Research on Energy-saving Campus Construction Based on Energy Consumption Monitoring Platform

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Abstract. At present, the hardware conditions of colleges and universities are getting better and better, but in contrast, the waste of resources is becoming more and more serious. In response to the call of environmental protection, universities are also actively seeking ways to reduce the waste of resources and build energy-saving universities. Because of staff and students' daily teaching and living needs, colleges are looking for ways to save money. In this process, the energy consumption monitoring platform plays a great role. This paper is based on the energy consumption monitoring platform to study the construction of energy-saving campus.

Keywords: Energy Consumption Monitoring Platform, Campus Construction

1. Introduction
Environmental protection is an inescapable topic in the current society. The construction of a two-oriented society should cover all aspects of the society. And school is a highly populated and electricity use powerful groups, now as the living standard of people more and more high, the students' dormitory is also more and more, some dorms are equipped with air conditioning and other equipment to the student, and now the small appliances is multifarious, school record high energy consumption, many schools begin to this aspect of the attention, but the effect is not very clear, no support by powerful data, artificial cannot detect real-time energy consumption, so the energy-saving lag and lack of sex. Therefore, adopting a powerful campus energy management system is the best choice.

2. Platform architecture mode

2.1. Platform functional framework
The economical university section supervision platform system fully embodies the campus energy saving management idea and the software development technology, the inspection control technology perfect union thought [1-3]. Taking ensuring and satisfying the energy consumption monitoring and management function of the campus as the center, it can not only overview the general situation of energy consumption monitoring and management, focus on monitoring and classifying energy consumption and the situation of key departments and buildings, but also monitor departments, buildings and even monitoring points or specific monitoring equipment, and provide powerful
management and service functions such as energy consumption monitoring and analysis, report form integrated management, energy consumption audit management and system integrated management [4-6]. The function of the energy supervision platform system consists of two parts: energy consumption monitoring and energy saving control system. Energy consumption monitoring is mainly to use the Internet of things technology to collect, transmit and store energy consumption data in real time, to realize the real-time monitoring of energy consumption use and the running state of energy use equipment, to analyze the data horizontally and vertically, and to realize the energy management decision functions such as energy audit, energy consumption prediction and energy saving diagnosis. The energy saving control system is mainly through the monitoring and analysis of energy data, making a reasonable energy saving strategy, and using modern control means to automatically control energy consumption equipment, so as to achieve the purpose of energy saving and consumption reduction.

2.2. Platform composition architecture
The energy saving supervision platform of conservation-oriented colleges and universities adopts SOA architecture, B/S design and MVC mode, which connects the different functional units of applications (called services) through the good interfaces and contracts defined between these services. The energy-saving monitoring and management platform has good compatibility and openness, and can fully integrate the existing energy management system on campus, platform adopts B/S mode and has the advantages of convenient use and maintenance. The implementation of the platform mainly includes three layers, namely, data acquisition layer, data storage layer and data display layer. By means of wired or wireless, the data acquisition layer realizes the field acquisition of intelligent instrument data, and can be compatible with various communication protocols, such as Mod-bus、DLT645M-bus, etc. The field collector uploads the collected data to the data center through the campus network and so on. The data center processes and stores the collected data centrally, and the data storage ensures the security and timeliness of the data. After analyzing the data, the system provides display and query service. See Figure 1 below for specific architecture.

![Figure 1. Architecture of the platform.](image)

3. Introduction to Platform Functions
The energy saving supervision platform of colleges and universities is a comprehensive energy use management information system which covers water, electricity, gas and heating, including data acquisition, three-dimensional data analysis, energy consumption traceability, energy consumption early warning, real-time control, trend prediction, decision analysis and other functions. According to the actual energy use situation in colleges and universities at present, the platform mainly includes energy consumption monitoring, lighting power saving, air conditioning energy saving control,
heating energy saving and other subsystems. According to the current energy use situation in colleges and universities, the platform mainly includes four subsystems as shown in figure 2 below.

**Figure 2.** Schematic diagram of the subsystem of high efficiency energy saving supervision platform.

### 3.1. Energy consumption monitoring system

The energy consumption monitoring system realizes the functions of classification, measurement, management and statistics of building energy consumption. By using modern communication technology and Internet of things technology, the dynamic real-time energy consumption data and operation parameters are collected and monitored. Collect data for centralized storage, and provide data query, display function. The system has multi-topic energy consumption analysis and comparison, including comprehensive energy efficiency analysis, time analysis, benchmarking analysis, energy consumption prediction analysis, energy efficiency special analysis of school heating center, power distribution room and so on. The system also has the function of developing and visualizing the statistical algorithm library of energy consumption. The analysis of data is displayed by pie chart, column chart and graph.

