Research on the Intelligence of Carbon Number in Data Center

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Keywords: Data Center, Carbon Verification, Intelligence, Monitoring Software, Accounting System.

Abstract: Introduced carbon verification in the data center and designed carbon monitoring software. Based on the R-8555CDMA Modem wireless communication module, builds an intelligent accounting system for the energy and carbon data of the data center, which realizes the intellectualization of the carbon emission verification of the data center.

1 INTRODUCTION

A data center is composed of a computer site (computer room), other infrastructure, information system hardware and software, information resources (data) and personnel, and corresponding rules and regulations. It is mainly a construction site that provides an operating environment for centralized electronic information equipment. It can be one or several buildings, or it can be a part of a building (GB/T32910.1, GB 50174). As an infrastructure for storing, processing, and utilizing computing power, data centers can be divided into enterprise data centers (EDCs), internet data centers (IDCs), and other institutional data centers (Wang Jiye, 2022).

The construction of data centers is one of the seven key construction tasks of the "new infrastructure", and it is also the key to the digital transformation of the economy. With the rapid development of social economy, data centers are also expanding rapidly. As the infrastructure of the digital economy, data centers occupy a large area, are mostly located in urban centers, have a large number of devices, and consume a lot of energy. Their huge energy demand inevitably leads to an increase in carbon emissions. The data center industry belongs to the consumer side of energy in energy activities. The main sources of its energy activities include the consumption of electrical energy in the power supply sector and the use and consumption of diesel generators. Among them, diesel generators are used to ensure continuous power supply for the data center center.Its energy consumption accounts for a very low proportion of the energy consumption of the entire data center. Therefore, under the premise of thermal power generation, the carbon emissions of the data center mainly come from the power consumption of the power supply department.

2 ARBON VERIFICATION IN DATA CENTER

Article 6 of the Measures for the Administration of Carbon Emission Trading (Trial) stipulates that the formulation of technical specifications for national carbon emission trading and related activities, as well as the supervision and management of local carbon emission quota allocation, greenhouse gas emission reporting and verification shall be "the Ministry of Ecology and Environment, with assistance from relevant departments of The State Council." Greenhouse gas emission reporting and verification is the process of comprehensively verifying and verifying the emission facility information, accounting boundaries, accounting methods, emission factors, activity data, and other relevant information of carbon dioxide generated by national key emission (quota management) units.

The verification of the carbon emissions of data centers and the production of reports must be carried out in accordance with the requirements of the accounting methods and reporting standards for greenhouse gas emissions in the Measures for the Administration of Carbon Emissions Trading (Trial); And relevant standards and technical specifications. The verification process mainly includes: initiating verification, arranging verification, establishing verification technical working group, document review, establishing on-site verification group, on-site verification, writing verification report,

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informing verification results, saving verification report, and ending verification.

Carbon verification is the main way to achieve the "dual carbon" goal, and scientific, accurate, and efficient carbon emission measurement and accounting methods are the foundation for achieving "measurable, reportable, and verifiable" carbon emission data. They are also key factors for controlling total carbon emissions and optimizing resource allocation. As the main assessment and supervision object for government to achieve energy savings and reduce greenhouse gas emissions, the carbon emission measurement and accounting of data centers has also become a key influencing factor for their rapid development.

Against the backdrop of new developments such as carbon peaking and carbon neutrality, in order to focus on solving the key tasks of optimizing resource allocation and energy conservation and carbon reduction in data centers, using energy measurement as the basis and carbon verification as a means to calculate carbon emissions in data centers has become an effective way to strengthen energy conservation and carbon reduction management in data centers and continuously promote green, low-carbon, and efficient operation. The measurement and accounting of carbon emissions in data centers is based on the emission factor method.

Article 27 of the "Energy Conservation Law of the People's Republic of China" stipulates: "Energy-consuming units should strengthen energy measurement management, and equip and use energy measuring instruments that have passed the legal inspection in accordance with regulations. Energy-consuming units should establish energy consumption statistics and energy utilization. And ensure that energy consumption statistics are true and complete. Among them, as the basis of energy measurement, the meter used for energy measurement shall comply with the requirements of GB17167-2006 "General Rules for the Equipment and Management of Energy-using Unit Energy Measuring Instruments". The general rules specify the proportion of energy measuring instruments in energy-using enterprises, the limit values of energy consumption of primary secondary energy units and tertiary main energy devices, and the accuracy of energy metering meters (GB17167).

