

**Current Status of Energy Efficiency in Newly-built Buildings in Hot  
Summer & Cold Winter Area and Implementation of “Design  
Standards of Energy Efficiency in Residential Buildings in Hot  
Summer & Cold Winter Area”  
(EF Report on Technology of Projects in Hot Summer and Cold  
Winter Area)**

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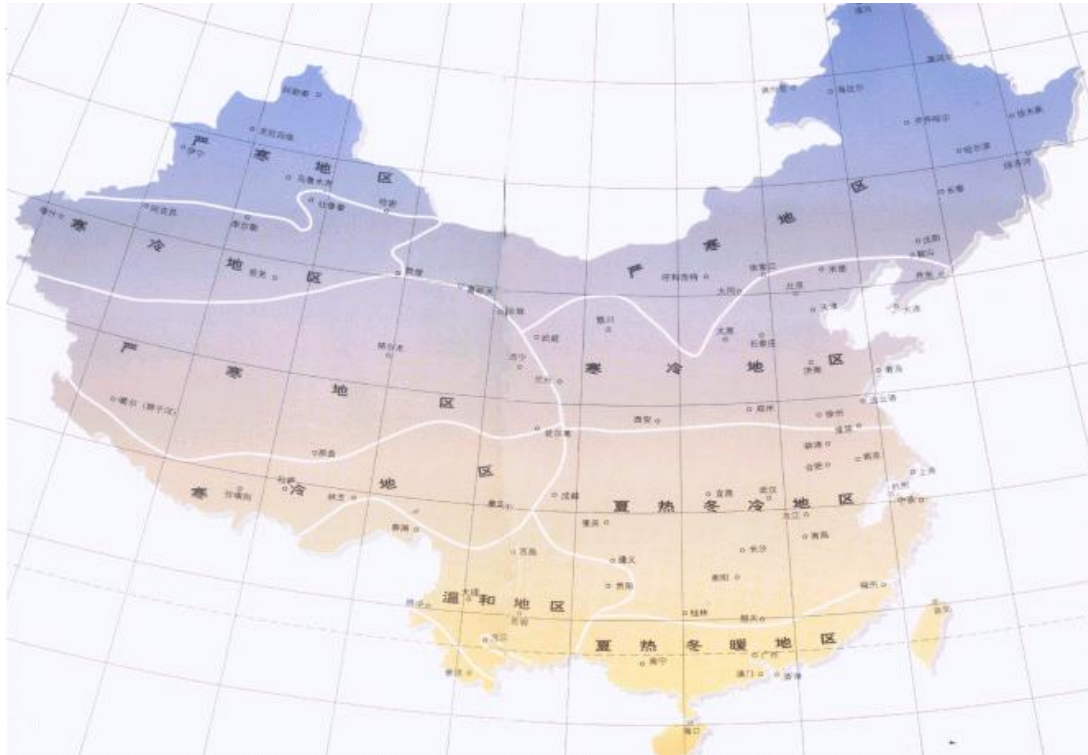
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## **Part One: Outline**

### **I Range of Hot Summer and Cold Winter Area**

According to China's climatic patterns, the middle part of China along Changjiang River and its surroundings belong to "Hot summer and cold winter area". It's also located between the cold area in North China and hot area in South China, therefore it's also called "transitional area". This range of the area roughly includes: south to Longhai Line, North to South Mountain Line, East to Sichuan, and can be described as "the middle and lower reaches of Changjiang River". It includes two municipalities—Shanghai and Chongqing; all of Hubei, Hunan, Jiangxi, Anhui, Zhejiang; the eastern part of Sichuan and Guizhou; the southern part of Jiangsu and Henan; the southern half of Fujian; the southern part of Shanxi and Gansu; the north top of Guangdong and Guangxi. All in all, hot summer and cold winter area includes 16 provinces and cities, and covers an area of 180 million square kilometers, with a population of 550 million. It takes a portion of 48% in China's GDP, and is the area with the biggest population. With the rapid development both in economy and culture, it is of great importance both politically and economically.



