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Review on Performance of Zero Energy Building

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Abstract - *Today in India more than 60% population are wasting their time just to arrange the basic needs of the life i.e.; drinking water, electricity and cooking fuel. This is a biggest barrier for are country's ennoblement because its effecting our daily life, children's education, economy of the country, life style of the common people. Every environmental process works in a cycle. If any face of this cycle is disturbing by human or anything result will be, the whole cycle will disturb and result will be more calamities so with the disturbing of every part of environmental system cycle all the system get disturb and whole process stops that time. Now this time we all are facing lot of problems in the society by environment and we all are responsible for this. We all are using non-renewable resources and requirement is increasing day by day with the increasing of the population. This is affecting our environment. Due to the usage of oil as oil, coal we are increasing pollution in the air due to this all eco system got disturb so we all our facing shortage of drinking water in the cities and towns with the increasing of the pollution in the rivers so people started to get water from hand pump by boring and with the taking of this step ground water level is also going down day by day and there is a limit of drinking water down the ground after that there are so many piousness down the water this is also the Couse of health problems for the people. Now this time every thin is getting polluted by the in balance in eco cycle. We have only one solution to control pollution in the environment and after that we can balance the eco cycle also. From today on, we should adopt zero energy building concepts in our country, which is defined as a building that produces as much energy as it consumes from renewable energy sources on-site. Zero-energy buildings can exchange energy with the power grid as long as their annual net energy balance is zero. This will help to control ground water levels and pollution in the environment, as well as make our environment pollution-free and control the disturbed eco cycle.*

Key Words: Zero energy building, energy savings, water harvesting, Eco system, solar energy, renewable energy

1. INTRODUCTION

Now a day we are facing many problems in our country because of in balance in environmental it's happening with the increasing of population and their needs so this time we need to think to conserve our non-renewable resources and should increase the use of renewable resources for energy production. For the solution for all the problems we should work on the zero energy building concepts in the architecture. This is an autonomous building energy option, which is defined as a building that generates as much energy as it consumes on-site from renewable energy sources. Zero-energy buildings can exchange energy with the power grid as long as their annual net energy balance is zero.

A zero-energy building (ZEB) or net zero energy building is a common term for a building that has zero net energy demand and zero carbon emissions per year. Zero energy buildings are often used outside of the electricity grid – energy is frequently generated on-site.[1]

1.1 Present condition of electricity in India

India's fundamental energy shortage is compounded by a policy that sells electricity at politically acceptable prices to consumers. The state-owned distribution monopolies have all but lost their ability to buy power, as their bosses force them to sell it to voters at a low cost, sometimes at no cost. This opportunism hurts the economy: in India, the government estimates the cost of 1% of its gross domestic product at a third of the total.

If electricity is distributed by government in four villages out of five villages, almost equivalent electricity is distributed to all villages shown above. That is why power cuts are being made in India.

Electricity production in India is mostly achieved through coal thermal power plants. Although there have been efforts to diversify the options, particularly in the case of renewable energies, coal remains the dominant source of electricity in the country. Since 2000, the share of electricity production from coal has been slowly increasing; it was 68% at the start of the millennium and has increased to 73% in 2013. The

percentual shares of all other energy sources, except renewables, have
decreased during that time. In 2015, India generated a total of 1078 TWh from coal, natural gas, oil, nuclear and hydropower sources. Renewable and alternative electricity in the form of solar, wind, biomass and small hydropower (less than 25 MW) plants are also making big progress. These types of electricity source were estimated to generate approximately 70 TWh of electricity in 2015. Non-utilities or independent power producers have also been growing at a rate of 9% over the years and it was estimated that they produced approximately 185 TWh in 2015. India also imported some electricity from Bhutan in
2015 (5 TWh) to satisfy its demand.[2]

1.2 Water problem in India: Present scenario

India is a sufficient water country, not too much, not too little. We've got everything we need. In India, a lot of places get high precipitation. Some parts of the country are so rainy that some parts of the country are completely dry every year on the other side. If this situation remains the same, all food products will almost disappear from the ground after a few decades in the future. It's not far from now when all of our water resources are drained, our big Dams are silted and our irrigation channels are turned into waterless weeds to our farms that have been excavated to distribute water. Water will become a costly thing.