Table 1. Limit values of energy consumption value per unit of main secondary energy consumption.

Energy type	Electricity	Coal, Coke	Crude oil, Refined oil, Petroleum liquefied gas	Heavy oil, Residual oil	Gas, Natural gas	Steam, Hot water	Water	Other
Unit	kW	t/a	t/a	t/a	m^3/a	GJ/a	t/a	GJ/a
Limit value	10	100	40	80	10000	5000	5000	2926

Note 1: a in the table is the symbol of "year" in the legal unit ofmeasurement.
Note 2: m^3 in the table refers to the standard state, same as table 2.
Note 3: 2926GJ is equivalent to 100t standard coal.Other energy sources should be converted according to the equivalent calorific value, as shown in Table 2.

Table 2. Limit values of energy consumption (or power) of main energy-consuming equipment.

Energy type	Electricity	Coal, Coke	Crude oil, Refined oil, Petroleum liquefied gas	Heavy oil, Residual oil	Gas, Natural gas	Steam, Hot water	Water	Other
Unit	kW	t/h	t/h	t/h	m^3/h	MW	t/h	GJ/h
Limit value	100	1	0.5	1	100	7	1	29.26

Note 1: For energy-consuming units (device, system, process, workshop, etc.) that can be assessed separately for energy measurement, if the energy-consuming unit is equipped with energy measuring instruments, the main energy-consuming equipment in the energy-consuming unit may no longer be equipped separately.
Note 2: If the energy use body such as boiler room, pump room and other centralized management of similar equipment, if it has been reasonably equipped with metering meters, the main energy use equipment can no longer install energy metering meters.

Table 3. Provisioning rate requirements of Energy Measuring Instruments Unit: %.

Energy type		In and out energy consumption unit	Access to main and secondary energy-consuming units	Main energy-consuming equipment
Electricity		100	100	95
Solid state energy	Coal	100	100	90
	Coke	100	100	90
Liquid energy	Crude	100	100	90
	Refined oil	100	100	95
	Heavy oil	100	100	90
	Residual oil	100	100	90
Gaseous energy	Natural gas	100	100	90
	Liquefied gas	100	100	90
	Gas	100	90	80
Energy-carrying medium	Steam	100	80	70
	Water	100	95	80
Surplus energy that can be recycled		90	80	—

Note 1: Seasonal heating steam (hot water) entering and exiting energy-consuming units can adopt other measurement and settlement methods that do not directly measure the flow of energy-carrying working fluid.
Note 2: Seasonal heating steam (hot water) entering and exiting major and secondary energy-consuming units may not be equipped with energy measuring instruments
Note 3: Electricity and steam, water and other energy-carrying working media used as auxiliary energy on the main energy-consuming equipment, if the energy consumption is very small (less than the requirements in Table 2), energy measuring instruments may not be equipped.

A secondary energy consumption unit whose energy consumption (i.e. energy produced or transported) is not less than one or more of the energy consumption limits in Table 1 shall be regarded as a primary secondary energy consumption unit.

The energy consumption of a single device is greater than or equal to one or more limit values of energy consumption in Table 2 as the main energy-consuming equipment.

The proportion of energy metering instruments shall comply with the requirements of Table 3.

The activity data involved in the accounting is obtained based on annual consumption statistics, and the emission factor data mostly adopts regional default values. However, when obtaining carbon emission inventory activity data based on annual consumption statistics, the workload of data processing is large, which is prone to issues such as missing information, manual statistical errors, and ineffective verification of data authenticity.

In recent years, the widespread use of technologies such as intelligent networking, artificial intelligence and aggregated data has essentially changed the management, control and development mode of many basic operation architectures (Gang Xiong, 2020). Based on information technology, intelligent collection and accounting of data center energy consumption data and carbon emission data are realized. It can not only improve the accuracy and security of data collected in the data center, but also save resources and improve work efficiency.

