



## Critical review

## The green school project: A means of speeding up sustainable development?



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## ABSTRACT

Climate change and energy problem are major challenges facing the human race. To solve these problems, administrators and policymakers all over the world are promulgating agreements, laws, standards and regulations. In the implementation of these policies, sustainable awareness of people on issues related to energy has greatly improved, but the low carbon concept is far from being popular. School, as a special community, not only should meet the demands of ordinary communities, but also have the possibility to spread awareness of the concept. Currently, the green school project has been launched in some areas of China, which aims at providing a better research environment and cultivating the concept of sustainable development to greatly promote trends of sustainable development. This article introduces the concept, requirement and rating system of green schools, which aim to cultivate more educated people with sustainable consciousness and improve the awareness of sustainable development.

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## 1. Introduction

With the deepening of industrialization, the past 200 years have witnessed global warming and climate change caused by discharge of greenhouse gases. According to reports by the Intergovernmental Panel on Climate Change (IPCC), global surface temperature increased  $0.74 \pm 0.18$  °C ( $1.33 \pm 0.32$  °F) during the 100 years ending in 2005, and the rate of temperature increase in the past

50 years is 2 times higher than the past 100 years observed from 1856 to 2005 (IPCC, 2007). Under the background of global warming, many extreme climates around the world have been staged, such as blizzard, hurricanes, floods and drought. Meanwhile, some disasters occurred frequently, such as glaciers melting, sea level rise, the collapse of grain production, and species extinction.

However, mankind's use of fossil fuels not only has a warming effect on the weather, but also has caused the shortage of energy. Based on BP energy statistics, the proven mineral resources reserve can only meet the recent overall demand around the world. Mining at the current rate, the global oil reserves are only available for 40 years, natural gas and coal will deplete in just 67 and 164 years,

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respectively. At current levels, environmental issues and energy problems have become the focus of human beings, and “low-carbon economy”, “low-carbon city” and “low carbon era” has been the hot topic.

## 2. Great efforts made to deal with sustainable problems

To deal with these problems, many organizations, institutions and some government departments have made great efforts in some countries. According to the United Nations Environment Program (UNEP), more than 270 international environmental treaties have been set by 2012. In the early 1990s, the United Nations had discussed issues about international environment and development conferences and established the United Nations Intergovernmental Panel on Climate Change (IPCC). Meanwhile, many countries had signed international climate treaties. In June 1992, heads of governments around the world signed an international treaty titled United Nations Framework Convention on Climate Change (UNFCCC) during the United Nations conference on environment and development held in Rio De Janeiro, Brazil. It is the first convention in the world to comprehensively control CO<sub>2</sub> and other greenhouse gas emissions and to effectively cope with global warming to human economic and social disadvantage. Furthermore, it provides a basic framework for international cooperation for the international community in dealing with global climate change. Kyoto Protocol, which is the supplementary terms of the UNFCCC, was set at a meeting in December 1997. In February 2005, the Kyoto Protocol on reducing greenhouse gas emissions formally went into effect, and this was the first time that limits to greenhouse gas emissions was set in the form of regulations. On December 19, 2009, with joint efforts, IPCC made the non-binding Copenhagen Accord possible; it is designed to discuss the follow-up project, after the expiration of the Kyoto Protocol.

On February 24, 2003, the British government issued the Energy White Paper, and they announced in the next few decades, energy policy in Britain will focus on renewable and clean energy, and they will reduce the use of fossil fuels, such as coal, natural gas and nuclear energy. Later, many countries responded to them to support them. In March 2010, China and India formally agreed to join the Copenhagen Accord, and this could greatly reduce CO<sub>2</sub> emissions. China promised to voluntarily reduce CO<sub>2</sub> emissions to the level of carbon emissions in 2005 under the premise of reducing economic growth, where “carbon intensity” will be reduced by 40–45% by 2020. India announced that carbon emissions, excluding in the agricultural sector, will be slashed by 20–25% by 2020. China, the largest energy consumer and the largest CO<sub>2</sub> emitter in the world, must make more efforts to solve these problems. To solve the above problems, in addition to extensive agreements reached with other countries, the Chinese government has made significant efforts, such as introducing a series of plans, laws, regulations and codes for various fields (Li et al., 2014).

## 3. The importance to promote green school campus

For energy and environment related professionals, policy makers, students and researchers on environment and energy, they can accurately understand the above agreements and regulations, and they can actively put in place practices to protect environment and save energy. However, for personnel without any relation to these professions, they cannot fully understand these agreements and they have no idea on how to perform a sustainable concept. At present, although we have made great achievements, what we are doing is far from enough for universal access to sustainable development.

Presently, to actively respond to sustainable development initiatives, many areas have carried out green community activities. Schools not only have to provide students with a good living environment, but also is also potentially the birthplace of advanced ideas and trends; hence the green school project is rising quietly in some areas of China (Choi et al., 2014). By providing students with energy conservation and environmental protection context, students' consciousness of sustainable development will be greatly enhanced, at the same time they can actively participate in the green energy-saving campaign. Once they get out of the campus, they will become the main force of sustainable development. So it is of great significance to popularize the sustainable development (Simpson, 2003).