If this situation remains the same, all food products will almost disappear from the ground after a few decades in the future. It's not far from now when all of our water resources are drained, our big Dams are silted and our irrigation channels are turned into waterless weeds to our farms that have been excavated to distribute water. In cities water is going to be rationed as expensive as milk or petrol. Water struggles are going to happen that can cost lives. The next world war is due to waters. It's like a bad dream that comes every day towards us.

Table -1: Survey result of 2010-2011 power cut in different cities of India

CITIES AND TOWN	SEDULED POWER CUTS	UNSEDULED POWER CUTS PER DAY
Noida	8-10 hours per day	2-4
Allahabad	2-4 hours per day	1-2
Muradabad	6-8/day and sometimes it's longer than expected	around once a month
Ghaziabad	4-6 hours per day	ones 1-2 hours
Meerut	6-8 hours per day	4-6 hours
Pilibhit/Puranpur	10 hours per day	Unscheduled power cuts is more than 18 hours
Dehra Dun, Uttarakhand	No scheduled power cut	Unscheduled cuts of more than eight hours per day
Budgam district of Jammu and Kashmir	No scheduled power cut	Unscheduled cuts of more than 8 hours per day. –Sometimes it is less or more also
Mohali, Punjab	8 to 10 hour power cuts was in July month, after monsoon rain power cuts has been reduced to 1-2 hours	Unscheduled power cuts about once aweek
Udaipur, Rajasthan		in August reported that there were outages in that city three times each day
Faridabad, Haryana	more than 10 hours	8 hours per day. –Residential might be better at 5-6 hours, industry goes up to 16-17 hours also
Gurgaon	6-8 hours per day	6-8 hours per day
Manipur	6 hours per day	4-6 hours per day
Jamshedpur	4-6 hours per day	2-4 hours per day

1.3 According to government survey

Since the last 15 years, 5000 villages in Maharashtra have relied on water tankers for direct distribution, and the tankers dump the water into wells. Villages emerge like armies of ants as soon as the tanker horn is heard. They dash out of their houses, holding buckets. They swam the well's mouth because it was overcrowded. A boy drowned in Rewadi village (Maharashtra). In his haste to draw water, the boy fell in. The water was insufficiently deep. He falls and hits the stone, and no one notices. They assumed the boy was in the water because he wanted to swim. He died, and his blood became mixed with water.

- This tanker culture appears to have evolved into a new culture in which everything revolves around the tankers. if the tanker transports
- Drought in India killed tens of millions of people during the 18th, 19th, and 20th centuries.
- Drought set a new world record in Rajasthan, India, in 2000.

Table -2: Many states governments are fighting in courts over their sights

rivers	States
Cauvery water	Kerala,tamilnadu,Karnataka and pondicherry
Krishana	Maharastra, Andhra Pradesh and karnataka
Ravi and beas	Punjab and haryana
narmada	Rajasthan,gujrat,maharastra and Madhya pradesh
godawari	Maharashtra, Andhra Pradesh, Madhya Pradesh and orisha

1.4 Cooking fuel in India: Present scenario

Cooking fuel is currently a major issue in India, with the price of LPG rising on a daily basis. For the last three decades, the government of India has suffered a significant loss due to fuel costs.

Kerosene and LPG Markets in India

In India, the two main clean household fuels that have replaced biomass for cooking are kerosene and LPG. Natural gas and electricity are two other alternatives that are not widely used due to a lack of general availability for household use in the case of natural gas and a much higher cost in the case of electricity. Biomass-based clean fuels, such as biogas, have yet to be commercialised, despite significant interest in India in investigating the potential of no hydrocarbon alternatives.

