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## ARTICLE

# PRACTICE RESEARCH ON THE CONSTRUCTION OF ENERGY AND RESOURCE SAVING UNIVERSITIES ORIENTED BY QUOTA MANAGEMENT

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## ARTICLE DETAILS

## ABSTRACT

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Oriented by strengthening energy management and reducing energy consumption and carbon emissions have significant economic and social benefits for universities, and are of great significance to students' energy conservation awareness education and behavior training. Based on a university in Kunming as an example, this paper analyses "administrative supervision and technical support" working mode, energy saving propaganda and the practical significance of the informatization management of energy conservation and carbon reduction, proposed use of energy consumption quota management, energy saving carbon reduction can be mining potential, develop scientific energy saving management goal system, improve the management of energy consumption level of refinement, promote the construction of a conservation-minded campus.

## KEYWORDS

Energy Conservation and Emission Reduction, Ecological Civilization, Green University, Energy Resources

## 1. INTRODUCTION

As a public institution, universities shoulder the heavy responsibility of cultivating talents. It is a great responsibility to strengthen students' ecological civilization education, and it has a great responsibility and potential to promote the transformation of consciousness and green lifestyle. Universities are an important window to promote the concept of green and low-carbon development and promote the transformation of green and low-carbon lifestyle in the whole society. It will play an exemplary and leading role in implementing the goal of carbon peaking and carbon neutrality. It is necessary to strengthen students' concept of saving and recycling resources, advocate a simple, moderate, green and low-carbon lifestyle, and form a good trend of teachers and students' participation [1, 2].

The key energy-using public institutions such as universities have a large consumption of energy resources and a large number and variety of energy-intensive equipment. A university in Kunming has more than 1326 sets of equipment with power above 1kw, and the total power is more than 30621kw. It is the key field of energy conservation management and the breakthrough point to practice the goal of carbon peaking and carbon neutrality [3-5].

At present, there are some problems in the work of energy and resources conservation in universities. Such as the top design is in place, the lack of details, energy saving concept consciousness is not strong, management refinement degree is not high, the form of publicity and education is monotonous and the scope of participation is not broad enough [6-8].

The energy saving action of some teachers and students in universities lags behind the consciousness. There is a lack of energy saving knowledge,

energy saving consciousness and behavior weak phenomenon. The problem of "high identification and low cognition" still exists widely in universities. The influence of group factors such as group norms, group environment and group pressure on individual energy saving behavior is ignored [9-13].

This paper takes a university in Kunming as the research object. Based on statistics of water and electricity consumption, the goal is to improve the application level of school energy quota standard. To explore the experience measures of energy and resource saving campus construction analyze the problems, put forward the management measures and technical measures to reduce energy consumption, Improve the precision of energy conservation management in schools improve the ability of using energy quota standard to regulate energy use behavior. Promote the construction of energy-saving, low-carbon and green campus, and provide practical cases for the application of energy consumption quota standard in Yunnan Province.

## 2. DISCUSSION ON THE EXPERIENCE OF ENERGY AND RESOURCE SAVING CAMPUS CONSTRUCTION

We adhere to the concept of system and strengthen system construction. Guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era. We will implement the new development concept of "spearheading ecological progress", To leverage the exemplary role of public institutions in planning a beautiful Yunnan. We will build a working model of "administrative oversight and technical support", continue to optimize the energy consumption structure, and continue to increase the share of green energy consumption. Explore the feasibility of roof resource utilization, rainwater collected in the campus will be used for greening irrigation. The university integrates ecological civilization

construction, green development concept, carbon peak carbon neutral goal and sustainable development strategy into the whole process of personnel training, discipline construction, scientific research, campus construction and management. Strengthen top-level design and improve management ability. Set up a management organization headed by the Secretary of the Party Committee and the president. We promulgated and implemented the Implementation Plan for green universities, developed a green university creation plan, strengthened overall planning and coordination, strengthened responsibility, and focus on continuous promotion [14].

We actively advocated "135" green travel mode. It is widely publicized and calls on teachers and students to practice the green travel concept of "walking within 1 km, cycling within 3 km and public transport within 5 km". Try to take subways and buses when going out, promote the use of new energy vehicles, and reduce the intensity of car use. The campus bus used inside the school is pure electric, which relies on electric power to drive, low noise, green environmental protection, is a strong measure of green campus construction. The bus circulating in the subway station and campus plays an important role in improving the "last kilometer" of the campus. The teaching area is located in the middle of the campus. The teaching buildings of each college are arranged as close as possible to the students' living area of the college. In this way, the commuting time for students to and from classes can be reduced. Regulate the parking of bicycles and electric vehicles on campus, issue campus passes for standardized management, and regularly clean up "zombie bikes" to encourage low-carbon travel.