## 4. The concept of green school project

### 4.1. The proposal of green school project

The concept of the green school originated in an Ecological School Plan proposed by The Foundation of European Environmental Education (FEEE) in 1994. Its purpose is to make environmental education gradually penetrate into every sector of daily school management in an education classroom setting, and then to set up a comprehensive environmental management system for school. However, European green campus plan in early times was mainly confined to the level of environmental education in primary and secondary schools, or the level of sustainable education alliance in colleges and universities.

In 2007, with the deep research on the green building, United States Green Building Council (USGBC) launched National Green Schools Campaign, and they support green schools for everyone within this generation. To further its efforts to give access to green schools to all students within a generation, the U.S. Green Building Council (USGBC) has launched a new Center for Green Schools, which is funded by America's United Technologies Company. It is a very important step in the process of green school development, not only because they have a certain institution with funding, but also because the funded positions could become permanent in many places, as school districts realize the value of the position and begin paying salaries themselves. Compared with the green campus plan in Europe, Green Schools Campaign in United States covers all the school level, related students, teachers, principals, parents, government and other interest groups could experience comprehensive practice through green education, green space,

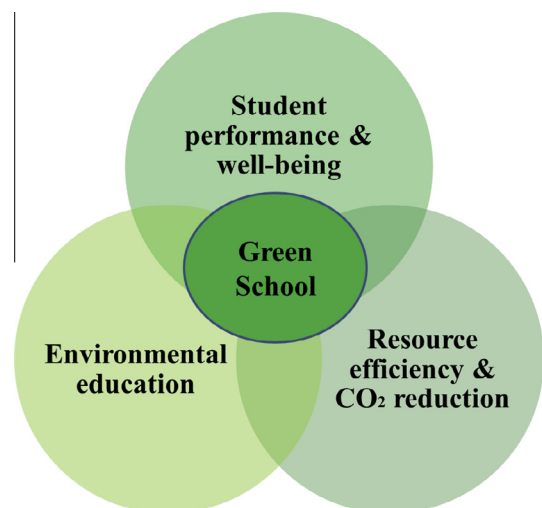


Fig. 1. The basic framework of green school.

and green alliance, so it has the stronger operability and practicality (Ramli et al., 2012).

#### 4.2. Definition of the green school

Globally, United States is the country to most widely carry out green school campaign with the necessary depth and the most abundant practical experience; so green schools in the United States has important significance for other regions. According to statistics, there are 133,000 primary and secondary schools (K-12 Schools), 4300 Colleges or Universities in the United States, about 25% of the population go to school every day. At present, in 20 of the largest school community, 80% of them promise to build green school, 94% of them promise to do this nearly every five years.

According to Center for Green Schools, “Green schools” is school building or facilities that create a healthy environment that is conducive to learning as well as saving energy, resources and money. Green campus without K-12 schools is defined as: A higher education community that is improving energy efficiency, conserving resources and enhancing environmental quality by educating for sustainability and creating healthy living and learning environments. While this definition is just a simple description of the green school, its long-term meaning is far more than that. According to Ireland, the green school, also known as Eco-Schools, is an international environmental education program, environmental management system and award scheme that promotes and acknowledges long-term, whole school action for the environment. Unlike a once-off project, it is a long-term program that introduces participants (students, teachers, parents and the wider community) to the concept of an environmental management system (He et al., 2014). However, green schools are far more than just an environmental management system. As shown in Fig. 1, in any case as a green building, the basic requirements of green school are energy efficiency, resources efficiency and CO<sub>2</sub> emissions reduction. Students must have a good environment to learn in; so it must create an indoor environment that provides good indoor air quality, thermal comfort, acoustic and day lighting. Green schools are more than green buildings; in the long term, the most important thing is to ensure the environment education significance of green schools.

#### 4.3. Characteristics of the green school

To develop and to build the green school design, the Centre of Green School USGBC had emphasized the general characteristics of green school:

- Conserve energy and natural resources
- Improve indoor air quality
- Remove toxic materials from places where children learn and play
- Employ day lighting strategies and improves classroom acoustics
- Decrease the burden on municipal water and wastewater treatment
- Encourage waste management efforts to benefit the local community and region
- Conserve fresh drinking water and helps manage storm water runoff
- Encourage recycling
- Promote habitats protection
- Reduced demand on local landfills

For architect or staff, the above requirements can be seen or can be quantified. However, for a green school with full education meaning, many requirements and characteristics are invisible

(Nifa et al., 2014). From the design point of view, a truly green school also is not the simple sum of a green classroom, green office building, green canteen and green dormitory (Tan et al., 2014; Muthu et al., 2015). To build a green school, we have to fully consider the systematic and integrity of green school from planning to monomer design, to reduce costs in the whole life cycle and to bring students from behavior consciousness of green design education significance.