LPG is used for cooking and heating all over the world, particularly in areas without access to piped natural gas. It is a non-polluting fuel. LPG has two drawbacks for low-income households: its relatively high start-up cost and the large (lumpy) cash outlays required for cylinder refills.

LPG must be stored under pressure, which necessitates the use of metal cylinders. An initial deposit fee is required to cover the cost of cylinder production. This could be more than US$20, not including the cost of an LPG stove and possibly the cost of cylinder deliveries. The combination of the start-up cost and the cash outlay at each refill (which is typically not breakable into smaller instalments) presents a significant barrier to low-income households' adoption and regular use of LPG.

Another issue is ensuring a consistent supply of refill cylinders. Refills may be delivered once a week or every other week in small and remote markets. For users who do not keep a second cylinder on hand, this could mean going without fuel for up to two weeks. Signing up for two cylinders to avoid running out of cooking fuel would raise the LPG service's start-up cost even more.

Again, the infrequency with which refill cylinders are delivered serves as a disincentive to switching entirely to LPG. the need for households to refill more frequently—a problem, particularly if cylinder delivery poses logistical challenges (such as slow delivery or the need to arrange for cylinder pick-up when the dealership is far away).

Low population density, poor road infrastructure, low LPG uptake, and low consumption among those who sign up for LPG can make it difficult for LPG dealers to establish a commercially viable LPG distribution network in rural markets. One of the major barriers to ready access to LPG is a lack of economies of scale in catering to rural domestic consumers.

Andhra Pradesh for no LPG, 23 litres for below poverty line white card holders, 10 litres for above poverty line pink card holders in Hyderabad, and 10 litres per household in the rest of the state in urban areas; Kerala 2 litres for electrified houses and 5 litres for non- electrified houses, with figures in the table for cooking purposes against permits.

The consumption of subsidized LPG is a strong function of income. LPG consumption in fiscal 1997–98, when the consumption of subsidized LPG was seriously constrained by supply problems. It is clear that proportionally the subsidy favoured better-off households. This trend is confirmed in the analysis of the 1999–2000 household survey data, as Chapter 3 shows.

Annual per Capita LPG Consumption as a Function of Annual per Capita Gross Domestic Product (GDP) in 14 Indian States, Fiscal 1997–98

This figure incorporates data from the following states: Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal. The annual per capita consumption includes all residents of the states, both LPG users and non-users.

1.5 Fuel Expenditure Comparison

It is instructive to compare the operating costs of LPG and kerosene with and without price subsidies. What ultimately influences a household's choice is how much it would have to spend to do a given amount of cooking and other household activities. Cooking is used as an example because it consumes the majority of household energy (World Bank

2002b). Compares the cost per unit of energy delivered to the burner tip. The subsidised and unsubsidized prices of LPG and kerosene as informed by the Minister of Petroleum and Natural Gas, Ram Naik, to the Ministry of Finance in February 2003 and reported in the Business Standard (2003) are used as retail prices.

LPG's higher start-up cost makes it even more expensive. The final column depicts the monthly expenditure of a household consuming one LPG cylinder per month.

It costs about Rs 240 per month to cook with LPG at the subsidized retail price levels observed in February 2003, which are regarded as unsustainable by both the finance and petroleum ministries. This assumes that cooking uses one cylinder per month, which is typical of urban households. The figures of Rs 170 and 190 for kerosene cooking are not realistic because few households can afford to buy 20 litres of PDS kerosene every month; rather, the majority of kerosene used for cooking is likely to come from the parallel kerosene market. Without price subsidies, it would have cost Rs 310–350 per month to cook with kerosene and Rs 470 per month to cook with LPG at the international price.

What to do?

We have already seen the basic problems that the people of India are facing, and these problems are affecting the country's economy, the future of the children, and the basic life of the people. People are primarily concerned about drinking water, electricity, and cooking fuel. We'll see how architecture can solve all of our problems.

