NATIONAL INSTITUTE OF SCIENCE AND TECHNOLOGY
Palur Hills,Berhampur,ORISSA - 761008

GREEN SENSE

REC
RENEWABLE ENERGY CLUB
Go Renewable Go Non Exhaustible

PRATHAMA

From the Desk of the Director

It gives me great pleasure to see that the Renewable Energy Club is publishing its quarterly newsletter GREENSENSE . This is a good effort specially at the time when the entire country has realized that the potential of all renewable forms of energy . It is a matter of deep concern that Indian cities are often cited as worst examples of pollution – air , water and land . I hope the editors of the news letter will encourage original articles that deal with the burning issues that affects the lives of ordinary Indians.

(Prof Sangram Mudali)
Director

From the Desk of the Placement Director

I congratulate the members of the Renewable Energy Club for publishing this quarterly magazine Green Sense for the first time . The objective of the magazine is to generate awareness about renewable energy sources and related products . This magazine will cover some of the latest topics like Ocean Thermal Energy , Wave Net and Floating generators.
I appreciate the efforts of the club members and wish them all success.

(Prof Geetika Mudali)
Placement Director

From the Desk of the Faculty Advisor

At a time when the institution's involvement in the sector of renewable energy growing significant keeping pace with the global RE developments, the campus should have the know-how and the R&D updates in the area. I congratulate the club REC for their in-time venture of the campus news letter on RE updates "GREEN SENSE" & wish them a good luck to make it more interactive with the readers & educate the campus with its quality content in due course.

(Mr. Bhagabati P. Pattnaik)
Faculty Advisor

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Eco-Inventions

SAVE ME!

live green

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Ocean Thermal Energy

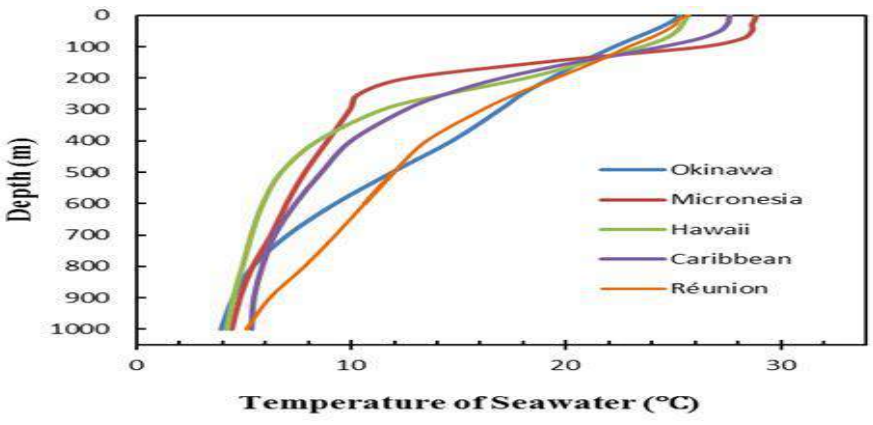
Image Link

Basics of OTEC :

The oceans cover more than 70% of Earth's surface and capture a large part of the sun's heat in the upper layers, making them the world's largest solar collectors and energy storage system. Utilizing just a small portion of this energy, can cover the global energy need[1].

Defining OTEC :

Ocean Thermal Energy Conversion (OTEC) is a marine renewable energy technology that harnesses the solar energy absorbed by the oceans to generate electric power. The sun's heat warms the surface water a lot more than the deep ocean water, which creates the ocean's naturally available temperature gradient, or thermal energy[1].



Graph 1. Ocean Temperature V's Depth

Image Link

Efficiency of OTEC's

The efficiency of the cycle is strongly determined by the temperature differential. The bigger the temperature difference, the higher the efficiency.
The technology is therefore viable primarily in equatorial areas where the year-round temperature differential is at least 20 degrees Celsius or 36 degrees Fahrenheit[1].

Process :

- OTEC uses the ocean's warm surface water with a temperature of around 25°C (77°F) to vaporize a working fluid, which has a low-boiling point, such as ammonia.
- The vapour expands and spins a turbine coupled to a generator to produce electricity.
- The vapour is then cooled by seawater that has been pumped from the deeper ocean layer, where the temperature is about 5°C (41°F).
- That condenses the working fluid back into a liquid, so it can be reused.
- This is a continuous electricity generating cycle[1].