**Picture 1 Thermal Division in Buildings in China**

## **II Climate in Hot Summer and Cold Winter Zone**

The most distinct climatic characteristic of hot summer and cold winter area is that it's cold in winter while hot in summer; there are distinct differences between the four seasons, while summer and winter last for a long time with a high humidity; it's hot and humid in summer; cold and humid in winter. The daily temperature range is small, and the annual precipitation is big, with a comparatively shorter time of sunlight. There're many cloudy and rainy days at the end of spring and beginning of summer, and storm rain often falls.

In hot summer and cold winter area, there are about two months in spring and autumn separately, and about four months in winter and summer separately. In summer Pacific Subtropical High comes west along the river and will last for about one month. The ultra-hot area with a temperature over 35°C will last for half a month to one month in many places. The average temperature at 14 o'clock in the hottest month is as high as 32 ~ 33°C; and the lowest temperature is over 28°C. It's hot in the

day, and there's seldom wind at night, so the heat energy accumulated in the day can't be eliminated, which leads to a high temperature at night. When the strong cold wind comes, the cold air is blocked by South Mountain Line and hills in Southeast, so the cold time will last for long; especially in January, the average temperature is 8 ~ 10°C lower than any other area in the same latitude in the world, and is the coldest area in areas of the same latitude.

Besides, hot summer and cold winter area is also a water web zone, so the relative humidity (RH) in winter and summer is high, mainly at 70%. It's hot and humid in summer while cold and humid in winter, so isn't comfortable for living.

### **III Thermal Characteristics and Energy Consumption Status in Hot Summer and Cold Winter Zone**

#### **1. Thermal Characteristics in Buildings**

The outer wall of multi-storey buildings have been using 24-cm-thick solid clay bricks with the coefficient of heat transmission of  $2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$ . Even though other types of wall materials are used, the 24-cm-thick solid clay bricks are still taken as the reference object, and no other measure of heat insulation is used. In some places, hollow clay bricks are used so the heat insulation efficiency is comparatively higher; in other places, non-clay bricks such as shale bricks or sand-lime bricks are used; though their strength is higher, the heat insulation character is comparatively unsatisfying.

In terms of window, the single-glassed and metal-covered window is widely used, and measure of solar shading is seldom used outside the building. The heat insulation of single-glassed and metal-covered window is bad; in summer a lot of solar radiation can get indoor via windows as there's no solar shading measures; in winter the cold air will penetrate inside. As the commercial buildings are coming into market, some building designs increase the window-wall ratio to pursue the face effect, which will lead to a worse indoor thermal environment. In terms of the roof, flat roof is mainly

used, whose heat insulation is even worse than the wall; the aerial roof is used at many places, but it only has limit effect in heat insulation in summer.

In recent years, with the high pace of China's economic development, residents in the area take measures to solve the indoor thermal condition in summer and winter; using air conditioner in summer and heat supplier in winter has become a common phenomenon.

## **2. Energy-consuming Status in Buildings**

For many years, most of the buildings in hot summer and cold winter area haven't taken any measure of heating or cooling. Now as the living standard is advancing, residents use air-conditioners for cooling and electric heaters for heating; therefore, the energy efficiency is low and a lot of energy is wasted, which leads to a sharp increase in energy consuming in buildings. However, as the heating insulation of the buildings isn't changed, the improvement for residential environment is very limited.

On the other hand, due to the economic and historic reason, the present buildings in hot summer and cold winter area weren't built according to the requirements set by the energy efficiency in buildings design, and belong to high energy-consuming buildings; the indoor environment quality didn't even match the basic requirements for comfortable living. The peak electricity consumption in winter for heating and in summer for air-conditioning can take a portion of 40% in total electricity consumption.