2. SOURCES FOR NET ZERO

Place– Auroville, International house (this building is not a zero-energy building after some years it will be zero energy building it will take around 4 to 5 years to reach the goal.)

2.1 Energy savings in homes

The following measures can help you save energy in your home. Using renewable energy devices/systems such as solar water heaters, solar cookers, solar lanterns, solar home systems, solar generators, and other devices to retrofit some components of solar passive architecture, such as sunshades, double glazing windows, smart glazing, window overhangs, roof treatments, vent evaporative cooling, and day light on the climatic zone where the h is built.

Adopting energy-saving devices such as LEDs (light-emitting diodes)/CFLs (compact fluorescent lights) instead of incandescent bulbs, electronics chokes and fan regulators, sensors for automatically turning lights on and off, and auto-dimming lights.

Renewable energy system/devices

a. Solar Water heater

A solar water heater is a device that uses the sun's heat energy to provide hot water for a variety of applications. It is useful in the home for bathing, washing, cleaning, and other household chores. A 100 lpd (litres per day) domestic solar water heater is adequate for a family of four or five people. It is easily capable of replacing a 2-kW electric geyser and can save up to 1500 units of electricity per year.

It pays for itself in three to five years, depending on the electricity tariff and the amount of hot water used in a year. After that, the hot water is almost free for the rest of the system's lifespan, which is about 15–20 years. The system is typically installed on a terrace and requires very little maintenance. It operates automatically, and no part of the system needs to be operated. Installing it typically necessitates a surface area of 3 sq m. If space on the terrace is limited, the system can also be installed on a south-facing windowsill.

There are two types of systems being promoted: one based on FPC (flat plat collectors) and one based on ETC (evacuated tube collectors).

FPC-based systems typically have a lifespan of 15–20 years and are more expensive than ETC-based systems. There are 57 BIS (Bureau of Indian Standards)-approved manufacturers of these systems in the country, and they have had a stable market for many years. ETC-based systems are relatively new and may be more reliable in colder climates and areas with hard water. However, the life of these systems is reduced because their collectors are made of fragile glass tubes. The MNRE (Ministry of New and Reliable Energy) has approved 29 suppliers of these systems.

Solar water heaters with a capacity of 100 lpd cost between Rs 18000 and Rs 25000. To compensate for the initial high cost, banks/financial institutions offer 2% loans to users. The Ministry's website contains a list of such banks/financial institutions. Furthermore, some state governments provide state subsidies. For example, Delhi Transco Ltd offers a Rs 6000 rebate on system installation. A few governments also provide property tax and electricity tariff rebates if a solar water heater is installed at home. The Ministry's website has more information.

These banks/financial institutions also offer incentives to motivators who bring them business. The incentive is Rs 200 for every 100-lpd system installed. Unemployed youth who can work as solar entrepreneurs could be motivators.

b. **Solar cooker**

The most common type of solar cooker made for personal use is the solar box cooker or solar oven. It is very simple to build, consisting of a box (square, rectangular, or cylindrical) painted black on the inside and insulated on all sides except the window side, which is double glazed. Inside the box, up to four black-painted vessels are placed with the food to be cooked. Rice and vegetables take 1 to 2 hours to cook in the cooker.[3]

c. Solar lantern

It is a portable device for lighting. It is available with a 10 W SPV (solar photovoltaic) module, 7W CFL, maintenance-free lead acid. Because of its portability and versatility, a solar lantern is a viable option for replacing kerosene-powered devices in domestic lighting applications. A solar lantern is a portable lighting device that uses either CFL or LED luminaires and is housed in a plastic or metal enclosure that contains a rechargeable battery and the necessary electronics. The rechargeable battery is charged by connecting it to a separate PV module via an electric plug-and-socket arrangement. In some designs, the PV module is integrated into the top cover of the lantern, resulting in a self-contained integrated unit. [4]

d. Solar home system

It is a device that powers lights, fans, and solar home systems, which are listed below. W module with a single light (cost: Rs 5000 approximately) 37 W module with two lights or a light and a fan (cost: Rs 10 000 approximately) 74 W module with two lights and one fan, or four lights and one fan (cost: Rs 10 000 approximately) State Nodal Agencies provide up to a 50% subsidy on these models in general areas and up to a 90% subsidy in the North-East and special areas.

