthly/executivesummary/2017/exe\\_summary-01.pdf](http://www.cea.nic.in/reports/monthly/executivesummary/2017/exe_summary-01.pdf)

<http://www.livemint.com/Industry/jqvJpYRpSNyldcuUIZrqQM/Indias-per-capita-electricity-consumption-touches-1010-kWh.html>

<http://indianexpress.com/article/opinion/columns/for-the-middle-class-only/>

Rs 1.95 for up to 200 units, or even Rs 2.90 for up to 400 units, cannot cover the cost of supplying power and will involve some subsidy. In short, the benefits are for the “haves” and not “have-nots”. Surplus funds or even subsidies, if any, should be mandated to be used to give electricity connections to have-nots. What is worse is that the other states have started to make similar promises, though they are not largely urban states. In Delhi, technical transmission and distribution (T&D) losses should be much less due to its compact geography and high density.

<https://scroll.in/article/670348/a-delhi-resident-consumes-12-times-more-electricity-than-one-in-bihar>

Per person consumption of electricity in rural India was 8.9 kilo-watt hours, costing Rs 25, as compared with 25.8 kWh in urban India, where it cost Rs 87. Urban consumers spent 3.5% of their consumer expenditure on electricity, in rural India it was 1.76%.

The map below shows statewise per capita consumption of electricity, urban and rural combined. The divide between the Hindi heartland and west and south India is clear.

<http://www.thehindu.com/todays-paper/tp-national/tp-karnataka/a-model-biogas-plant-that-produces-320-units-of-power-a-day/article3879626.ece>

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