We strengthened energy conservation publicity. Centering on the fundamental task of cultivating people by virtue, we should take improving the quality of talent training as the core. We made full use of the "We media platform" to push the "Water Conservation Initiative", "Cloud Launch Ceremony", "Cloud Class", "Cloud Live", "Cloud Contest" and other themed articles and micro-videos to the teachers and students of the whole school. Ecological civilization education was included in the theme of the Youth League Day, and knowledge of energy conservation and emission reduction was publicized. Posters and other publicity methods were used to educate and guide students to take ecological civilization construction and energy-saving campus construction as their own responsibility. Carry out ecological civilization and thrift education and publicity activities such as "save food, save water, save electricity, save paper", so that students can form civilized consensus and develop civilized habits. In the process of promoting college labor practice education, organize students to participate in the publicity of water conservation. Paste stickers of "Water saving and emission reduction make Dianchi Lake more Beautiful" on public washbasins, calling on teachers and students to participate in the action of "Building a beautiful Dianchi Lake starts from little drops".

We implemented technical transformation. We widely promote the use of green LED energy-saving lamps, adjust the brightness of street lamps after 12 o'clock at night or adopt the way of light separation, and use air source heat pump to replace high-energy boiler to provide bath hot water. In the purchase of new equipment to choose energy-saving certified products, eliminate old high energy consumption equipment, through a series of measures can reduce the power consumption of the school. In terms of water saving, daily inspection and maintenance should be strengthened. BOT is adopted to introduce social service enterprises in student dormitories and transform hot water circulation system, which can reduce water resource waste. Water balance testing should be carried out in accordance with the requirements of government departments, and regular leak detection and census should be carried out on the water supply pipe network to ensure that the leakage rate of the water supply pipe network is controlled within 5%. In the aspect of domestic sewage treatment, by replacing submersible pump, lifting pump, using self-priming pump to replace submersible sludge pump, eliminating high-energy sludge dehydrator and other technical means, sewage treatment efficiency can be improved, and sewage reuse quality can be improved. The second phase of the sewage treatment station expansion project was implemented to realize the full collection and treatment of domestic sewage, and the greening of the campus was irrigated with reclaimed water.

We leveraged the role of the energy saving supervision platform. A total of 1,069 long-distance meters, 190 long-distance water meters and 34 multifunctional power monitoring terminals have been installed in the school's energy saving supervision platform project. An electric ener-

gy metering and energy saving supervision system and a water supply network monitoring system have been built, with functions of real-time meter reading, data analysis, water balance analysis and power distribution system monitoring. In terms of water saving, it focuses on observing water consumption at night based on the characteristics of regular school life. Since 2021, through the leakage in the underground pipe network, it has proactively discovered water leakage in the underground pipe network for several times. After timely maintenance, the water leakage can be reduced by 29m<sup>3</sup>/h, and the average daily water leakage can be reduced by 696 m<sup>3</sup>. To open the hot water room has carried on the analysis of energy consumption, found that the average power consumption of about 300000 kW·h, annual water consumption of about 400 m<sup>3</sup>, combining school enabled student dormitory roof heat pump and solar thermal system, students reduce the hot water demand, after reduce the amount of hot water room open and optimize the cycle time of hot water, in the case of meet the demand of students, annual electricity consumption can be reduced by 250,000 kW·h. Intelligent distribution system module can monitor the low-voltage terminal phase voltage, line voltage, current, active power and reactive power of transformer in the distribution room in real time. It can master the operation state of transformer by observing the three-phase unbalance. By observing the transformer load rate and line load rate, it can provide reference for the rational configuration of transformer input quantity and the reasonable adjustment of three-phase load configuration.

### 3. SOME REFLECTIONS ON THE PROBLEMS EXISTING IN THE PROCESS OF BUILDING ENERGY AND RESOURCE SAVING CAMPUS

#### 3.1 Teachers and students' understanding of the creation of "green University" is not comprehensive enough

Many people intuitively understand that green university is simply green school, such understanding is not comprehensive. The construction of a green university also includes important contents such as the economical utilization of water, electricity, energy and resources, garbage sorting, stopping food waste, patriotic health and so on. There are still deficiencies in the development of interest-oriented and value-oriented ecological civilization general education courses and cultural quality courses, and there is still a gap in the popularization of green knowledge.

#### 3.2 There are still deficiencies in the establishment of a cultural system for ecological civilization

Although a lot of publicity work has been done on energy conservation and emission reduction, and some student activities have been carried out, the number of student activities is not enough, and teachers and students lack enthusiasm to participate in some aspects of environmental protection projects, which increases the difficulty of the formation of ecological civilization culture communication. Taking the use of elevators on campus as an example, although the system has been introduced and the publicity has been strengthened, the contradiction between reducing the use frequency of elevators and the convenience for teachers and students to travel leads to many difficulties in the implementation of the "initiative for teachers and students to take the stairs below the sixth floor". Due to the large area of the new campus and insufficient charging facilities, it is still common for teachers to use cars for short distance travel, and the use of new energy vehicles is still low.

