

# An Exploration Of Industrial Utility Monitoring Technologies For Energy Usage

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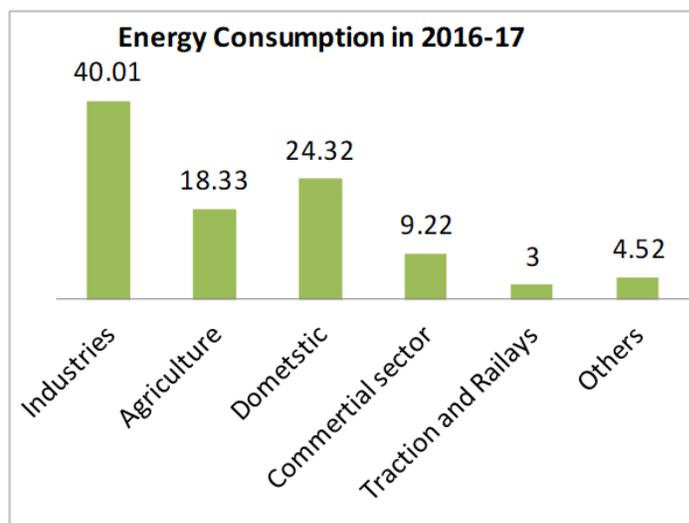
**Abstract:** Utility consumption is the most important part for each unit of all industries. It helps to improve the production efficiency of industry. Controlled electricity use is one of the biggest challenges in this sector. This paper presents the exploration of the monitoring and control systems for all electricity consuming appliances. We have chosen the best monitoring system of energy management in industrial, commercial and domestic areas by comparing different technologies. Efficient use of system Application helps in reducing electricity consumption and carbon emission at work station. Industries do their annual audit on a regular basis for energy use. Energy consumption of the company in the industrial area gets measured. The energy audit is having a key role in finding large electricity consumption areas. This still does not have the proper solution for energy monitoring. This audit does provide information about potential areas, where industrialist needs to concentrate and reduce its energy consumption. Internet of Things (IoT) is introducing new age to monitoring and controlling many sensors remotely. All system control activities, products, and utilities of the industry can be remotely monitored using an IoT.

**Index Terms:** Utility Consumption, Sectors, Energy consumption Audit, Monitoring Applications, IoT, Remote monitoring.

## 1 INTRODUCTION

THE audit of energy source in the industry is very crucial study; this helps industries to step up in energy management program. This will work to find different opportunities to conserves energy sources. This audit should know about the management person in the industry to know about energy waste, product cost, and efficiency time to reduce these energy consuming products. The energy management is always going schematically from controlling the structural energy of the building. This can reduce the power and cost by using the location and climate factor. The timing functions are also another factor for energy consumption. Monitoring electricity is the first approach parameter in any energy audit/management. The monitoring sensor implementation is the first step in this approach. This will give the actual parameter, which attracts the energy consumption. It is responsible to determine and think about the solution after having energy consumption parameters. As energy is concern with the electricity, so electricity is the first parameter we will think about. Electricity is measured in (KWh) and (MWh) on the electricity bill. We need to install measurement systems at different places separate for each on work station for actively analysis of electricity consumption. Finally, we need to decide the particular measurement time to check and calculate parameters. Most probably we can take a weekly check from the report. Any increase in energy consumption should measure carefully. A small monitoring level should be analyzed if the monitoring level gets unexpected results in the consumption of energy. Electricity management is a very well managed algorithm. This algorithm systematically arranges and controls the total consumption of energy. This management is important to reduce the product cost, reduce emissions, to prevent waste of electricity. Three different aspects should be analyzed like when amplitude has lower data points that mean consumption in short equipment like motor operations in empty condition. A higher data point

means power loss in lighting, transformer, functions. According to India's Energy Statistics in 2018, National Statistical Organization (NSO) of India has given an amount of electricity consumption, which has increased by 58% as compared in 2016-17. In year 2016-17 According to the total use of power, the Industrial sector uses the major amount (40.01%). Residential uses (24.32%). Agriculture consumes (18.33%) and commercial sectors (9.22%). From 2008-17 electricity supply increased from 6,89,780 GWh to 11,68,317 GWh. Thus recording Compound Annual Growth Rate (CAGR) is 5.41% during this period. Expected energy use increases by up to 76% by 2030. As a large demand for electricity will come from domestic areas in India [8].



**Fig. 1.** Graph of Consumption of Energy in Different area [6]

Electricity use in domestic household buildings consumes more power. Increase in a population and urbanization result in increasing demand for electricity [7]. This energy is used to control the climate of building using electronic appliances. In other areas, some of the consumption of energy is for the same purposes, like buildings in industrial, agriculture, railways, commercial sector. Electricity gets to use in the domestic household by many appliances like Lighting, Air conditioning, Fans, Refrigerator, T.V. are the commonly installed appliances.