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Wind energy

Defining wind energy:

Wind energy can be defined as the energy contained in the wind. Solar radiation differentially absorbed by earth surface is transferred to the air through convective processes due to the temperature differences and set air to motion.[2]

Types of wind:

There are various types of wind our earth is exposed to. Few of the strong winds are:

1. Jet streams
2. Trade winds
3. Thermal winds
4. Gradient winds[2]

The power contained in the wind is given by:

$$P = \frac{1}{2} * \rho * A * v^3$$

where, P= power harnessed

A=rotor sweep area

ρ= density of air

v=velocity of wind[3]

History and harnessing:

Harnessing the wind energy is a tradition of hundreds of years started long back in Persia. Wind energy was previously used for chores such as pumping water or grinding grain. We can harness wind energy using the wind turbines or wind mills. The wind turbines are of two types:

1. Vertical axis turbine
2. Horizontal axis turbine[2]

Fundamental equations of wind power:

Wind power depends on the following quantity :

1. Amount of air (volume)
2. Speed of air (velocity)
3. Density of air

flowing through an area of interest. This is technically termed as flux.[9]

Efficiency :

59% efficiency is the BEST, a conventional wind turbine can do in extracting power from the wind.

[2]

GREEN BUILDING

In today's world, the designed buildings work towards isolating the internal from the external environment, thereby resulting in very high energy consumption. Traditionally we have always designed using local materials, responding to local climate, and displaying architectural and engineering talent which the whole world still holds in awe.

But today we mostly build forgettable buildings, where buildings in one city look exactly like ones in other cities. Most people are not used to thinking of large buildings as vast, energy-guzzling machines. But that is what they are. It should be our endeavor to help secure the energy and resource for the future through green buildings and habitats which are in harmony with the environment and suitable for people.

What is a Green Building ?

The ideal "green" project preserves and restores habitat that is vital for sustaining life and becomes a net producer and exporter of resources, materials, energy and water rather than being a net consumer[4].

A green building is one whose construction and lifetime of operation assure the healthiest possible environment while representing the most efficient and least disruptive use of land, water, energy and resources[4].

Image Link

Integrated Design Process

Building a green building is not just a matter of assembling a collection of the latest green technologies or materials. Rather, it is a process in which every element of the design is first optimized and then the impact and interrelationship of various different elements and systems within the building and site are re-evaluated, integrated, and optimized as part of a whole building solution[4].

Image Link

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How is green building related to sustainable development?

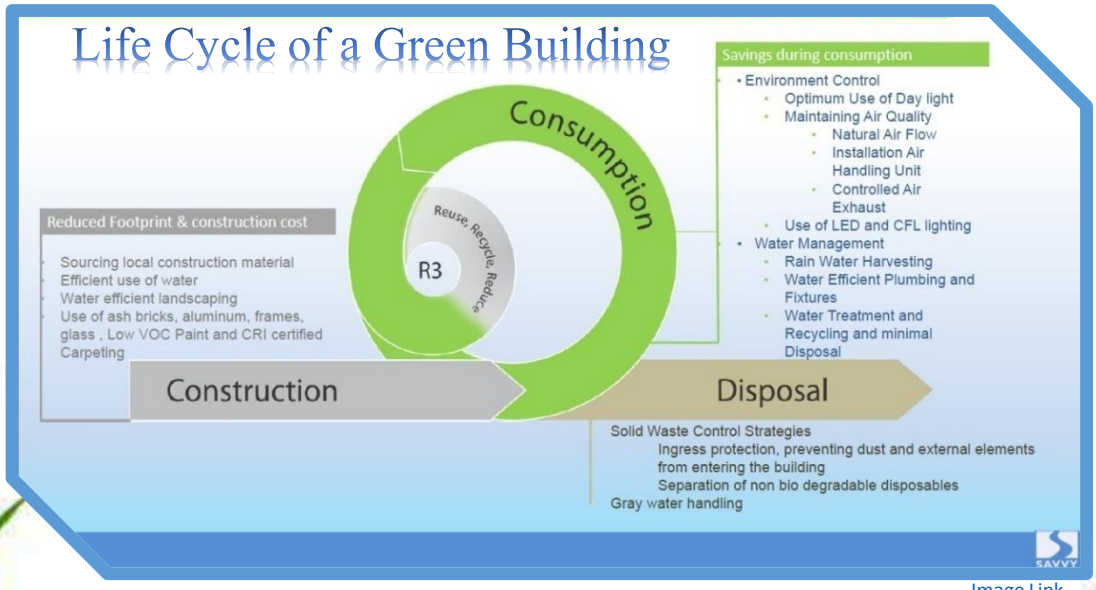
Sustainability, or sustainable development, is the ability to achieve continuing economic prosperity while protecting the natural systems of the planet and providing a high quality of life for its people.

