Implementation of Industry 4.0 in the Energy Sector

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***Abstract*— The paper sheds light on the many difficulties that humans have long encountered as well as any that may arise in the near future. Poor sanitation facilities are one of the main causes of malnutrition and it leads to a number of illnesses, which indirectly impacts other sectors. Excessive use of resources that are not renewable is another issue. There is a lot of energy resource waste; for example, street lights in cities and on highways are often left on during the day, which is a complete energy waste. As all aware that these resources are about to run out. Therefore, we require alternative energy sources, such as renewable energy like wind, solar power, and others. Future times may witness an increase in the usage of electric vehicles, therefore we should develop some clever ways to fulfill their needs. Through innovative technologies like IoT, we should utilize energy efficiently.**
IIoT aims to automate system-based monitoring and control of devices. This energy technology, known as a smart power grid, nano grid can regulate the pace and flow of energy based on needs.

Keywords—Internet of things, Industrial Internet of things, smart grids, nano grids solar energy, Electronic vehicles

I. INTRODUCTION

India is one of the leading countries in tourism, where millions of people come as tourists to visit the most popular destinations in the world. India is known for its natural and cultural heritage. Almost all the major cities are connected via National highways and state highways. In the year 2013, national highways account for roughly 2-3% of India's overall road network but carried out 40 percent of all road traffic. [1] The roads have become more accessible resulting in increasing highway road traffic.

The travel and tourism sector contributes almost 5.8 percent of the total GDP of India, which is very less compared to other developed countries; due to a lack of facilities, amenities, poor infrastructure, and sanitation facilities, etc. travel, and tourism sector is not flourishing, and also a lot of tourist destinations are getting destroyed

For mitigating the above-stated problems and to generate more revenue we must adopt Industry 4.0 technologies such as solar-powered lights, smart power grids, IoT-based EV-charging stations, etc. One of the main problems faced by tourists in India is sanitation facilities as there are no proper restrooms even on the toll plazas and fueling stations. In this aspect tourists face a lot of difficulties, hence they choose inappropriate ways. Except in some cities and towns, the condition is the same everywhere around India. Especially on the highways, there are very few restrooms. The state government of Kerala has come up with an initiative to construct 12000 public toilets along the roadside of National highways [2] By implementing the IIoT 4.0 technologies to this initiative could possibly conserve energy and also could be economic.

In the near future when the usage of EVs will increase, more charging stations should be setup so these solar-powered or smart power grid-based toilets can be used as charging stations. A multipurpose station where people can use the toilets and also charge their vehicles. Hence it could be a step to generate profitable revenue.

II. LITERATURE SURVEY

Self-Contained Solar-Powered Toilet

A self-cleaning, solar-powered toilet that can turn human waste into hydrogen and fertilizer It is a computerized loo that is affordably priced and could inspire the development of more effective sanitation systems. This toilet turns solid waste into fertilizer using solar-powered panels that fuel an electrochemical reactor. Fuel cells may then be filled with hydrogen to power the reactor when there is little sunlight. A storage tank atop the toilet receives clean, recycled water through a pump. The toilet may function without power. The device treats wastewater for a period of three to four hours. [3]

The iot in Energy(Renewable Energy)

While the cost of the necessary technology is declining, society's need for energy from renewable sources is rising. Therefore, it is projected that the use of clean energy for the generation of electrical energy would grow. However, this use strains the existing electrical grid infrastructure.
It lowers building-related emissions by using renewable energy. Additionally, the utility may experience lower demand periods and avoid making significant investments in new production and transmission. The fact both solar and wind power are not simply for buildings should be noted. Large-scale solar and wind energy facilities are also being built by utilities to enhance their existing power assets. [4]

Technologies used for using energy efficiently

Smart Power-grids: An electrical energy network that relies on digital and other cutting-edge technology to monitor and regulate the transmission of power from all kinds of sources in order to fulfill the various electricity needs of end consumers is referred to as a "smart grid." [5]
Nano-grids: A nano-grid is smaller than a microgrid and is typically utilized in single-family homes or similar small structures. Batteries are often used for storage, and on-site "grid" components and solar PV is usually employed for generating. Due to their larger scale, micro-grids may be employed in large campuses and buildings. They are sometimes used to combine generating and storage technologies (such as solar photovoltaic, wind, and energy producers). Grids have to be placed in a specific area, away from structures. It supplies numerous structures with electricity and storage. [4]

Vehicles with a plug-in charger

Due to electric vehicles, the electric system is undergoing significant change. Overall EV usage is expected to increase from the present one percent of the light-duty fleet throughout the world to seven percent before 2030 and thirty-three percent before 2040. The problems and opportunities of structures and the electrical system are defined by EVs. EVs are considered to be a significant factor in the increase in the demand for electrical energy overall, according to the grid. Since they strive to sell less electrical energy, utilities may regard an electrified transport sector more favorably as a benefit to their business model. Owners of electric vehicles (EVs) desire to create ways to charge their vehicles at home, at work, and in public areas from the standpoint of the building.

