

THE CURRENT STATUS OF BUILDING ENERGY EFFICIENCY AND COUNTER-MEASURES FOR BUILDING ENERGY EFFICIENCY IN THE PROCESS OF URBANIZATION IN CHINA

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1. Background of building energy efficiency developed in China

1.1 Population, geological position and climate characteristics

There is a large population in China, about 1.3 billion, among which urban population accounting for 30.89%, while rural population accounting for 69.11%; China is a country with a vast territory, occupying a land of 9.6 million square kilometers. It is situated in the northern semi-sphere at middle low latitude. Most of the area belongs to monsoon climate of Eastern Asia, with strong characteristics of continental climate. In winter, it is very cold; the temperature is much lower, 5 °C to 18 °C lower than the areas at the same latitude in the world. In summer, the temperature is higher, about 2 °C higher than the areas at the same latitude in the world.

According to building thermal design zones, our country is divided into five climate zones, i.e. severe cold, cold, cold winter - hot summer, mild and hot summer - warm winter zones. Generally speaking, severe cold and cold zones are situated in northern areas, cold winter - hot summer zones are situated in transitional areas, and hot summer - warm winter zones are situated in southern hot areas.

1.2 Economy, energy production and consumption level

Following the reform and opening to the outside world of our country, economy has been developing rapidly. The gross domestic product GDP increased from 896.4 billion RMB in 1985 to 8191.1 billion RMB in 1999. Due to the rapid economic development, energy consumption is bound to increase rapidly. The energy production and total energy consumption increased respectively from 855.46 million tons and 766.82 million tons of standard coal in 1985 to 1.10 billion tons and 1.22 billion tons of standard coal in 1999. Although average energy consumption for per capita did not reach half of the world average level, total energy consumption got the second place in the world. Anyway, our country is lack of energy resource respectively and average amount of energy possessed by per capita is

only 40 % of the average world level. What is more, the main energy resource is the coal, which accounts for 73.5% of the composition of energy consumption in our country.

1.3 Status of buildings stock and energy consumption

A large amount of buildings has been built. Until the end of 2000, in the existing civil building areas, the urban building areas reached to 7.66 billion square meters (in which the area of housing was 4.41 billion square meters), while the rural building areas reached to 29.94 billion square meters (in which the areas of housing accounted for about 80%). Most of buildings were built before 1986 when energy efficient design code has not adopted. The thermal performance is and the energy consumption of the buildings is relatively high which is much high than developed countries at the same latitude.

In order to increase energy utilization efficiency, reduce atmospheric pollution and reduce emission of CO₂ and its greenhouse effect, the following energy conservation work has been done for many years.

2. Policy, practical progress and effect of building energy conservation in China

2.1 Evolution of building energy conservation work developed in China

The **first period** (1980~1987): the period of technical research and technical standard research and formulation.

In March of 1986, the first standard in our country, the 《Energy conservation design standard for new heating residential buildings》(JGJ26-86) was issued. Relevant institutions were organized to undertake research and formulation of 《Energy conservation design standard on building envelop and air conditioning for tourist hotels》.

The **second period** (1988~1994): the period of undertaking pilot project experiment on building energy conservation and expanding demonstration effect.

The 《Opinion on speeding up renovation of wall materials and popularizing energy conservation buildings》 was formulated and implemented and energy conservation demonstration projects were developed; These pilot demonstration projects have provided successful experience for promoting comprehensive energy conservation work and obtained better result.

In September of 1993, the first commercial building standard, the《Energy conservation design standard on building envelope and air conditioning for tourist hotels》(GB 50189-93)was issued by the Ministry of Construction in our country and the work for energy conservation of commercial buildings was developed.

In this period, the Ministry of Construction issued early or later a series of standards and codes concerning energy conservation: in May of 1990, the 《Standard for design of artificial lighting of civil buildings》(GBJ 133-90) and in March 1993, the 《Code for thermal design of buildings》(GB 50176-93).

The **third period** (1994-1996): the period of formulating building energy conservation

policies and implementing building energy work in organizational way.

In 1994, the Ministry of Construction set up Building Energy Conservation Office and Energy Conservation Work Coordination Group with participation of responsible persons of various professional departments of the Ministry of Construction. A new period of formulating building energy conservation policies and implementing building energy conservation work in organizational way has started.

The 《The Ninth Five Year Plan and 2010 Planning for building energy conservation of China》 was formulated to make clear targets, key points, tasks, practical measures and steps; the 《Energy conservation design standard for new heating residential buildings》 (JGJ 26-95) (simplified as 《New standard》) was issued, by adopting of which 50% of energy could be saved; the 《Technical policy for building energy conservation》 and the 《Technical policy for energy conservation of municipal public utilities》 have been formulated and issued. In order to fully develop building energy conservation, technical preparation, technical standard preparation, organizational preparation and policy preparation have been fulfilled.

The **fourth period** (1996-): the period of implementing the second step of the target for energy saving 50% and start the energy conservation work in other areas.