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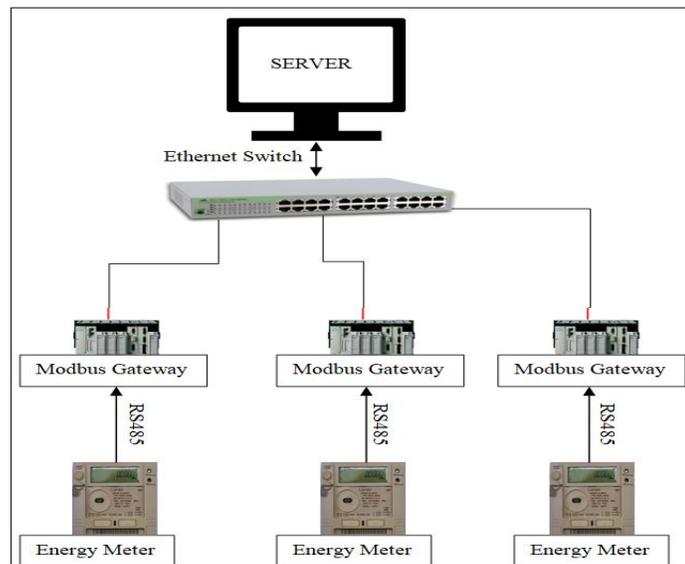
The other than the above equipment includes oven, bread toaster, induction, Personal Computers, charger, etc.

**TABLE 1**  
**ENERGY USE IN DOMESTIC BUILDING [7]**

Sr. No	Electricity Usage in Domestic Building	
1	Laminations	28%
2	AC(Air conditioning)	7%
3	Fans and coolers	34%
4	Refrigerator	13%
5	T.V.(Television)	4%

## 2 ENERGY MONITORING SYSTEM

Industry uses energy monitoring applications for monitoring purposes. Indian industries are widely attracted to the IoT based energy monitoring system. Because this application will show you some of the periodical energy graphs according to the given condition for a given interval. There are many types of system and sensors which helps in monitoring of energy. Some of them are PLC based monitoring system, Controller based monitoring system, Sensor-based monitoring system, and GSM based monitoring system. Most of the energy monitoring system is based on PLC technology. Energy meter will give data in RS485 data formats, which can read data from desktop application.

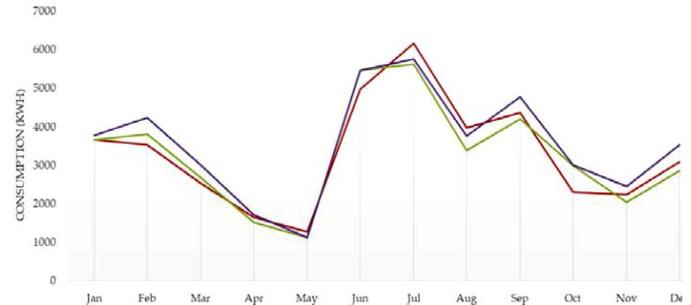


**Fig. 2. System diagram Electronics monitoring system [19]**

As shown in Figure 3 diagram gives the flow diagram of the system information transmission and connection diagram. EMS (Electricity Monitoring System) components are following –

1. Digital Energy Meter: These are specially manufactured meters of industrial purpose. Its micro-processing units can calculate different parameters of energy parameters like amps, watt, volts, etc. This can store and transfer this record throw Modbus and Serial data transmission protocols to get the values of the parameters.
2. Data Logging: This part allows electricity meter to store or record data over the server or can communicate remotely to share the data.
3. Software Application: This monitoring algorithm code will take the data from an energy meter. Using that data consumer or supplier can monitor, plot graph and

prepares breakdown report by transferring data using RS485 from this software for future use.



**Fig. 4. Representation of data [5]**

Figure 4 shows the digital graphical chart, which represents the different energy parameters and values from the energy meter for every month. Shown values are calculated by energy meter throw its embedded unit. Software applications are used only for logging data and showing those graphs.

## 3 SYSTEM TECHNOLOGIES

As the internet technologies are growing and spreading, the existing systems for energy monitoring are getting replaced with new monitoring systems based on IoT technologies. Toshiba company announced a concept of new energy control and monitoring systems in 1999, which includes Supervisory Control And Data Acquisition Systems (SCADA), Energy Management Systems (EMS), and Distribution Management Systems (DMS). This technology was based on Internet and Intranet technologies. It performs instantaneous operation with high reliability and accuracy. Multiple systems are being manufactured and many of them are already making a strong impact on the market.

### 3.1 Using PLC SCADA

System which handles the monitoring problem in very easy and efficient manner by tallying the energy usage in different workshop of the industry. It shutdowns power by measuring a huge amount of energy wasted in a particular area. This gives an automated energy monitor and controller to the industries. Energy Meters, PLC's and PC's SCADA (Supervisory Control and Data Acquisition) are used in this system. To make easy communication between the (PLC) programmable logic controllers and computer serial communications protocols are used for this operation [3]. These systems are software and hardware combinations that make communication between a monitoring device to a central unit. The systems are programmed to collect records from the energy monitor and send this information over the database server. A user can see the use of energy throw a dashboard on a mobile device or Personal computers. This system allows control and monitoring via handheld devices [11]. The technique used in this system works properly for large (over 150 W) electricity consumption. It doesn't work properly for low electricity consumption or use with a large number of inconsistent systems like the dishwasher or electric stove. NILM doesn't give a similar level of accuracy for direct metering [15].