3 ENERGY AND CARBON NUMBER INTELLIGENT ACCOUNTING SYSTEM

This paper uses the CS development model to design and develop an energy carbon monitoring software, and based on the R-8555CDMA Modem wireless communication module, builds a data center energy carbon number intelligent accounting system, thereby realizing the intelligentization of data center carbon emission accounting. Figure 1 shows the system diagram of the data center energy carbon number intelligent accounting system.

The energy and carbon intelligent accounting system consists of a data center energy consumption main control cabinet, AF-HK 100 data acquisition instrument, front-end computer, laptop, R-8555 CDMA Modem wireless communication module, and LIMS system. In Figure 1, the portable computer is equipped with data center energy and carbon monitoring software. After connecting to the LIMS system through the network cable, the data interaction with the LIMS system can be realized. During field monitoring, the af-hk100 data acquisition instrument is connected to the main control computer system of the data center, and the real-time monitoring data is collected into the front-end computer. RS232 serial cable is used between the front-end computer and the portable computer, and the R-8555CDMA Modem wireless communication module is used to transmit the carbon emission accounting data back to the LIMS server continuously, so as to realize intelligent monitoring.

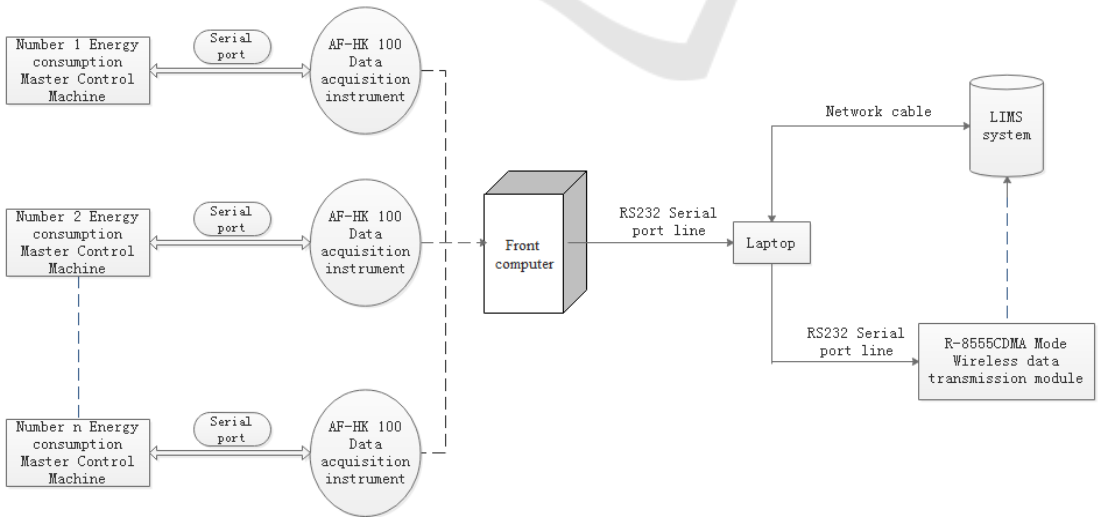

Figure 1. Data center energy carbon number intelligent accounting system diagram.