Remember - Sustainability is ALWAYS local (context specific). The minute we start importing designs, technologies, products or materials, the environmental impact increases multi-fold, defeating the very purpose of designing a green building.

Five 'R' philosophy of sustainable development, namely

- Refuse – to blindly adopt international trends, materials, technologies, products, etc. Especially in areas where local substitutes/equivalents are available
- Reduce – the dependence on high energy products, systems, processes, etc.
- Reuse – materials, products, traditional technologies, so as to reduce the costs incurred in designing buildings as well as in operating them
- Recycle – all possible wastes generated from the building site, during construction, operation and demolition
- Reinvent – engineering systems, designs, and practices such that India creates global examples that the world can follow rather than us following international examples. [5]

Green building fits almost perfectly with these concepts, as it promotes building practices that conserve energy and water resources, preserve open spaces through brownfield development, and are accessible to public transportation.



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Overview of the Five Principles of a Green Building Project[4]

Principle	Key Principle	Key Strategy
Sustainable Site Design	◎ Minimize urban sprawl and needless destruction of valuable land, habitat and green space, which results from inefficient low-density development	Renovate and re-use existing vacant sites, and consider re-development of *brownfield sites Preserve and restore the region's natural habitat and heritage while emphasizing the use of indigenous, drought resistant trees.
Water Quality and Conservation	◎ Preserve the existing natural water cycle. ◎ Emphasis should be placed on retention of storm water and on-site infiltration and ground water recharge	Special effort should be made to preserve areas of the site that serve as natural storm water retention and ground water infiltration and recharge systems. Use on-site treatment systems that enable use of rain water for hand washing, **greywater for toilet flushing etc.
Energy and Environment	◎ Minimize adverse impacts on the environment through optimized building design, aggressive use of energy conservation measures. ◎ Maximize the use of renewable energy and other low impact energy sources	Optimize passive solar orientation Incorporate sensors and controls and design circuits so that lighting can be switched off independently Consider on-site small-scale wind and solar based energy generation
Indoor Environmental Quality	◎ Provide a building design, which affords the best possible conditions in terms of indoor air quality, ventilation, thermal comfort and day lighting.	Use building materials, and furnishings which do not contain or release any particulate or gaseous contaminants Maximize the use of natural day lighting.

*Brownfield is a term to describe land previously used for industrial purposes or some commercial uses. Such land may have been contaminated with hazardous waste or pollution or is feared to be so.

**Greywater is gently used water from your bathroom sinks, showers, tubs, and washing machines

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Overview of the Five Principles of a Green Building Project

Principle	Key Principle	Key Strategy
Materials and Resources	◎ Minimize the use of non-renewable construction materials ◎ Maximize the use of recycled content materials	Identify ways to use high-recycled content materials in the building structure and finishes Explore the use of bio-based materials and finishes. Use locally materials and products to support the regional economy and to reduce energy use.

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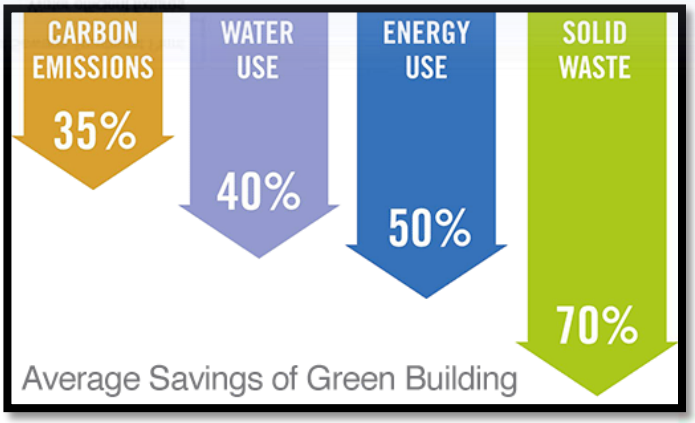