2.2 Solar Inverter

The need to power AC loads with solar energy prompts the development of the Solar Power Inverter. The Power Inverter will be the heart of the Solar Energy System because the majority of modern conveniences run on 220 volts alternating current. It not only converts the low voltage 12 volts DC to the 220 volts AC required by most appliances, but it can also charge the batteries if connected to the utility grid, as in a completely self-contained solar power system. These are specialized inverters that draw energy from a battery, manage the charge with an onboard charger, and export excess energy to the utility grid.

Solar inverters can effectively replace small generators, which run on kerosene and petrol and cause pollution and noise. Installed in homes and small establishments, these inverters could power lights, fans, computers, and other electronic devices. The solar inverter comprises a solar photovoltaic panel, battery, and an inverter. It costs about Rs 2–3 lakh/kWp (kilowatt peak).

1. Retrofitting solar passive features

The majority of passive architectural features are incorporated during the design stage of new homes. However, if your home still lacks some concepts, you can retrofit certain features to achieve thermal and visual comfort while also lowering energy consumption.

2. Sunshades

These are typically installed at the top of windows/doors to prevent sunrays from entering the building during the summer and allow them to enter during the winter. This helps to keep the building cool in the summer and warm in the winter, reducing the amount of electricity used by room coolers/heaters. Chhajjas and sunshades should be used to adequately protect the windows on the east, west, and south sides of the house. In the absence of such features, provide awnings or other shading devices to shield windows from direct sunlight.

3. Double glazed windows

Insulation that aids in reducing heat gain into and heat loss from a structure. Double-glazed windows with air gaps can provide adequate insulation. The insulating air gap reduces the building's heat gain. It should only be used in air-conditioned areas. In the Energy Conservation Building Code 2007, the BEE (Bureau of Energy Efficiency) has recommended glazing specifications for air-conditioned spaces (www.bee-nic.in). Most homes have a single pane of clear glass. To reduce the amount of energy used for air conditioning, double-glazed windows with sun control (coatings, shading, and so on) should be preferred over single-glazed windows.

4. Roof treatment

Roofs receive the greatest amount of incident solar radiation. As a result, it is critical to protect your home's roof from solar gain. Some simple roof treatments that can be applied to existing homes to reduce summer heat gain are as follows:

i) Whitewashing the roof before the onset of the summer.
ii) Spraying water on the roof. Sprinkling water at regular Intervals reduce heat gain through roof.
iii) Using shining and reflecting material, for example, light-coloured broken china mosaic, heat reflecting.

5. Evaporative cooling

The ambient temperature is reduced when water stored in a water body evaporates into the surrounding air. This is referred to as evaporative cooling. A nearby body of water, such as a pond, lake, or sea, or even a fountain in the courtyard, can provide a cooling effect. A desert cooler, which consists of water, evaporating pads, a fan, and a pump, is the most commonly used system. External cooling can also be achieved through humidification by keeping roof surfaces moist with sprays or lawn sprinklers. In hot and dry climates with low humidity, evaporative cooling is very effective.

6. Landscaping

Landscaping provides a buffer against heat, sun, noise, traffic, and airflow. It is also effective in diverting airflow or exchanging heat in a solar-passive design. Deciduous trees, such as amaltas, champa, and similar varieties, provide shade in the summer and sunlight in the winter when their leaves fall. So planting such trees to the west and south-west of a building is a natural solar passive strategy. Evergreen trees provide shade and wind control round the year. They are best placed to the north and north-west of a building. Natural cooling, without air-conditioning, can also be enhanced by planting trees to channel south- easterly summer breezes in tropical climates.