### 3.2. Lighting power-saving system

Lighting power saving system is mainly to the school public lighting, including classroom lighting, street lights, landscape lights, energy saving automatic control to achieve the purpose of saving electricity. The energy saving control of classroom lighting is mainly to group the classroom lighting, dynamically detect the number of classrooms, light intensity combined with the schedule to control the classroom lighting on demand. The platform can automatically (manually) control the lighting switch, can provide real-time monitoring of the opening state of the lamp, the number of classrooms, illumination, and can alarm the abnormal situation such as daytime light, night lights out, large area lights out, and can notify the relevant management personnel in time by short message. Combined with 3D campus map, the platform can group and control the street lamp and night view lighting flexibly, and control the street lamp according to the illumination. To estimate and calculate the light rate of street lamp, to alarm and deal with the abnormal situation such as circuit grounding, daytime light, night lights out, large area lights out, and to inform the manager in time by short message and so on.

### 3.3. Air conditioning energy saving control system

Air conditioning energy saving control system mainly includes three parts: air conditioning operation parameter monitoring, air conditioning energy consumption management, air conditioning energy saving control and so on. The platform can monitor the operating parameters, indoor temperature, provide dynamic temperature change curve, and monitor the air conditioning unit, frequency converter voltage, current, electricity consumption data, provide time-by-time, day-by-day, month-by-month, year-by-year and any time period data query, analysis, provide pie chart, column chart, graph display
function. Air conditioning opening strategy can be set according to indoor temperature and number of people to realize air conditioning manual/automatic control.

3.4. Heating energy saving control system
The variable flow optimization regulation system is introduced to increase the outdoor climate compensation control function, combined with the time-sharing temperature control system, according to the change of load, the heating load of the gas boiler control system varies with different time.

4. Energy saving effect analysis
According to the requirements of energy-saving monitoring and management platform of economized campus and the actual management needs of the school, a university has established a unique platform, which has run smoothly at present Eight months. According to the building power supply line, the university installed the total building scale, and the whole school teaching building, experimental building for the division, division, stratified power supply line transformation, the school organs and office, laboratory sub-room measurement, teaching building zoning, stratified measurement, public facilities, power equipment electricity measurement separately. With the secondary water supply pump station as the system and the single building as the unit of measurement, the water supply system is installed. Heat exchange station, boiler room as the system, single building as the unit of measurement, the installation of heating system heat meter and single building time-sharing temperature control equipment. Through the energy saving monitoring and management of the platform, the total energy consumption standard coal of the school decreased by 13.4% in 2014 compared with 2013, and the annual average energy consumption decreased by 13.46%, and the energy consumption per unit area decreased by 17.7% in 2014.

5. Operational support
The establishment of energy-saving supervision platform provides data support and guarantee for the construction of energy-saving colleges and universities, establishes energy-saving supervision center, strengthens the daily operation, maintenance and management system of energy-saving monitoring and management platform, determines personnel to carry out maintenance and management, is responsible for the collection of energy consumption and water resources consumption data on campus, the deployment, operation, maintenance and management of transmission equipment, the detection and maintenance of terminal measuring instruments, the statistics, analysis and uploading of energy consumption data, and the maintenance of related equipment in the monitoring center, etc. In order to better serve the school teachers and students. We will earnestly achieve energy conservation and emission reduction, formulate rules and regulations for energy conservation, establish and improve all kinds of post responsibilities and management systems of energy monitoring and control centers, operating procedures for energy monitoring and management platforms, platform database management procedures, energy consumption and water consumption publicity systems, platform maintenance procedures, energy metering work systems, and energy metering instruments management systems. Strengthen energy-saving publicity, hold water-saving publicity week, energy-saving publicity week, through the campus broadcast, prize writing, publicity bar, school newspaper, campus network, energy-saving tips and other forms of energy-saving ideas among teachers and students, promote green low-carbon life, achieve better publicity results.

6. Conclusion
The annual power consumption of school buildings accounts for about the increase of the total power consumption in cities and towns all over the country year by year. How to understand, analyze and control energy consumption in real time has become the focus of attention. In addition, the emergence of these large platforms requires energy use data. The energy consumption monitoring platform has solved the problems of colleges and universities in these aspects, provided technical support and data.
statistics for the construction of energy-saving campus, and made great contributions to speeding up the construction of energy-saving campus.

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Green saving type campus based on data Analysis from Energy consumption monitoring system. NO. 2019003.

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