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The Cutting Edge

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WAVENET - WAVE ENERGY GENERATOR

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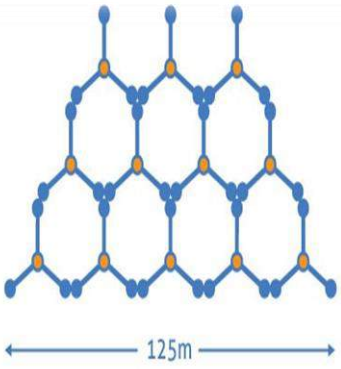
WAVENET is a scalable array of floating "Squid" generator units that harvest wave energy as their buoyant arms rise and fall with the motion of the waves. Each Squid can link up to as many as three others, effectively creating a large, floating grid that's flexible in every direction. The bigger this grid gets, the more efficient it becomes at harvesting energy, and the more different wave movements it can extract energy from. Albatern's 10-year target is to have 1.25 kilometer-long floating energy farms pumping out as much as 100 megawatts by 2024.[6]

UNIQUE ADVANTAGES

Because the WAVENET system is set up as an array, it's able to extract energy from five of the six degrees of wave movement – pitch, roll, heave, surge and sway. Because it's flexible and connected to the ocean floor at multiple points, it's resistant to damage from large waves because some or all of the array can be fully submerged without issue. And because most of the action takes place underwater, the only visual impact of a WAVENET array is a group of floating yellow buoys, not unlike a mussel farm. [6]

HOW IT WORKS

Each Squid unit in the WAVENET array consists of a central ballast pole, surrounded by three buoyant floats that connect to the central post with linking arms. The linking arms connect to the central post with a fully articulating pump unit at each end, thus any movement of the arms as the floats move in the water causes those pumps to create hydraulic energy. [6]



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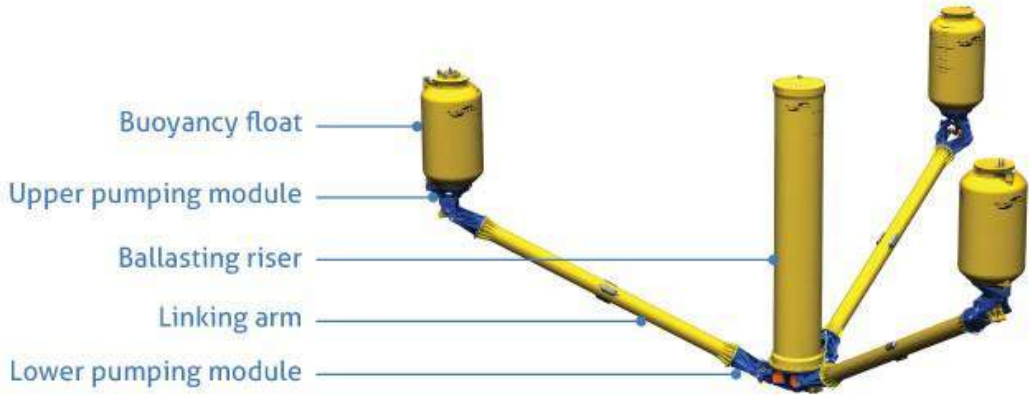
The Squid units can be connected to one another at the floatation points, and Albatern has discovered that building a large array gives you "dramatic non-linear yield improvements." Imagine a blanket of points floating on the surface of the sea – as a wave travels through the blanket, those points are pushed together, pulled apart and moved individually along X, Y and Z axes relative to one another – and every time those points move, they're generating energy. [6]



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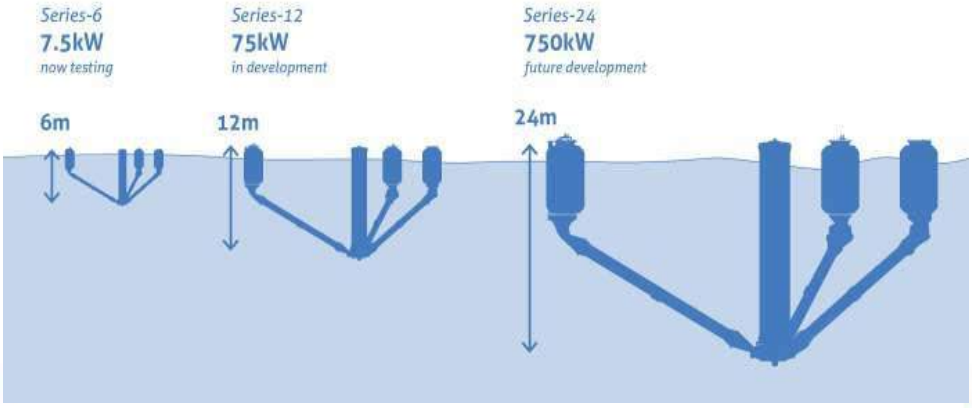
Using a common hydrostatic transmission system, the hydraulic energy pumped through all these units is gathered at a central point and converted into electrical energy through a "power take-off" module, and here the electricity can be transmitted to shore. [6]