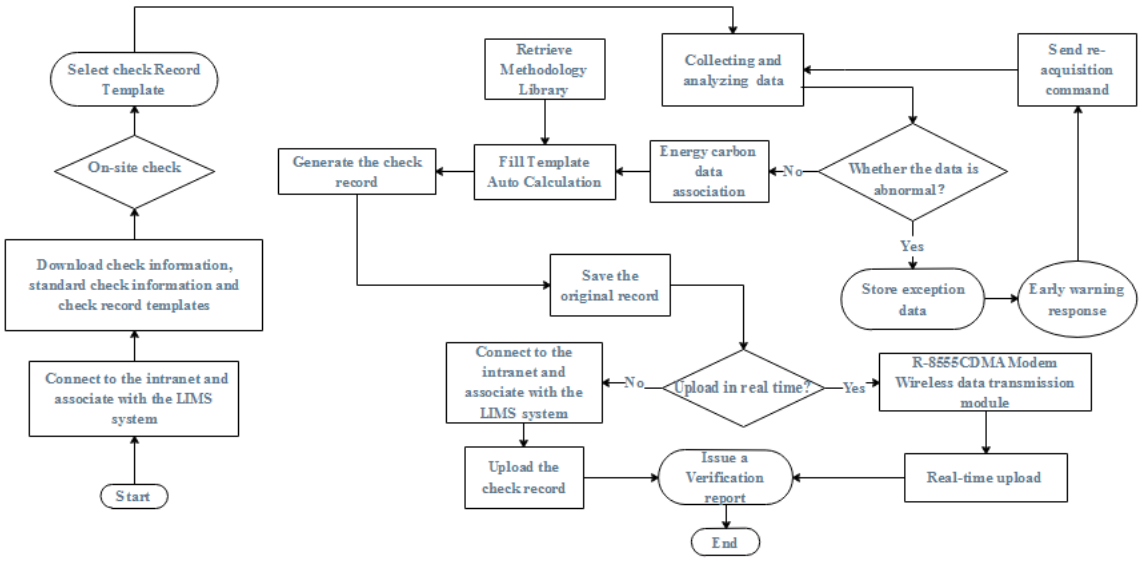

Figure 2. The process of intelligent calculation of energy carbon number.

3.1 Monitoring Software Design

The monitoring software is developed based on CS, and Access is used as offline database, and unified communication protocol is written to realize single data transmission, so as to ensure the security of data collection and transmission. According to the protocol requirements, different types of data centers use energy master computers to send monitoring data to the energy Carbon monitoring monitoring software in real time without obtaining data.

The collection and monitoring software integrates LIMS connection module, data collection and analysis unit, data anomaly disposal unit, carbon emission method library call unit, energy carbon association unit, carbon emission data automatic calculation unit, data storage library, network security guarantee unit, and has the functions of historical information verification, template, standard information, historical verification information download and data sharing. The data monitoring and analysis unit can collect energy metering data transmitted by the data center in real time and parse it into fields in a specific format. Exception handling units are distinguished based on the collection and parsing of data. If the collected and analyzed data does not meet the corresponding field requirements, data missing or blank, etc., the abnormal alarm mechanism will be triggered, and are collection command will be sent. The abnormal data will be saved to facilitate later investigation of the cause of the abnormality. The methodology library unit establishes an industry carbon emission accounting factor library based on the national, Ministry of Health and Environment, and local levels, facilitating the retrieval of emission factors corresponding to activity data according to needs during enterprise carbon emission accounting. The energy carbon correlation unit matches the fuel type corresponding to the carbon emission calculation based on the collected energy subcategory data. The carbon emission data automatic accounting unit can automatically calculate the carbon emission data based on the emission factor method. The storage unit is used to store monitoring process related data and separate and save abnormal data for the convenience of analyzing the cause of data anomalies.

3.2 Intelligent Accounting Process for Energy and Carbon Number

The monitoring software utilizes an intranet linked LIMS system to obtain verification tasks and download verification information, verification standard information, verification record templates, and other information. During on-site verification, a laptop equipped with data center monitoring software is connected to the front-end computer through an RS232 serial port cable to collect monitoring data in real-time and parse and fill in the verification record template. The generated verification records are saved locally and return the LIMS system in real-time through the R-8555CDMA Modem wireless communication device, achieving intelligent collection and efficient certification of carbon emission verification data in the data center. The

process of intelligent calculation of energy carbon number is shown in Figure 2.

4 CONCLUSION

An energy Carbon monitoring software was designed and developed, and based on the R-8555CDMA Modem wireless communication module, an intelligent accounting system for energy and carbon data in the data center was built, thus realizing the intellectualization of carbon emission accounting in the data center. Not only can reduce the workload of monitoring implementation process, avoid human error, but also solve the data center monitoring data storage is not convenient, query trouble, data classification is easy to confuse the problems, on the basis of effectively improving the carbon accounting efficiency of data centers and data security, but also for the intelligent application and promotion of data center online monitoring provides a foundation.

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