According to the prediction by some data, if no effective measure of energy saving is taken, the residential building in hot summer and cold winter area will consume a lot of electricity energy in order to meet the thermal comfort condition: the electricity burden for air-conditioners is about 80 million kW in summer, and 200 million kW in winter; the electricity consumption in one year is about 224 billion kWh, while the annual electricity productivity of Three Gorges Dam is 84.7 billion kWh. Therefore, in order to satisfy the residential thermal environment along

Changjiang River, 3 Three Gorges Dam will be needed.

## **Part Two: Current Status of Energy Efficiency in Newly-built Building in Hot Summer and Cold Winter Area**

In order to carry out the related laws and regulations, policies and standards of nation energy efficiency, boost the energy efficiency work in China, make sure the smooth development of energy efficiency in buildings, so as to achieve the set goal, all places are carrying out energy efficiency work actively. As the key area in energy efficiency in buildings, the hot summer and cold winter area have already set a frame for energy efficiency, by ways of organizing special institutes, setting the policies, carrying out propaganda and training, constructing the technology platform, pay attention to demonstration projects, and strengthen supervision, etc. The energy efficiency work in all places is boosted smoothly.

### **I Organization Construction of Energy Efficiency in Buildings in Hot Summer and Cold Winter Area.**

In order to make sure the carry out of energy efficiency in buildings, and the related laws, regulations and policies are launched, 16 provinces and cities in hot summer and cold winter area have set the special leading team and office for energy efficiency in buildings, which is in charge of organizing, coordinating the energy efficiency work; further more, organizations are set in towns, states, counties and districts, which will take charge of implementation of energy saving in buildings in local.

A strict system for energy efficiency approval in buildings has been set in hot summer and cold winter area. All key points of energy saving are raised at different stages of a certain project, include project setting, scheming, designing, constructing, supervising, checking, checking and accepting at the completing stage, on sale approving, maintenance. No approval will be given to those projects which can't meet



the requirements by energy saving standards can't be approved. In general, a full close-cycle management system on project constructing is set.

In actual work, effective supervision is a lacked in the constructing procedure. Some real estate developers pursue “maximum of profit” and alter the approved designing plan, so there comes out a kind of false plan—the rate of energy efficiency in buildings at the designing stage is high, and is low at the construction stage; and the coordination in the check and accept stage is not good. As for those problems, the administration department in energy efficiency in buildings should take measures, such as strengthening the check up, issuing notification for those who broke regulation on energy efficiency, punishing the real estate developers, in order to make sure the energy efficiency work can be done practically. Meanwhile, the administration department should make sure the professional supervision and evaluation towards energy efficiency in buildings, and take full control of every procedure of construction.

The launch of “Statues on energy efficiency in civil residential buildings” in the nation and provinces will serve as a more effective facility of energy efficiency in buildings.

## **II Construction of Laws and Regulations System of Energy Efficiency in Buildings in Hot Summer and Cold Winter Area**

### **1. Construction of national laws and regulations system of energy efficiency in buildings**

Energy saving is a long-term strategy in the economy development in China. In terms of laws and regulation of energy efficiency in buildings, the national government and related administration department have launched policies, laws and statues targeted to different levels, which serve as legal bases and guarantees for the energy efficiency in buildings.

o In February 18, 2000, Ministry of Construction issued “Statues of energy efficiency in civil buildings”, which makes a clear definition of all procedures in energy efficiency in buildings, including the approving, designing, supervising and operating, etc., and sets a clear punishing system. In October 28, 2005, after discussion in the Ministry’s 76<sup>th</sup> executive meeting, some modifications were made in “Statues of energy efficiency in civil buildings”, so as to make it more suitable in the practical application.

In order to strengthen the management on energy efficiency in buildings, lower the energy consumption in buildings, advance the energy use efficiency, improve the indoor thermal environment and protect the environment, the Ministry of Construction issued “Architectural Energy Saving Management Regulations (SOLICIT OPINION DRAFT)” in February 7, 2006, thus made the energy efficiency policy concrete and restrainable. In June 27 2007, “Statues of energy efficiency in civil buildings (Draft)” was discussed in State Department Executive Meeting. The Meeting made a decision to notify this statues draft to the whole society; after collecting the feedback, the draft was again discussed by the State Department and announced to implementation.