Need for smart street lighting system

Almost all locations are connected by roads and have access to power; as a result, street lights in urban, rural, and highway areas are always on, even when not in use. As a result, there is considerable energy waste. The following design for a street light setup that consumes less energy is suggested in this study. The following elements make up the design: redesigned regulating center, and roadway lighting with numerous low-power, brilliant LED lights with quick responses, and low-power sensors, street poles with solar panels, batteries for the storage of energy, a smart grid, and a database server. [8]

Maintaining sanitation/hygiene

We have to listen to the call of the body. However, it might be difficult to locate a clean public bathroom in India, whether you're in a metropolis or the countryside. Either you have to wait till the individual finds a decent loo, or you have to put up with the person having a horrible experience in a public loo. Since there aren't any clean public restrooms, women are more likely to get urinary tract infections in addition to physical and sexual assaults.

TABLE I COMPARATIVE STUDY

Title	Advantage	Disadvantage
Industrial Internet of Things application in the clean energy sector	• For technologically based industries, the IIoT may greatly enhance connection, effectiveness, adaptability, and time and cost savings. • The transmission of energy collected by solar panels inside a micro grid can be regulated by an IoT-dependent control system. • This technology enhances the amount of solar radiation absorbed and aids in maintaining the system's adaptability as well as durability in the case of faults. • The traditional grid's dependability, protection, scalability, and stability can all be enhanced by deploying smart grid technology. • Energy wastage is reduced and electrical energy use can be optimized through smart grid. • Micro grids make it feasible to use clean renewable energy. • Through the use of reasonably small neighborhood generators, solar panels, wind turbines, and other sources of energy, community groups and commercial campuses may quickly and economically expand their total electrical energy delivery with the help of smart microgrids.	• Solar power plant energy generation is uncertain due to fluctuations and changes in radiation from the sun. Therefore, more remote monitoring is needed. • The thermal power plants in the current electrical grid are only approximately 30 – 40% productive and significantly contribute to the emissions of carbon and other pollutants. • The electrical energy poses hazard to the building's tenants, callers, and employees. • The smart grid also has a significant issue with interoperability. •As we add unusual and intermittent energy supply to this system, we face uncertainty from both the demand side and the expansion of renewable energy on the other side. • Fossil fuel generators, such as coal power plants, have been restored back to maintain steady electricity distribution so as

		to keep up for a lax generation.
https://sustainablebrands .com/read/products-and-design/self-contained-solar-powered-toilet-could -transform-sanitation-in-developing-world	• Waste breaks down into solids that can be used as fertilizers. • Self-contained (no sewer connection required) • Wastewater is cleaned up by the system in a period of three to four hours.	• Production cost is high • Need remote monitoring. • Not yet fully automated. In case of a breakdown, local technicians are needed.
https://www.thebetterindia.com/122372/solar-self-cleaning-toilets-eram-scientific-sanitation-un-india/	• Innovative, easy-to-operate. • Before and after each use, the e-toilet flushes by itself. • Minimal utilization of water • Provisions for waste treatment using anaerobic biodegradation. • Pretty cost-effective • Inside the restrooms, a coin-operated sanitary napkin vending machine.	• Less employability due to automation. • Regular maintenance and monitoring
Smart Grid and Adaptive Street Light Design	• The LED's intensity will be regulated based on visibility conditions and weather. • Switching off of lights in no traffic area. • A smart grid incorporates more energy-efficient techniques and decreases product ion of energy.	• To put the theory into practice, an intelligent street light pole with several sensors is needed. • Results are limited to area of 1km distance. • Skilled workers to implement this technology driven setup.