#### 4.4. Rating systems of the green school

With the development of the green campus activities, many countries launched a green campus rating system based on the actual situation. To promote the green school, USGBC launched LEED for Schools rating system in 2006 based on LEED green building system. With gradual improvement, USGBC launched The LEED 2009 Green Building Rating System for Schools New Construction and Major Renovations, which address seven topics: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation in Design and Regional Priority. At present, the rating system of green school in United Kingdom is BREEAM Education 2008 based on Building Research Establishment Environmental Assessment Method. Table 1 compares the detail information of green school rating system in the world.

The classification forms are different in these standards; some use grade rating system, such as LEED for School, BREEAM Education 2008 and Green Star Education v1, and some adopt a complete degree rating system, such as DGNB, CASBEE and CSUS/GBC, as shown in Table 1. But these standards invariably reflect the sustainable development requirements of environmental protection and “four savings” (land saving, energy saving, water saving and material saving). Furthermore, all the requirements run through the planning and design, construction, operation and management in the whole life cycle.

Although these countries have launched corresponding rating systems according to the actual situation within their nations, these systems are open and professional. All data and methods in these evaluation systems are open to the public, so everyone in different countries could adopt them. Due to early development, LEED for School has been adopted by Canada, India, Indonesia, Saudi Arabia, Malaysia, and China. King Abdullah University of Science and Technology (KAUST) in Saudi Arabia had been awarded LEED Platinum certification, the highest of five possible environmental certification awards given out by USGBC in 2009. That was the first LEED certified project in Saudi history and was the largest LEED Platinum project in the world. An eco-friendly building at Taiwan’s National Cheng Kung University (NCKU) has achieved LEED Platinum certification in 2011. Additionally, some schools have been certified by other systems. With 805,000 m<sup>2</sup> green area, Shantou University in China became a famous scenic spot; the university focuses on renewable perception and traditional Chinese ancient beauty to create a green landscape campus with green central park concept (He et al., 2014). It depends on green technology, green education and green administration to build ecological environment with “green” theme. In 2008, its green school was the first school that passes the Germany environment star evaluation.

One aspect reflecting the sustainable development of green school is that these evaluation systems are continuously updated and developed. Green school is a complex and continuous developing building system, each issue or category is repeatable and adaptable, so it will respond in a timely manner to change uncertain performances. LEED for School is released based on LEED for New Construction (LEED NC) by USGBC. According to USGBC in United States, LEED for School will replace LEED NC to guide all new and major repaired primary and secondary schools teaching

**Table 1**  
Green campus evaluation systems in the world.

Item	LEED for School	BREEAM Education 2008	Green Star Education v1	DGNB	CASBEE	CSUS/GBC
Country	United States	United Kingdoms	Australia	Germany	Japan	China
Assessment criteria	Sustainable sites, Water efficiency, Energy and atmosphere, Materials and resources, Indoor environmental quality, Innovation in design, Regional priority	Management, Health & well-being, Energy, Transport, Water, Material, Waste, Land use and ecology, Pollution, Innovation	Management, Indoor environmental quality, Energy, Transport, Water, Material, land use & ecology, Emissions, Innovation	Ecological quality, Economic quality, Sociocultural and Technical quality, Technical quality, Process quality, Site quality	Environmental quality of the building, Environmental load reduction of the building	Planning & Sustainable site, Energy, material and water, Indoor environmental quality, Management, Education
Rank	Certified, Silver, Gold, Platinum	Pass, Good, Very good, Excellent, Outstanding	Best practice, Australian excellence, World leadership	Gold, Silver, Bronze	Poor (C), Fairly Poor (B-), Good (B+), Very Good (A), Excellent (S)	One star, Two star, Three star

buildings since April 2007, and scientific research buildings in university, sports buildings in primary and secondary schools and interpretive centers also could apply LEED for School. LEED for School put more emphasis on sustainable site, water efficiency, indoor environmental quality and innovation design issues. BREEAM Education 2008 is the latest version of BREEAM rating system, and it includes the early BREEAM school version and the new BREEAM Education version, so it extends the evaluation targets to a broader area.

## 5. Conclusions and discussion

In order to cope with environmental and energy problems, great efforts have been made all over the world in terms of agreements, projects, laws, standards and regulations. The green school project is put forward to promote initiatives toward the sustainable development of the whole society. Firstly, the basic function of green school is to improve the efficiency of energy and resources use and reduce carbon emissions; secondly, the green campus aims to create a healthy, comfortable and sustainable campus space, intending to improve the indoor comfort and students' performance. School, as a place to impart knowledge, should especially pay attention to environmental education, cultivating students' sustainable development awareness and spreading the concept of sustainable development. This article introduced the concept, the requirement and rating system of green school, which will make the whole society have a deeper understanding of green schools, and promote the development and construction of green school at a wider level.

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