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RENEWABLE ENERGY TECHNOLOGIES IN HEALTHCARE INSTITUTIONS

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ABSTRACT
This research paper aims at providing a better insight towards the energy efficient healthcare institutions. And it also gives insights towards government policies as well as the advantages of using these technologies over the conventional ones. Then, we gaze into the energy usage of a 100 bed hospital with ideal equipments. After analyzing the data of the usage, kind of wastage and the economic viability, we come across the practicability of using alternative clean or renewable energy technologies. The cost benefit analysis, the plans to reduce energy wastages and carbon footprints were also mentioned. In the recommend section, village adoption schemes and new technologies to ease the energy business process were also revealed.

KEYWORDS: *Renewable energy, Solar rooftops, Energy policies*

1. INTRODUCTION
It is known that the healthcare industries use a huge amount of energy and it is also very obvious that they play a major role in carbon emissions too. Each and every hospital is depending upon electric supply to run their medical diagnostic instruments as well as other allied devices. Many common pieces like MRI machines, CT scanners and 24/7 air conditioning devices uses significant amount of energy. The conversion of healthcare institution's conventional energy resources to non-conventional energy or renewable energy resource will reduce the environment footprints effectively.

2. OBJECTIVE
- Identifying the nature of energy consumptions and carbon emissions in the healthcare institutions.
- Discussion on reducing carbon footprints of health care institutions
- Estimate the economic practicability of installing alternative clean or renewable energy technologies.
- Brings up solutions for addressing the current flaws

3. DISCUSSION AND RESULTS
3.1. Current Issues in adopting Renewable Energy Technologies
Major sources of renewable energy are solar, wind and tidal. In these three other than solar, rest of the sources majorly depend upon geographical characters. In solar, the space crunch of the land resources emerged as a major problem. Also the centralized grid approach made the problem of net metering and the selling of electricity worse. The cost and viability of storage devices as well as the huge amount of capital cost robbed the popularity of renewable energy resources. In healthcare institutions, the space crisis to implant solar panels continues as a predicament.

As the output power from the solar panels are deeply depend upon sunshine availability, the storage mechanisms plays an important role in maintaining the electric power in nights or in cloudy days. Considering the inverter scenario, a 100 kW inverter should have approximately 1000Kgs. Normal hospital buildings are not capable with placing this heavy machine in the top floor, and so the ground floor implementation of this device results in energy

loss due to transmission cables length. Since the hospitals are always in need of powering a life-saving equipment. The solar alone won't be suitable to address the demand and so, it should always in conjunction with another source of power like diesel generator or some batteries.

4. CURRENT POWER SOURCES AND CARBON EMISSIONS

Most of the hospitals are depending upon the diesel generators for the uninterrupted power supply. When we calculate the carbon emissions with diesel usage, every 5L of diesel fuel contains 3500 grams of pure carbon. Every gram of atomic carbon, when oxidized with oxygen, forms 3.666 grams of carbon dioxide. In an average liquid hydrocarbon-burning engine, it can be assumed that about 99 percent of the fuel will oxidize. Therefore, we can multiply the amount of carbon per 5L of diesel by the ratio of carbon weight to CO2 weight by 99 percent.

3500 g x 3.66 x 0.99 = 12681.9 g.

5L of diesel fuel produces, on average, 12681.9 g of CO2, or about 27.9 lb.

So a diesel generator in a healthcare institution uses 30L of diesel fuel in a day,

6 x 12681.9 g of CO2, or about 27.9 lb= 76.09 kg

And so, it'll be producing 76.09 kg hydrocarbons per day (IEEE, 2019).

5. FEASIBILITY OF INSTALLING SOLAR POWER PLANTS IN HEALTHCARE INSTITUTIONS

To reduce and transform the healthcare institutions carbon footprints and conventional energy resources utilization, a wide installation of solar panels would be a solution. The geographical position around the Tropic of Cancer makes the sunshine availability of Kerala, India, a suitable place to install solar plants. But the land availability remains a concern for all. Since, healthcare institutions are unlikely to have the space or resources to build hydro plants or wind farms, an organized arrangement of solar panels over the roofs emerged as a viable alternate. 300 or more days of sunshine availability virtually guarantees better productivity throughout the year.

6. CLEAN ENERGY TECHNOLOGIES TO ENSURE LAST MILE HEALTH FACILITIES

The primary health centers (PHC) play an imperative role in maintaining the health of rural India. But the power supply remains a problem to run these health centers. Lack of uninterrupted power supply deprives the medical storage facilities, and so the inadequate medicines to address the emergency or epidemic prone situation in a village make the situation worse. Additionally the study conducted by the government points out that solar-powered PHCs admitted 60% more patients and conducted twice as many child deliveries in a month compared to the PHCs which lacked a solar power system. Also, nearly 90% of the PHCs with solar power systems reported savings on their energy expenditure, and about 25% depended exclusively upon solar power for critical equipment needing round-the-clock supply (ETHealthworld.com, 2019). In view of the cost, a 1kW rooftop solar plants costs around 1lakh INR, with an average direct normal irradiance (DNI) produces 4-5kWh.