III.PROPOSED SYSTEM

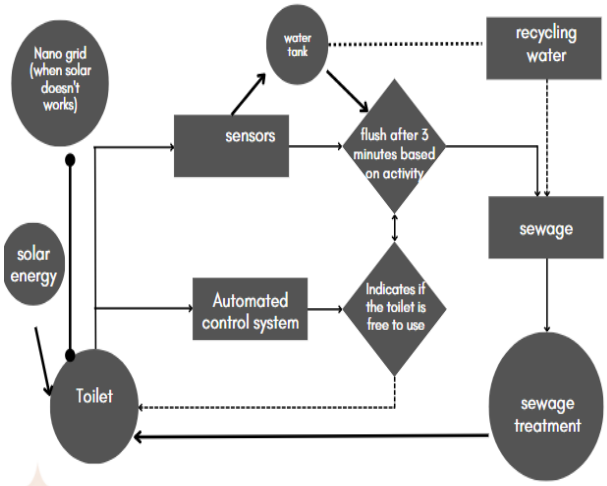

Fig 1 – Self -contained solar powered toilet system

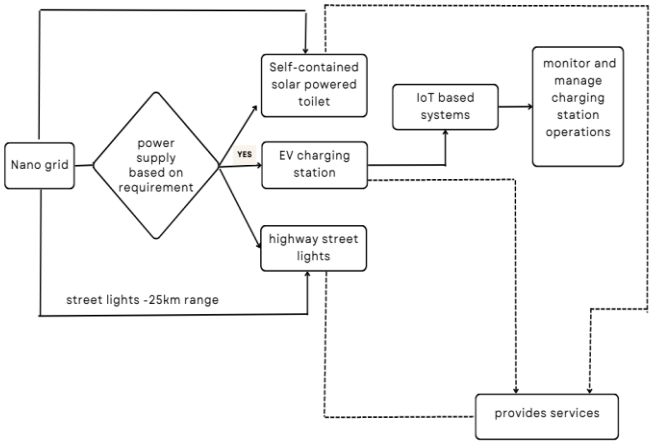

Fig 2 – Multipurpose station

India is the country with the highest population in the world, and to initiate and implement even the small schemes by the government is ambiguous. To make this approach sustainable we must implement it along with some government schemes like [2]. Each restroom should be set up 25 km successively along the roadside highways.

Each of the restrooms mentioned in fig.1, will be self-contained solar-powered toilets, which promises to be eco-friendly in many aspects of conserving energy, limited usage of water, and fewer emissions. These toilets have automated control systems, sensor-based water flushing, and self-cleaning systems. Even if people use the toilet and forget to flush, it will automatically flush it and keep the restroom hygienic. After the usage based on the activities after 3-4 minutes flushing and cleaning of the floor will start, this can be done manually as well using the buttons present inside the restroom. Toilets have an inbuilt water tank and all the sewage is collected and treated in sewage treatment plants. To perform all these complex tasks energy is required, in day time solar energy is utilized, and backup batteries are used if

necessary. But during the night time and especially during the rainy season, there's not much sunshine because of it solar may not work efficiently in this case the energy supply can be provided using smart power Nano grids, which are set up near every Toilet. Smart Power Grid and Nano Grid

Smart Grid systems were in development stages in recent years. An electrical network known as a "smart grid" combines cutting-edge technology like the Internet of Things (IoT) and others to monitor and control the flow of power from electricity-producing stations depending on consumer needs of the energy supplied. It reduces the wastage of electricity when not required. Smart Grids are environmentally friendly and also the cost of electricity can be minimized. Recently, the use of EVs in India has increased, according to research, it will rise from one percent of the world's light-duty fleet now to seven percent by 2030, and thirty-three percent by 2040. [4]. more usage requires more energy. EVs are not meant for long drives they need to get charged after a certain limit which differs for every EV.

A junction mentioned in fig.2. consisting of Public toilets and an EV charging station and smart highway street lights should be set up where people can use the toilets as well as charge their vehicles. The electric vehicle station is a very important part of the electrical grid. The notable thing about this charging station is that it should be capable of handling emergency situations as well as minimizing waste of energy. The Industrial Internet of Things is playing important role in electrical vehicle charging stations. It helps in connecting the devices and systems in real-time. Using this technology, it can monitor the charging status and send notifications to the users when the charge is full which will help in avoiding extra billing and saving energy as well. It can track what is energy requirements and usage patterns. We can power the street lights along the highway roads up to 25 km range by using 1 grid.

In this case, Nano grids are useful. Each of the stations consisting of Solar powered toilets and EV charging stations and street lights will be connected and based on the requirements the energy can be drawn.

IV.CONCLUSION

The use of solar-powered toilets incorporating IIoT 4.0 will result in reduced energy consumption using it we turn the solid waste into fertilizers and also recycle the water and reuse it again, this saves a lot of energy and water. It brings a positive impact on the environment as it will use less nonrenewable energy and hence there are no emissions of pollutants.

A multipurpose station consisting of a solar-powered public toilet and an Electrical vehicle charging station will help to mitigate sanitation and vehicle charging problems and electricity wastage. People can charge their vehicles in the dedicated stations which will be available every 25 km. thus reducing the waiting time at a particular station. A smart power nano grid supplies electricity to the charging station and also if required to the solar toilet. By connecting the street lights to the nano grid we can lower consumption of electricity. This grid minimizes cost and environmental impacts and maximizes stability, reliability, and flexibility.

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