### 3.2 Using ZigBee Technology

Non-disturbing Electricity Meter for energy monitoring in

Buildings using the ZigBee communications module. A wireless Energy Meter is proposed with self-power ability. This system connects to clamp on a current transformer, which is for calculating total current use. Not direct contact with supply makes it a safer method. This system takes low-power, microcontroller and a wireless transceiver for a safe Energy computing Gateway using ZigBee [14]. A system that used a ZigBee module for wireless communication between sensors and networks. Energy parameters are measure and send to the monitor. It controls the system wirelessly for less carbon reduction and safe use. The system contains an intelligent outlet module, wireless transceiver module, and a controller. Device level metering system calculates the consumption of energy in each unit, which helps a lot in studying the load and consumption of energy in U. S. building [4].

### 3.3 Using GSM Technology

Rashdi et al.[1] proposed a system using a GSM module for electricity monitoring. This system is integrated with the systems customers energy meter unit, which can be a single phase, two phase or three phase supply. This digital electric meter is integrated with the smart transmission module. This system reads meter reading and sends alerts in terms of shot messages. The supplier and consumer both can be benefitted from this reading. This reading can be used to calculate the bill cost, revise the record and updates an energy consumption records. Different types of alerts can generate by the supplier for better performance.

### 3.4 Using WSN technology

Anbarasu and Rajendhiran.V2 [2] proposed a system, which determines the bonding between wireless sensor networks (WSNs) and electrical- signal-based motor signature analysis. This method for Wireless Sensor Network using Internet based system can remotely monitor electricity use and troubleshoots faults for industrial motor systems. The main objective to provides a system overview to consumer. Anbarasu.and Rajendhiran.V2 [2] proposed a system, which determines the bonding between wireless sensor networks (WSNs) and electrical- signal-based motor signature analysis. This method for Wireless Sensor Network using Internet based system can remotely monitor electricity use and troubleshoots faults for industrial motor systems. The main objective to provides a system overview to consumer. Lanzisera [11] proposed a concept of data communication between the power supply and the database. This concept sends data of electricity consumption, which will help in calculation of bills. This system technology will be used in the future for monitoring energy and all electricity consuming appliances. In the future, each and every product will have their identity and will share their information on the internet by themselves. Lanzisera and Cheung [12] proposed a method for the system to take a complete record of total energy consumption in the office building. How to decide multiple factors to log energy consumption data is explain by this method. Factors for calculating energy consumption are number of records, logging meter data, and sampling data rate. The study designs an annual energy use record. It contains the Energy consumption pattern of building, which can predict energy savings methodology in office buildings is counted in that study. The Internet of Things (IoT) proposes each and every object can be globally accessible from the internet if we interrogate these devices with some sensors

and networks. These implements will make a major impression on society from monitoring respect of view. This paper presented the use of IoT technology to provide controlling and monitoring. [18]. By using these technologies improvements in flexible Systems in controller features, high-speed data transfer protocols we are able to build different metering options. Embedded designers can build low-cost, wider memory, reliable network and higher accuracy solution [16]. Coding ability and tracking ability of products have been making companies more effective, high-speed processes, reduces errors, prevention from theft, and more precise by using the Internet of Things (IoT). This technology revolution that represents the future of controlling, monitoring. This development depends on various technology enrolments. In wireless technology, the company is tagging each and every product for detection, automation, monitoring and controlling [17].

### 3.5 Technology Comparison

As shown in Table 2 Technology Comparison Parameters like Cost, Range, Installation, Size, Storage, And Accuracy. Parameters for different technology is taken for PLC/SCADA [3],[11],[15]. ZigBee [14],[4]. GSM [1], and WSN technology [2],[11],[12],[18],[16],[17] To choose best technology for industry.

**TABLE 2**  
COMPARING DIFFERENT TECHNOLOGY USED FOR MONITORING

Factors	Technology			
	Using PLC/SCADA	Using ZigBee	Using GSM	Using WSN
Cost	High	Moderate	Moderate	Low
Range	Small	Moderate	Long	Long
Installation	Hard	Moderate	Easy	Easy
Size	High	Moderate	Moderate	Small
Storage	Large Storage	Moderate	Moderate	Cloud dependant
Accuracy	High	High-moderate	Moderate	High-Moderate

## 6 CONCLUSION

In this paper, we have discussed various energy controlling and monitoring systems which are based on different technologies. According to this comparison study, the device-level Wireless Sensor Monitoring using the internet technology performs better over the other energy monitoring systems. As this technology gives an advantage of the internet, monitoring and controlling individual electronic gadgets. This system requires very low cost compare to others. It is easy for installation and small in size which attracts use of this system in the industries. In the future, internet of things (IoT) will be the most dominating technology in the market because of its advantages and ease of use.

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