7. Passive heating

In places in cold climatic zones, for example Shimla, where temperatures outside are lower than they are inside, heat flows away from buildings through their external envelopes and due to air exchange. In such climates, passive heating measures are adopted to provide thermal comfort and also to reduce the demand for conventional heating. If your house faces south, construct sunspaces adjacent to south-facing walls. A sunspace can be constructed by using double glazing. The space between the glazing and the living space should have a thermal mass, which will capture solar heat during daytime and release it into the space during night time. The sunspace glazing should be protected by curtains and blinds so that heat does not escape out at night.

2.3 Energy conservation devices/ systems

Efficient lighting

Lighting in a home is generally responsible for 20% of the monthly electricity bill. Efficient lighting reduces energy consumption, thereby saving energy and money, without compromising on the quality of light. Lighting improvements are the surest way of cutting energy bills. Using new lighting technologies can reduce energy use in the house by 50% to 75%. Lighting controls offer further energy savings by reducing the amount of time that lights are on without being used. Indoor lighting Use fluorescent tube lights and energy-efficient CFLs in fixtures at home for high-quality and high-efficiency lighting. Fluorescent lamps are much more efficient than incandescent (standard) bulbs and last up to six times longer. Although fluorescent and compact fluorescent lamps cost a bit more than incandescent bulbs, they pay for themselves by saving energy over their lifetime. A 15 W CFL can replace a 60 W incandescent bulb and a 20 W CFL can replace 100 W bulb. The average cost of a CFL is Rs 100, and the excess investment is easily paid back in a year‘s time. A 36 W triphosph or tubelight, provides 32% more light than an ordinary tubelight and can be used in larger spaces. T5 tubelights are also good replacement for ordinary tubelights. They save about 40% energy and last twice as long as ordinary tubelights. The cost of a T5 tubelight varies between Rs 450 and Rs 500. Outdoor lighting Many homeowners use outdoor lighting for decoration or security. Outdoor lights can be powered by small PV (photovoltaic) modules that convert sunlight directly into electricity. Consider PV-powered lights for areas that are not close to an existing power supply line. Solar outdoor lights also come as standalone fixtures. An 11 W CFL, with a 74 W photovoltaic module and a 12 V/75 AH battery, costs Rs 22 000–24 000. When fully charged, the battery can power the light from dusk to dawn

2.4 Tips for saving energy

Passive design

- For effective day lighting, paint the interior of your home in light colours.
- Solar passive designs should be incorporated into buildings during the construction process.

- In the summer, draw curtains or use sun films over windows facing south, west, and south-west.
- Install double-paned windows—heat escapes nearly 14 times faster through a single glass pane than through a well-insulated wall.
- Control heat, air, and moisture leakage by using natural materials to seal windows and doors.
- To keep the interior cool, use reflective tiles or insulation on the roof.

Lighting

- Switch off lights and fans when there is nobody in the room.
- CFLs use 75% less electricity and offer similar amount of light as incandescent bulbs. If you replace 25% of the lights in high-use areas with CFLs, you can save up to 50% in lighting energy bills.
- Electronic ballasts can reduce power consumption by 20%. You can cut consumption by 10%–50% with slim
- tube lights that are star-rated by BEE.
- Use artificial lighting only when there is inadequate natural light in a space.
- Ensure that the type of lamp used in a space complements the tasks being performed in that space. This is commonly referred to as task lighting. For instance, do not use two wall-mounted bulbs where a single table lamp will suffice.
- Make use of dimmer switches. They allow lighting levels to be adjusted based on the occasion or task, as well as lowering the lamp's energy consumption.
- Use timers or photocells on outdoor lights to turn them off automatically during the day.
- Electromagnetic (copper) ballasts (chokes) should be replaced with electronic ballasts.
- CFLs should not be used to replace tube lights. A CFL is a point source, which means it emits light from a single point, whereas a tube light is a line source, which means it emits light over a larger linear spread.
- Workrooms should not have dark-coloured surfaces. This reduces the amount of reflected light and increases the number of lamps needed to illuminate the space.
- Avoid turning on and off lights frequently.

