

## РОЛЬ ИНТЕРНЕТА ВЕЩЕЙ В ВОЗОБНОВЛЯЕМЫХ ЭНЕРГЕТИЧЕСКИХ РЕСУРСАХ

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***Abstract.**As the notion of smart cities progresses from concept to development, it becomes a reality. Energy and electrical power flow must be resilient, reliable, efficient, and seamless in order to energize and power smart city services such as smart hospitals, smart buildings, smart factories, and smart traffic and transportation. Smart energy and electrical power networks, which are considered among the most crucial pillars for such cities, are intended to keep all of these smart services running without disruptions. The Internet of Things (IoT) and cloud computing play a critical role in keeping smart city services linked and in sync. The role of the Internet of Things in the integration of renewable energy supplies into the power grid is discussed in this paper.*

***Keywords:** Internet of Thing; smart grid; smart energy; smart cities; renewable energy.*

## THE ROLE OF THE INTERNET OF THINGS IN RENEWABLE ENERGY RESOURCES

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*among the most crucial pillars for such cities, are intended to keep all of these smart services running without disruptions. The Internet of Things (IoT) and cloud computing play a critical role in keeping smart city services linked and in sync. The role of the Internet of Things in the integration of renewable energy supplies into the power grid is discussed in this paper.*

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Sensors that are attached to generation, transmission, and distribution equipment are used in IoT applications in renewable energy production. Companies can use these devices to remotely monitor and control the operation of equipment. This lessens our reliance on already finite fossil fuels while also lowering operational costs. Renewable energy sources already have a number of advantages over traditional energy sources. We will be able to use these renewable energy sources to a greater extent as a result of the adoption of IoT [1]. In this paper we will analyze the benefits of using IoT in renewable energy solutions, for instance, Automation (A smart IoT solution enables to implement automated control to improve efficiency), Cost-efficiency (IoT in renewable energy solution can substantially cut down on monthly electricity bill), Grid Management (IoT not only enables the inclusion of more distributed resources into the grid but also improves grid energy), Distributed System (Sensors can help in the monitoring of a large number of points in a distributed system), Residential Solution [2] (With the aid of IoT devices, citizens can generate “green energy” in their backyards to meet their household needs), Internet of Things Concepts and Challenges faced in implementing IoT in renewable energy [3].

### **I. Automation and cost efficiency.**

When it comes to utilizing renewable energy, efficiency has proven to be a big roadblock. This is especially true for approaches that rely on intermittent resources such as wind and solar power. With a smart IoT system, automated controls can be implemented to boost efficiency with these electricity generation processes.

Energy from renewable resources can be utilized with optimum efficiency with the help of these controls. An Internet of Things device can assist in detecting the best circumstances for energy generation. To get maximum production, the equipment can be changed as necessary. The main advantage of IoT devices is that they generate data in real time, reducing any potential waste. The usage of IoT devices for monitoring and efficient operation of wind turbines is a great example of automation using renewable energy. By evaluating the data collected by IoT sensors, the orientation of the wind turbine may be changed to achieve optimal efficiency. Solar power use is an example of a similar application. Solar panels can be angled so that they are perpendicular to the energy source. This allows for the most efficient use of solar energy.[4] To maximize electricity output, these modifications can be made manually or automatically. The power plant can operate more efficiently with automated controls. This increases power output while simultaneously lowering running expenses and improving safety standards.

The internet of things offers good tools for power consumption monitoring. IoT technology can give utility businesses and electrical suppliers unparalleled control over their resources. This, in turn, supplies firms with useful information to help them make data-driven business decisions. Using IoT-generated data, power distribution firms may evaluate and analyze users' power consumption trends. Utilities can adjust their supply to meet consumer demand [5]. As a result, businesses are able to reduce their electricity waste and save a significant amount of money. By implementing IoT solutions in renewable energy power generation, utility companies can reduce their input costs. Businesses, as well as the average person, can significantly reduce their monthly electricity expenditures.