Scaling up

Each individual Squid unit in current WaveNET testing off the Scottish coast has a 6 meter (20 Ft.) tall central ballast pole, and has a generating capacity of 7.5 kW. Next up will come a 12-metre version with a 75 kW capacity, followed by a giant 24-metre Squid that can generate up to 750 kW. [6]



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Solar Power Tower

A power tower converts sunshine into clean electricity for the world's electricity grids. The technology utilizes many large, sun-tracking mirrors (heliostats) to focus sunlight on a receiver at the top of a tower. [7]

Image Link

Benefits of Power Towers

Solar power towers offer large-scale, distributed solutions to our nation's energy needs, particularly for peaking power
A single 100-megawatt power tower with 12 hours of storage needs only 1000 acres of otherwise non-productive land to supply enough electricity for 50,000 homes.

The 110MW Crescent Dunes Solar Energy Plant, located near the town of Tonopah in the Nevada desert, will be the largest solar tower plant with integrated energy storage facility built to date. [7]

Image Link

The project includes 17,500 heliostat mirrors that collect and focus the sun's thermal energy to heat molten salt flowing through an approximately 540-foot (160 m) tall solar power tower. The molten salt circulates from the tower to a storage tank, where it is then used to produce steam and generate electricity. Excess thermal energy is stored in the molten salt and can be used to generate power for up to ten hours, including during the evening hours and when direct sunlight is not available [7]

Crescent Dunes Solar Energy Project[7]

Location of Crescent Dunes Solar Energy Project in Nevada

Country	United States
Location	Tonopah, Nye County, Nevada
Coordinates	38°14′N 117°22′WCoordinates : 38°14′N 117°22′W
Status	Under construction
Construction began	2011
Commission date	2015
Construction cost	$0.975 billion
Owner(s)	Tonopah Solar Energy, LLC (Solar Reserve LLC)

Solar farm

Type	CSP
CSP technology	Solar power tower
Heliostats	17,500 × 62.4 m²
Solar field Aperture	269 acres (1,090,000 m²)
Site area	1,600 acres (647 ha)
Solar resource	2,685 kW·h/m²/yr

Power generation

Units operational	1
Make and model	Alstom
Nameplate capacity	125 MW
Capacity factor	52%
Storage capacity	10 hours
Annual generation	485 GW·h

Image Link

Ground was broken on the project September 1, 2011. Construction terminated at the end of 2013, followed by several months of testing the plant systems. Melting about 70,000,000 pounds (32,000,000 kg) of salt takes two months. Once melted, the salt stays melted for the life of the plant and gets cycled through the receiver for reheating.[The project entered commissioning phase in February 2014 following completion of construction. Commercial operation is expected to begin in mid-2015. [7]

Floating Generators

Floating generators are the Offshore Wind Farms established on the floating structure which enables the turbine to generate electricity on water surface where bottom –mounted towers are not possible.
These are chain of several wind turbines floating closely together to take advantage of power transmission infrastructure.[8]

Floating wind turbine attributes:

- Requires a water depth of 30 – 1000 m.
- flexible installation process
- Floater size is independent of water depth
- Mobility : easy movable in case of major maintenance
- Attractive economic and financial attributes[8]

Image Link

Structure:

A typical floating wind turbine consists of following parts(from bottom to top):

- Heave plates and stiffeners
- Mooring systems and anchors
- Gangways
- Turbine (blades, nacelle and lighting) [8]

Key features:

- expensive and high productivity than land wind farms.
- mostly off the coast of UK.
- require different types of bases for stability, according to the depth of water[8]

Power transfer:

For the transfer of power generated form the floating turbines to the shore the floaters are employed with cables which are buried deep under the sea bed. These cables are connected to the storage unit at shore and are responsible for the transfer whenever there is production. [8]

Controversial issues with floating wind farms:

1. Environmental issues:

- Risk of seabirds being struck by wind turbine blades or being displaced from critical habitats
- Physical presence of farms alter the behavior of marine life with attraction or avoidance

2. Construction:

- Independence of types of floaters with respect to water depth.