In September of 1996, the Ministry of Construction held the first national conference on building energy conservation work, to make concrete arrangement and working plan to develop building energy conservation work nationwide in an all-round way, to implement new standard for building energy conservation and realize the second step of the target of energy saving 50%.

In November of 1999, the Ministry of Construction held the second national conference on building energy conservation to put up the strategy of implementing leaping-over development.

In order to carry out the 《law for energy conservation of the People's Republic of China》 and promote the implementing of the new standard for 50% energy saving, on February 18, 2000, the Ministry of Construction issued ministerial order 76 on the 《Regulations on management of energy efficiency for civil buildings》 .

Through research and study, the 《Design standard for energy efficiency of residential buildings in hot summer - cold winter zone》 (JGJ 134-2001) (J116-2001) was issued in 2001 and the 《Design standard for energy efficiency of residential buildings in southern hot zone》 and 《Design standard for energy efficiency of public buildings》 were started to research and formulate.

2.2 Policy for building energy conservation in China

In order to carry out building energy conservation work in good order and fully implement design standard for building energy conservation, the following policies have been adopted: starting from housing, gradually going to commercial buildings, then to industrial buildings; from the northern areas to transitional areas, then extending to hot southern areas; from newly

built buildings to existing buildings; from cities where the energy conservation work has been well done to ordinary cities and towns, then extending to vast areas of countryside; the policy of taking as key point the northern heating areas and newly built urban houses in transitional areas; and the policy of realizing charge reform by heat metering.

2.3 Organization and capacity building for energy conservation of buildings in China

According to functional division of the State Council, the Ministry of Construction is in charge of the construction in China; the Ministry of Construction is responsible for building energy conservation work nationwide. The Ministry of Construction has set up Energy Conservation Coordination Group and Building Energy Conservation Office, which are in charge of drafting building energy conservation planning and policies, determining key scientific and technical items, international cooperation items and doing daily work; the Ministry of Construction has set up also the Center for Energy Efficiency in Buildings of the Ministry of Construction, which is composed of Scientific and Technical Development Promoting Center, China Academy of Building Research and Beijing Zhongjian Building Research Institute. The responsibility of the Center is energy conservation technique popularization and demonstration projects, energy conservation technique research and standard formulation, as well as inspection and testing in relation to building energy conservation. The Center has worked together with Professional Committee on Building Energy Conservation of China Society of Building Industry and Professional Committee on Solar Energy Use of China to undertake various activities. The local governments at different levels set up also building energy conservation offices.

2.4 Effect of building energy conservation and its contribution

The technical research on building energy conservation has been developed in depth and a large amount of scientific and technical achievements with practical value has been obtained.

Through research and development for many years, many building energy efficient technical systems for building envelop and heating supply have been formed, which are in accordance with conditions of China.

A series of standards and codes for building energy efficiency and its practical technique has been formulated.

Design standards on energy conservation for residential buildings and some other relevant standards and codes in heating supply areas and transitional areas have been drafted early or later. In order to put the standards in practical use, detailed implementation regulations have been made in most of the areas.

Development and spreading of products in relation to building energy conservation have promoted industrialization of building energy efficiency technique.

In combination with the climate and resources in China, a large number of new types of composite walls, energy efficient doors and windows, and applied technique have been developed which meets the demand for building energy efficiency, and technique of solar energy applied in buildings.

Obvious achievements have been made in heating system equipment, energy efficient lighting appliance of buildings, as well as in control system and software development.

Taking pilot demonstration project as example, a large amount of energy efficient housing and buildings has been built.

Until the end of 2001, according to part of statistics, 190 million square meters of building energy efficient housing have been constructed. Reduce CO₂ emission about 31.02 million t.

Nationwide training policy on energy efficiency in buildings has been made and related training has been carried out in a wide spread way.

Teaching materials for training have been worked out and more than 8,000 people have attended training in various places of our country. book collections on energy efficiency in buildings, like 《Exterior insulation technique for exterior walls》 and 《Temperature control for heating system and heat metering technique》 have been published, while 《Building energy conservation technique in hot summer - cold winter zone》 and 《Solar energy building technique》 are under compilation and will be published.

International cooperation in the field of building energy conservation has been widely developed.

Since 80's, international cooperation on building energy conservation has been developed with UK, Sweden, Denmark, Germany, Finland, France, Norway, Canada and the United States of America and other international organizations. At present, the project on the Research and drafting on policy of economic encouragement for carrying out building energy code is under implementation, which is supported by Energy Foundation. Under the support of World Bank and UNDP, an application to GEF for the items of the Building energy efficiency and heating reform in China and the Determination of priority fields for energy conservation in China is being made.

Contribution of building energy conservation

According to incomplete statistics, until the end of 2000, 220 million square meters of energy efficient residential buildings were constructed in accumulation in whole China, which saved about 6.75 million tons of standard coal as energy source in accumulation and reduced emission of 16.55 million tons of CO₂.