Electronic devices and appliances

- On electrical appliances, look for BEE-star labels.
- Use electronic devices with occupancy sensors, which turn on and off automatically based on whether or not the room is occupied.
- During the hot/dry summer months, replace air conditioners with evaporative coolers.
- Purchase split air conditioners rather than window air conditioners. They are more expensive, but they are more energy efficient and use less electricity.
- During the summer, do not install AC units on walls that are exposed to direct sunlight for the majority of the day. In other words, don't put the AC on the west or south walls.
- Do not use dark colors on the house's exterior surfaces (roof and walls). Darker colors absorb more heat than lighter colors, resulting in.
- When using ACs avoid overcooling of the room to a degree where quilts need to be used.
- An easy way to cut down on the energy required by an AC is to set the thermostat at the highest possible point, and turn on the ceiling fan. This shall create air movement, circulate the cooled air more effectively, and help your sweat to evaporate easily without greatly increasing electricity use.
- With each degree that the temperature setting of an AC above
- 22 °C, 3% – 5% less energy is used. Set the temperature of the AC at 25 °C for the most comfort at the least cost.
- Clean an AC units filter periodically to enable efficient airflow and cooling.
- Do not use remote controls for switching off televisions and ACs. Switching them off from the mains saves electricity.
- Switch off electrical appliances when not in use. Low power gadgets such as chargers, adaptors, inverters, televisions, and so on consume substantial power even in the standby mode.
- If computers must be left on, turn off the monitors; monitors alone use more than half the system‘s energy.

Renewable energy devices

- Use solar water heaters instead of storage electric geysers. They require near-zero maintenance and save up to 1500 units of electricity a year.
- Clean the surface of solar collectors/solar photovoltaic panels at least once in 15 days, if installed on a terrace or in the open.
- Following these power-saving tips can reduce electricity consumption by 30%–50% and can easily half your energy bill.

2.5 Water problem solutions

What is rain water harvesting (RWH)? —Capture rain water, store it and use it - it is as simple as that‖. Collect the rain water falling on house tops, collection ponds, lakes, open areas with natural grading. Rain water is naturally pure (excepting where it becomes acid rain due to industrial pollution). Ground water could be salty or brackish. Water everywhere starts as rain. Rain is the source of all water in the world. 98% of the world's supply of water is salt water in the oceans. 1% of pure water is in the arctic glaciers. The last 1% goes through the water cycle.

3. SUGGESTION

A well is not a storage tank to hold water. It helps to collect the rain water and change it into underground and later bring it out.
Roof water and runoff water can be diverted in to dried up bore wells after filling of the wells with pebbles and river sand. There should be an effective arrangement for desalting before diverting the water into these wells. There are 3 main Design Concepts of RWH displayed at the Rain Centre. There are 3 main Design Concepts of RWH displayed at the Rain Centre.

Design 1. Roof water harvesting.

Step 1. *Roof water collection*: Clean the roof first. Avoid keeping chemicals and other harmful materials. If there are nearby trees, clear the fallen leaves everyday particularly during the rainy season. The roof on top of the rain Centre is 1,400 sq.feet and 1 inch of rain can collect\ 3,265 litres. (1 cubic foot is about 28 litres).

Step 2. *Drainpipe brings the water down*: There are 3 drainpipes that bring the roof water down at the Rain Centre. These drainpipes are typically 3‖ diameter in size and capable of 6 Kg of water pressure. It costs about Rs 50 per feet installed (material+ labour).