3. Economic issues

- Economic feasibility of deep- water turbines are yet to be understood. [8]

Wind Farm	Capacity (MW)	Country	Commissioned in the year
London array	630	UK	2012
Greater Gabbard	504	UK	2012
Anholt	400	Denmark	2013
BARD Offshore 1	400	Germany	2013
Walney	367	UK	2012
Thorntonbank	325	Belgium	2013
Sheringham Shoal	317	UK	2013
Thanet	300	UK	2010
Meerwind Sud/Ost	288	Germany	2014
Lincs	270	UK	2013
Horns Rev II	209	Denmark	2009

[8]

WIND-PV HYBRID

Solar/wind hybrids use solar panels and small wind turbine generators to generate electricity. They work in small capacities. Typical capacities are in the range of 1 kW to 10 kW for the solar panel and the wind turbine combined system.
The solar wind hybrid systems are used where the load is relatively small. In commercial and industrial sectors, the systems are used (for example) in rural offices or small tourist hotels where power shortage is chronic. It can be used in schools especially in rural and urban fringe areas. It can be used for military (charging of communication units) as well as in railways (track signalling).

It can be used in high end residential apartments and villas for specific needs. Amitabh Bachchan's villa in Pune has a solar wind hybrid system for powering the garage doors! The solar panel and the wind turbine works in tandem to charge a battery via a controller. The wind turbine could be a vertical axis wind turbine or a horizontal axis wind turbine (wind mills of megawatt level capacities are always horizontal axis).

In a typical hybrid system the battery is first charged by the Solar, then by Wind and if necessary, by grid. You should discuss with your solution provider the vertical and the horizontal axis wind turbine choice based on the wind speeds prevailing in your region. It is hard to determine precise payback periods for solar wind hybrid systems.

The solar wind hybrid systems work best in industrial-commercial situations where the grid power is in chronic short supply or where the remoteness of the terrain makes power supply unreliable (military, railway application) or where the power is expected all the time (high end apartment owners have such expectations).

One type of industrial-commercial area which can use this product is small rural offices: rural health centres, e-governance canters, agricultural centre offices, Village Level entrepreneurs' kiosks/chauppals. These small rural offices will run on a few fans and lights, one or two computers and a laser/bio-metric scanner.