7. ECONOMIC VIABILITY OF INSTALLING CLEAN TECHNOLOGY DEVICES IN HEALTHCARE INSTITUTIONS

It is important to look up the fiscal practicability of installing clean energy devices. In order to maintain a sustainable business model, every investment should be scrutinized. As most of the solar panels have a life span of more than 15 years, the investments return ratio relics a high number. Here is the example of a cost-effective analysis of solar water heating system in a 100 bed hospital.

Analysis for the Solar water heating systems for 100 bed hospital

Patients on an average = 100. Assuming an average usage of 20 L of hot water per day. Thus daily amount of hot water needed = 100x20 = 2000 L

An average flat plate collector area of 2 m^2 gives 125L of hot water per day. So, total collector area required = 2000/125x2 = 32 m^2

Keeping the cost of installation to be around 10,000 Rs/m^2 . Total capital cost = 320,000 Rs. A 100 bed hospital normally has 10 geysers and its usage will be around 2 hours

Energy consumed by a 3 kW geysers in a year = 2x3x365= 2190 kWh. Total energy consumed by the geyser= 2190 x 10= 21900kWh

1kWh consumption cost will be around 5-8 Rs. So, Cost of 1 year = 21900kWh x 7Rs = 153,300 Rs

Hence, payback period = 320,000 / 153,300 = 2.08 years.The above calculations clearly say, it is worthwhile to install solar heaters instead of electric heaters.

8. SCHEMES AND POLICIES TO BOOST RENEWABLE ENERGY TECHNOLOGIES

The Ministry of New and Renewable Energy (MNRE) subsidy scheme provide financial assistance through capital or interest subsidy. The rate of subsidies are depend upon several factors (Solar Mango, 2019

Table 1- MNRE subsidy schemes

No.	Category	Maximum capacity	System with battery backup	System without battery backup	Interest Subsidy
1	Individuals for all applications	1kWp	Rs.51/watt or 30% of project cost whichever is less	Rs.30/watt or 30% of projectcost whichever is less	Soft loans @5% p.a.
2	Individuals for Irrigation, & community drinking water applications	5 kWp	Rs.51/watt or 30% of project cost whichever is less	Rs.30/watt or 30% of project cost whichever is less	Soft loans @5% p.a.
3	Non-commercial/ commercial/industrial applications	100 kWp	Rs.51/watt or 30% of project cost whichever is less	Rs.30/watt or 30% of project cost whichever is less	Soft loans @5% p.a
4	Non-commercial/ commercial/industrial mini-grids	250 kWp	Rs.90/watt or 30% of project cost whichever is less		Soft loans @5% p.a

8.1. Kerala State Electricity Board (KSEB) policies to boost Renewable Energy

Keeping the significance of using non-conventional energy sources, the KSEB came up with two options. Either land owner can set up the plant with his/her own capital and can sell the power to KSEB. If owner is not interested, KSEB will setup the plant and share 10% of the power generated from the plant with the land owner (B.Kumar, 2019).

9. RECOMMENDATIONS

9.1. Village Adoption Scheme

From the above discussions, we found that space remains a major problem to healthcare institutions. To overcome this, we propose a new scheme called village adoption. In this hospitals can adopt a village which doesn't have any electricity or using conventional sources as their primary energy supply and transform that village to a solar, wind, small hydro or tidal one (according to the geographical advantages). The electricity produced by these renewable energy sources can equalizes the usage of hospitals non-conventional energy resources. In an economical perspective the hospitals can earn money from the villagers and so the healthcare institutions can pay their electricity bill, or the corporate social responsibility will be an option too. In environment perspective, the carbon emission neutrality can be achieved through production of energy through clean energy technologies.

9.2. Hybrid Inverter or Bidirectional Inverter

Considering the fact of diesel usage, by placing a hybrid inverter in the roof top solar PV system, the solar plant can incorporate diesel generator. It will drastically reduces the diesel cost and hence the carbon emissions due to that so.

9.3. New Technologies and Renewable Energy

The centralized grid approach denies the flexibility of selling electricity on a large scale. And the renewable energy certificates (REC) are available and limited to grid-connected projects and the transaction of 1MWh or above. These all reduces the monetary attraction towards renewable energy technologies. The integration of current technologies like block chain and will reduce the complexity and it may help to increase the investments in the clean energy field

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