#### 3.3 Raising funds through multiple channels and promoting the construction of conservation-oriented campus are not enough

In the process of promoting the establishment of a conservation-oriented campus, there are not many contacts and cooperation with social enterprises. There are still deficiencies in expanding financing channels in multiple directions and exploring the construction of a new model based on government subsidies and organically combining school self-financing and market financing.

### 4. COUNTERMEASURES AND SUGGESTIONS FOR IMPROVING CAMPUS ENERGY CONSUMPTION MANAGEMENT

#### 4.1 Cultivate people with the idea of "green education" and strengthen the cultivation of teachers and students' consciousness of energy saving behavior

We can create a green and sustainable campus cultural atmosphere, so

**Table 1:** 2021 Electricity consumption schedule of the five units calculated with reference value

Units	Covered area (m <sup>2</sup> )	Standard (kW·h/m <sup>2</sup> ·a)	Electricity consumption (kW·h)
Unit 1	2580	18.71	48271.8
Unit 2	3725	18.71	69694.8
Unit 3	387	18.71	7240.8
Unit 4	1365	18.71	25539.2
Unit 5	276	18.71	5164.0

**Table 2:** The calculation schedule of “Day counting coefficients” according to the actual school hours of teachers and students in five units

Parameters	Unit 1	Unit 2		Unit 3	Unit 4	Unit 5	
		Group 1	Group 2			Group 3	Group 4
In-school time (days)	132.5	265	25	265	5	265	365
Number of days in a year(days)	365	365	365	365	365	365	365
Day counting coefficients	0.36	0.73	0.07	0.73	0.01	0.73	1.00

**Table 3:** The calculation schedule of “The number of energy users” according to the actual number of teachers and students and “Day counting coefficients” in five units

Parameters	Unit 1	Unit 2		Unit 3	Unit 4	Unit 5	
		Group 1	Group 2			Group 3	Group 4
Number of people	6976	338	470	14	10262	263	88
Day counting coefficients	0.36	0.73	0.07	0.73	0.01	0.73	1.00
The number of energy users	2511.36	246.74	32.9	10.22	102.62	191.99	88

**Table 4:** The calculation schedule of 2021 Water consumption according to the reference value of comprehensive water consumption per capita and “The number of energy users” in five units

Parameters	Unit 1	Unit 2		Unit 3	Unit 4	Unit 5	
		Group 1	Group 2			Group 3	Group 4
The number of energy users	2511.36	246.74	32.9	10.22	102.62	191.99	88
Combined water onsumption per capita (m <sup>3</sup> /p·a)	45.75	45.75	45.75	45.75	45.75	45.75	45.75
The water consumption (m <sup>3</sup> )	114894.72	11288.36	1505.18	467.57	4694.87	8783.54	4026.00

that “green” become an important concept of the university. With student associations as an important carrier, the green practice mode of student participation in social practice and green association activities is constructed. Energy saving, carbon reduction and environmental protection are combined with college students’ labor practice education to publicize the awareness of energy saving in labor, which can strengthen the concept of energy saving and environmental protection in labor, and develop the concept of environmental protection, energy saving, green and low-carbon life. Centering on the core goal of cultivating people, we should build a green education system, advocate green culture, integrate green education into courses and scientific research, implement it into all activities of universities, and integrate it into the whole process of university education.

#### 4.2. The implementation of energy quota management, a comprehensive implementation of energy-saving campus creation action

We installed metering meters in each building, college, department, power supply circuit and water supply area of the school. Through unified management and hierarchical management of energy metering, quantified energy management is promoted to achieve energy consumption data, energy consumption quota management has a basis, and energy conservation management has support. In 2021, the “Energy and Resources Consumption Quota and Calculation Method of Educational Institutions” (Yunnan Provincial Local Standard DB53/T 1046-2021) standard was promulgated (hereinafter referred to as the “standard”) [15], which is an auxiliary management measure

for implementing water and electricity energy quotas management and improving the “assessment and supervision mechanism”. It is an important supporting basis to improve the quota management of school water and electricity energy resources.