Step 3. *First-flush*: The first few litres of collected water when it starts raining may contain leaves and other contaminants. We try not to use this water. Once this section of the pipe is full, the excess overflows to the filter

Step 4. *Filter:* The filter chamber is filled upto 1/3 its volume with 2 layers of pebbles with coarse river sand in between. After this filter, the water flows to the sump. Each drainpipe may have its own filter chamber or a group of drainpipes may share a filter chamber. Cost about Rs 750

Step 5. *Sump:* Water from the filter chamber flows to the sump. Sump stores water for immediate consumption. In Chennai, sump construction costs in the range of Rs 3.5 to 4 per litre of water storage. With an existing motor you can pump this water to the overhead tank. Given the rainfall pattern in Chennai, you cannot design a sump large enough to hold water for the entire year. Most of the houses/flats in Chennai will have sumps for collecting Municipal water.

Step 6. *Well:* The harvested water that overflows the sump is taken to the well, which percolates to the underground Rain Centre by Akash Ganga Trust and CSE

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Step 6. *Well:* The harvested water that overflows the sump is taken to the well, which percolates to the underground. Rain Centre by Akash Ganga Trust and CSE

Design 2. Surface water harvesting

All the rainwater that falls around the house in open spaces can be harvested. Most house pavements are designed to flow the water away from the house. If your house surface area is covered with cement pavement, do not despair. We

can collect all the water at the gate and recharge the underground.

Step 1. *Collect*: At the Rain Centre, the surface water flows to the gate. There is 3.5 feet long, 1 feet deep gutter with a reinforced concrete slab with holes. Inside the gutter there are pebbles. The cost of this gutter costs about Rs 600 per foot. A small bump on the roadside just next to the gutter can make sure that no water flows to the street.

Step 2. *Recharging well*: Water from the gate gutter is taken to the recharge well. The recharge well is 3 feet in diameter, 10 feet in depth. The purpose of the recharge well is to collect the vast amount of water collected quickly when it rains. The depth of the recharge well corresponds with the depth of the clay soil layer. There is no filter media inside the recharge well. If you already have a working well, try to direct the water from the gate to the well. The recharge well at the centre cost around Rs 400 per 1 foot of depth.

Step 3. *Percolation pit*: Percolation pit is used if enough space for a recharge well does not exist. The percolation pit is about 2' X 2' X 2'. There is a bore well with a PVC pipe of 6|| diameter and 10 feet depth. In a large house, you can put a number of percolation pits all around house. The percolation pit at the center cost Rs 1,500.

Design 3. Loft tank using roof water harvesting:

A third design at the Rain Centre demonstrates how rain water could be used for immediate consumption. In this design, the harvested roof water is stored a plastic loft tank and the water is piped into the house.

Step 1. *Roof water harvesting using a drain pipe*

Step 2. *First flush:* The first few litres of collected water when it starts raining may contain leaves and other contaminants. We try not to use this water. Once this section of the pipe is full, the excess overflows to the filter. After the rain is over, we open the valve at the bottom of the first-flush and release the accumulated water in this pipe.

Step 3. *Loft tank*: The loft tank is located at the first-floor level. Water collected in this tank is used directly in the house using existing plumbing. The loft tank is made of PVC with a capacity of 200 litres. This particular loft tank costs about Rs 800. Water used for drinking and cooking must be boiled. Water supplied to the bathroom and toilets are used directly. A side benefit of rainwater is that it is soft water and hence will use less soap for cleaning purposes.

4. CONCLUSION

In conclusion, we determined that solar energy is the right energy option for our Zero Energy Project in terms of energy savings and cost effectiveness.

The aim of a modern building and property design is to use energy more efficiently and to reduce a building's detrimental effect on the environment. One key green-building goal of sufficiently or dramatically lowering energy consumption and carbon pollution over the building's lifespan is accomplished by zero energy buildings. Thus, this paper provides a simple idea of how to plan a zero-energy building and its energy conservation for the productive use of energies from the different green resources used in this building. As a consequence, zero-energy houses are the potential eco-house. Many pollution concerns are alleviated by low-energy buildings and zero carbon emissions.

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