## **II. Grid management**

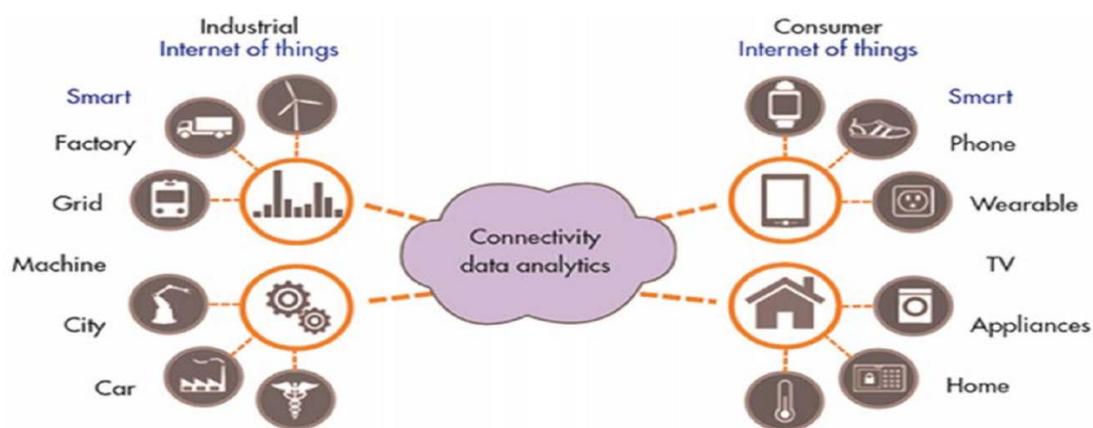
Integration of IoT technology not only allows for the addition of new equipment to the grid, but it also enhances grid management overall. Companies can acquire real-time power consumption data by installing sensors at substations and along distribution lines. This data can help energy businesses make better judgments about voltage regulation, load switching, and network layout. Grid sensors can also

help operators receive real-time notifications about disruptions. Workers can swiftly switch off power to damaged wires since real-time data is available. This minimizes the risk of electrocution, wildfires, and other dangers. Some of these decisions can even be automated via the Internet of Things. An automated system outperforms a human-controlled system. Smart switches can automatically isolate trouble regions in the event of a power outage. IoT devices can swiftly redirect power to turn on the lights [6]. As a result, time and human resources are both saved. Data on power use can also be used to predict load. Overloads on transmission lines can be managed with the help of IoT. They assist in ensuring that all power plants meet frequency and voltage control criteria. This data on energy use can also assist businesses in determining where new infrastructure should be built or existing equipment should be upgraded.

### **III. Distributed system and residential solution.**

Due to an increase in business and residential use, the smart energy grid is developing. For energy corporations, this increasingly dispersed power system signals a significant shift. They must now manage an increasing number of tiny generators spread around the grid in addition to their primary units. IoT allows for easy monitoring of these widely dispersed smart grids. Sensors positioned at numerous locations in the manufacturing and transmission stages can aid in the monitoring of a large number of points [7]. They may utilize this data to identify waste and, in particular, power-hungry appliances, which can help them save money on their energy bills. Other IoT devices, such as thermostats, can automatically optimize their functioning to save energy based on their surroundings [8].

**Internet of things concepts and challenges faced in implementing IoT in renewable energy.**



**Fig.1.** Internet of Things classifications.

Although there are numerous advantages to using IoT in renewable energy generation, it is not without its problems and obstacles. The initial investment cost is one of the biggest challenges in using IoT in renewable energy. Although the cost of renewable energy technology has decreased dramatically in recent years, it is still prohibitively expensive. The principal investment costs associated with renewable energy-dependent operations are increased by upgrading the grid with various IoT sensors, data storage, and monitoring devices. According to the current trend, if prices drop significantly in the future, IoT-enabled energy generation equipment will be widely adopted. Another issue with using IoT devices is that they are susceptible to hacking. Because the devices are connected to a network, a cyber attack is a possibility if the network is not sufficiently secured. This can put electricity companies and residents in a dangerous and undesirable situation. To counter any potential grid attack, a secure mechanism must be implemented.

#### **IV. Conclusion**

This paper proposed analyses of Internet of Thing in renewable energy, its benefits and challenges faced in implementing IoT in renewable energy. Also it provides information about Internet of Things concepts.

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