3. Trend of urbanization and analysis of future building energy consumption in China

3.1 Trend of urbanization in China

Speeding up the process of urbanization has become an urgent task for economic development and social progress in our country. During the period of “The Tenth Five Year Plan”, the urbanization level will reach to about 35% and urban population will reach to about 460 million; to the year 2010, the urbanization level will reach to 40% and urban population will reach to 550 million. 800 communities will be built at city level and 19,000 institutional towns will be built.

3.2 Amount of housing construction

During the period of “The Tenth Five Year Plan”, the completed residential building areas of urban and rural will reach to 5.7 billion square meters in accumulation in the whole country, in which the completed areas for cities and towns will be 2.7 billion square meters and rural residential buildings 3 billion square meters; to the year 2010, urban and rural residential buildings will reach to 11.5 billion square meters, in which housing in cities and towns will be 5.5 billion square meters and rural housing 6 billion square meters. The average area for per capita in the cities and towns will reach to 26 square meters, while that of in rural areas will reach to 30 square meters.

3.3 Improvement of people’s living standard must with increase of energy-cost facilities

Following economic development of our country, the people’s living standard has been gradually improving and the demand for housing comfort has been growing higher and higher. The installation rate of air conditioners for urban residents has been vigorously increasing, from 0.71% in 1991 to 30.76% in 2000. Heating and air conditioning facilities will be increased year after year and domestic hot water will also be popularized; in order to ensure indoor air quality, ventilation equipment will be gradually used; the energy consumption will surely increase greatly and the proportion of building energy consumption in total energy consumption will be bigger and bigger.

3.4 Increase trend of urban building energy consumption in future ten years and analysis of emission of CO₂

According to macro-development target of our country as medium-developed country level, the speed of economic development of our country will maintain at about 8%, the relatively higher level within certain period. In rather long period of time, building energy consumption will be increased in a big margin. To the year 2010, the emission of CO₂ of building energy consumption will account for 35% of the total emission of our country.

4. Counter measures for building energy conservation in the process of urbanization

4.1 Strategy of building energy conservation

Building energy conservation is one of the important fields for construction science and technique work during “The Tenth Five Year Plan” period, the 《Regulations on management of energy efficiency for civil buildings》 will be carried out consistently and thoroughly; The reform for heat metering in cities will be promoted and implemented; the step for building energy conservation work in the transitional areas and southern hot areas will be speeded up; the adoption of new energy sources, such as solar energy and underground energy in buildings will be actively promoted.

4.2 Counter-measures of energy efficiency in buildings

In the process of urbanization of China, Chinese government will take the following activities for energy efficiency in buildings.

4.2.1 The 《Regulations on management of energy efficiency for civil buildings》 will be implemented fully.

The compulsory articles in standards for engineering construction developed and the inspection of energy saving work carried out, so as to promote effective implementation of

standards on building energy conservation;

4.2.2 speed up heating reform in China

Chinese state council will issue the document on reform of heating mechanism of cities and towns to promote the development of energy efficiency in buildings and heating as earlier as possible. It will be useful for changing the traditional heating system to a new system for heat metering and heating charge by the real energy consumption. To realize the transfer of heat, make it to be a “commodity”.

4.2.3 The work in hot summer - cold winter zone and in southern hot zone also is the key.

The implementation of the 《Design standard for energy efficiency of residential buildings in hot summer - cold winter zone》 (JGJ 134-2001) (J116-2001) must be enforced, Ministry of construction will issue the 《Design standard for energy efficiency of residential buildings in southern hot zone》 and 《Design standard for energy efficiency of public buildings》 ;

4.2.4 Utilization of new energy i.e. solar energy and geothermal energy

Most energy is coal and electricity for Chinese Buildings before, it is necessary for China to use new energy in buildings for save energy and protect environment. Especially the “Olympic Games 2008” will be held in Beijing, Chinese government has planed to construct some buildings which energy supply will be solar for the Olympic Games 2008. It will be a “ Green Olympic Games” in Beijing.

To make full of solar and geothermal energy, we worked out many action plan, such as, to formulate relevant policies and codes, to establish demonstration projects of solar and geothermal energy, to enhance the industrialized exploration of related products, etc,

4.2.5 Retrofitting of existing Buildings

Everyone knows China is a country with very big amount of existing buildings, and most of them are non-energy efficiency, The heat loss through buildings is very big, no one can control the room temperature. The existing buildings cost too much energy every year. It is very obvious that air pollution in heating season is much higher than other seasons. The people of living and working in this kind of buildings does not feel comfortable, they are suffering sometimes. It is urgent for China to start to take measures to retrofit the existing buildings right now. Ministry of construction has issued the 《Technical Specification for Energy Conservation Renovation of Existing Heating Residential Building》 (JGJ129-2000) (J 68-2001) in 2001. We plan to do renovation for the residential buildings in some big cities at first recent years and then enlarge to medium and small cities as the time goes.