##### 4.2.1 Through the use of “standard” calculation of water and electricity energy consumption, strengthen the management of energy quota

The university has five funding units under its jurisdiction (hereinafter referred to as the “five units”). Due to the interwoven use of campus resources by all departments, it is difficult to calculate their water and electricity energy consumption because they have not installed metering meters separately. Therefore, the “standard” can be used to calculate the annual water and electricity energy consumption through the covered area and the number of people using energy, which is also a practical measure to promote the management of water and electricity energy index. The consumption of five units of electricity resources in 2021 calculated with the reference value [15] as the standard is shown in Table 1. In this calculation, the electricity consumption is simplified into a calculation model related only to the covered area, where the energy standard (kW·h/m<sup>2</sup>·a) represents the electricity consumption per square meter of covered area in a year.

The “standard” has the following requirements for calculating water consumption by the number of people using energy:

Day counting coefficients=in-school time/ Number of days in a year

**Table 5:** Statistical value of energy consumption index in educational area of school

Energy Consumption Indicators	Constraint Value	Reference Value	Guiding Value	Statistics of 2021
Combined water consumption per capita m <sup>3</sup> /(p·a)	63.55	45.75	38.14	40.86
Power consumption per covered area kW·h/(m <sup>2</sup> ·a)	25.79	18.71	15.59	21.11
Energy consumption per covered area kgce/(m <sup>2</sup> ·a)	5.76	4.15	3.46	3.17
Comprehensive energy consumption per capita kgce/(p·a)	100.72	72.51	60.43	88.08

The number of energy users = number of people \* Day counting coefficients

The water consumption= the number of energy users \* Combined water consumption per capita

Because the five units undertake the teaching tasks of full-time teaching, part-time teaching and short-term training, there are differences in the students' school time. Because some employees have winter and summer vacations, there are differences in the working time of the employees. Based on the actual school time and annual days (365 days in a year), the "day counting coefficients" of the 5 units are obtained as shown in Table 2. The actual number of teachers and students in 5 units and Day counting coefficients were used to calculate the number of energy users, as shown in Table 3. The water consumption in 2021 can be obtained according to the reference value of per capita comprehensive water consumption [17] and the number of energy users in five units, as shown in Table 4. Among them, Unit 2 and Unit 5 have different working and attending classes due to their "school time", which are respectively calculated based on the actual school time.

#### 4.2.2 Using "standard" to find out the shortage of energy resource management is the basis for setting the goal of energy resource management

In 2021, the total water consumption of the campus is about 1.325 million m<sup>3</sup>, the total electricity consumption is about 27.198 million kW·h, the number of students is about 34,000, and the covered area of the education area (excluding hotels, shops, hospitals, sports venues, faculty housing, etc.) is about 847,000 m<sup>2</sup>. The main energy consumption of the school is water, electricity, natural gas, diesel and gasoline. The calculation of school energy consumption indicators in 2021 is shown in Table 5. According to the constraint value, reference value and guiding value of the "standard", it can be seen that the energy consumption index per unit covered area is the best, which is lower than the guiding value, but there is still room for savings. The power consumption per unit covered area and comprehensive energy consumption per capita are better than the constraint value, but not up to the standard value. It can be seen that the school power consumption needs to increase energy saving transformation, take more powerful measures to reduce the consumption of power resources, improve the utilization efficiency.

According to the data, in 2021, the comprehensive water consumption per capita of public institutions in Yunnan Province was 22.92m<sup>3</sup>/person, the comprehensive energy consumption per capita was 51.51kgce/person and the energy consumption per covered area was 2.72kgce/m<sup>2</sup>, which were 17.94m<sup>3</sup>/person, 36.57kgce/person and 0.45kgce/m<sup>2</sup> lower than the statistical value of schools in 2021, respectively. The school's efforts to save energy and resources need to be further improved [16].

#### 4.2.3 We will work hard to improve the energy efficiency of public institutions

We will further strengthen the publicity and guidance of energy and resources conservation and ecological civilization construction, and drive teachers and students to establish the concept of simple, moderate, green and low-carbon green culture. We should eliminate energy-intensive equipment, upgrade lighting and power equipment with new green and energy-saving technologies and new equipment, improve the utilization efficiency of school water and electricity energy resources, and reduce school water and electricity energy resources consumption. We should explore and implement new models such as contracted

energy management, contracted water conservation management and energy cost trusteeship, and introduce social capital to participate in the school's energy and resources conservation work and green and low-carbon transformation. We will strictly assess performance, implement normative documents such as the energy consumption quota standard of public institutions in Yunnan Province, and incorporate the management of energy consumption quota into the energy conservation assessment and evaluation index system of public institutions [5,17,18].

## 5. CONCLUSION

The management of energy consumption quota has important practical significance in the process of building the conservation-oriented campus. It can tap the potential of energy saving and provide data support for formulating scientific energy saving management target system. The implementation of normative documents such as the energy consumption quota standard of public institutions and the incorporation of energy consumption quota management into the energy conservation assessment index system of public institutions are of great significance to the establishment of ecological civilization campus in universities.

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