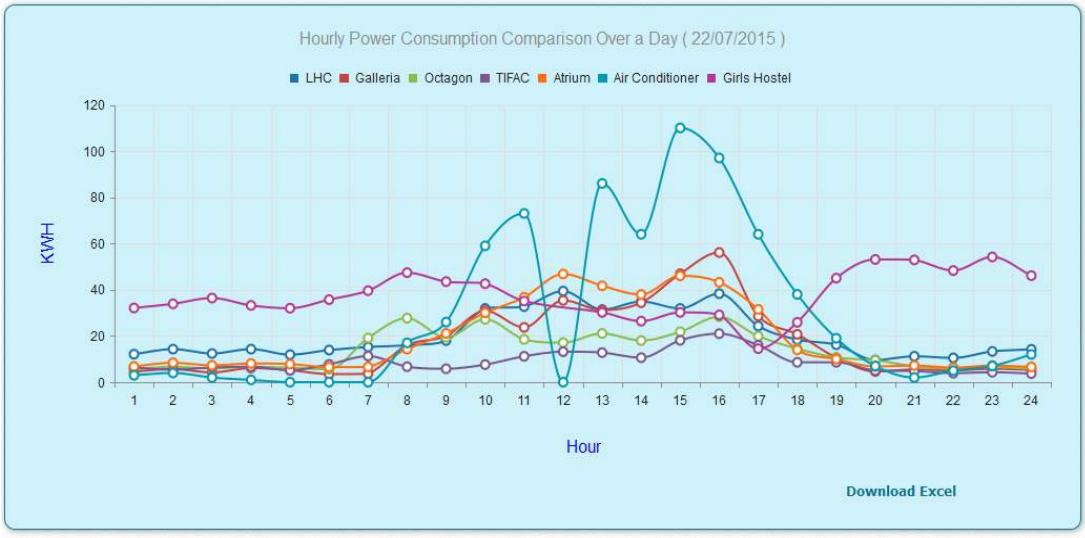
WIND-PV HYBRID AT NIST

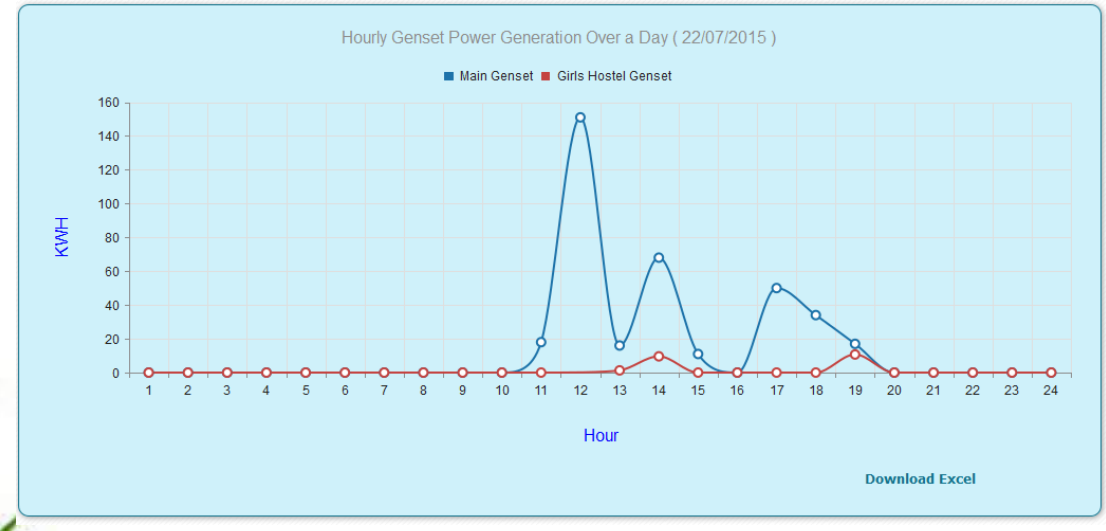
The Wind-PV Hybrid power plant in NIST is operational since July-2011. It is a hybrid unit of 3.2 kW wind power and 1.8kW solar generated power. The Wind Generator Whisper- 500 is from Southwest Power a US based Company and the Solar PV panels are from Luminous renewable, Pune. The Project was installed by Luminous Renewable Energy, Pune. The solar panels are arranged in 75wattsx8 =600 watts in each series row and three such parallel rows are joined to produce 1800watt of solar power. Whereas the wind turbine has a starting (cut-in) speed of 4 m/s and cut out of speed of 12m/s.

This turbine is furling controlled (Vertical Furling: when the wind speed goes to its higher limits (above 10m/s) the turbine adjusts its operation by changing its position in the vertical axis. The total power from the PV & Wind is charging the battery bank through the chargers at a battery voltage of 96 Volt which is fed to the 5kVA Inverter to generate 230 volt ac as its output (which fed to the EDC building).

Energy Monitoring System at NIST

The Energy Monitoring Tool designed by NTCS Energy Team, NIST, Lets you know the energy consumption every instant of the day, its comparison-building wise, the air-conditioner consumption of the day, the generator consumption per day etc. some glimpse of the same are below.





HEDWIG, THE OwL says !

Biomass is currently the largest U.S. renewable energy source with more than 200 existing plants providing electricity for 1.5 million American homes.

The largest wind turbine in the world, located in Hawaii, stands 20 stories tall and has blades of the length of a football field

Silicon from just one ton of sand, used in photovoltaic cells, could produce as much electricity as burning 500,000 tons of coal

One wind turbine can produce enough electricity to power up to 300 homes.

More than 10,000 homes in the United States are powered entirely by solar energy.

We built our first green building about 9000 years back, in Mehergarh (part of Harappa) now in Pakistan

Want to Know More or Have Any QUERIES????

Contact HEDWIG,THE OwL @

club.rec.nist@gmail.com

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UPCOMING

SOLAR HEAT CONCENTRATOR

A TEAM WORK BY REC

MFC