## **2. Construction of laws and regulations system of energy efficiency in hot summer and cold winter area**

According to the related national regulation, laws and policies in energy efficiency in building, in order to improve the law system on energy efficiency in local, places in hot summer and cold winter area set and launch a series of laws and regulations on energy efficiency in buildings, combining with the local status, which serve as the powerful weapon in energy efficiency work. Meanwhile, in order to strength the coordination between different department, places in hot summer and cold winter area boost the setting and launching work of inspiring policy on energy efficiency in buildings, thus make a better condition for energy efficiency in buildings.

( 1 ) In terms of constructing the law and regulation system, Shanghai set an administration system in energy efficiency in the “10<sup>th</sup> five year plan”. Shanghai launched a series of documents consecutively, such as “Provisional Method for Management of Energy Efficiency in Residential Buildings in Shanghai”, “Suggestions on boost the energy efficiency in buildings in Shanghai”. Combined with the reform in construction material industry, Shanghai has strengthen the supervision on energy efficiency in buildings, in terms of procedures such as bidding, designing, planning approving, supervising at the construction locale, checking and accepting, etc. In July 15, 2005, the municipal statue “Method for management of energy efficiency in buildings in Shanghai” is officially launched, which is a powerful aid in energy efficiency in Shanghai.

Chongqing launched a series of documents, such as “Provisional Method for Management of Energy Efficiency in Civil Buildings in Chongqing”, “Notification on strengthening the energy efficiency in civil buildings issued by Chongqing Construction Committee Transmitted by Chongqing People’s Government Office”, which serve as policy supports in energy efficiency work. “Statues of energy efficiency in buildings in Chongqing” is about to be issued. In order to strengthen the implementation of “Statues of energy efficiency in buildings in Chongqing”, Chongqing is now carrying out 8 categories of work, such as propaganda, and setting the token system.

In the 10<sup>th</sup>-five-year, Hubei has launched “Statues of comprehensive use of energy in Hubei” and “Method for implementation of energy saving law in Hubei”. The provincial government issued “Method for management on energy efficiency in buildings in Hubei”, in the name of “Order of Governor” (No. 281 of the provincial government), and declared the requirement of “putting the responsibility of resources saving and actual effect into the cadres’ checking system and the Target for Asset Management”.

In order to carry out the energy efficiency in buildings smoothly, Zhejiang province set and launched a series of legal documents. In June 26 2001, Committee of

Economy and Trade of Zhejiang issued “Guidance suggestions on reform of wall material and energy efficiency in buildings”, and raised the requirements, principles and main goals on the reform of wall material and energy efficiency in buildings. “Method for management on spreading the energy efficiency in buildings in Zhejiang”—No 171 Order of Zhejiang Government, was launched into implementation since May 1, 2004.

In general, the laws and regulations setting on energy efficiency in buildings in hot summer and cold winter is not complete, and the provincial setting of laws or regulations are not satisfying, only the “Statues of energy efficiency in buildings in Chongqing” is about to be issued; and the draft of “Statues of energy efficiency in buildings in Shanghai” is finished; and “Statues of energy efficiency in buildings in Hunan” has completed the 2<sup>nd</sup> solicit opinion draft, and is about to be launched in the first half of 2008. The reason why number of the statues on energy efficiency in buildings is rare are: the foundation of energy efficiency in buildings in hot summer and cold winter area is comparatively weak, also the complicated procedure of legislation has made it difficult to launch a law or regulation.

( 2 ) In term of economic incenting policy system, Shanghai input 30 million Yuan in 2007 as the first stage aided by the municipal finance, and will input 50 million Yuan annually ever since, as the special fund for energy efficiency in buildings, and set the “Provisional Method for Use and Management of Special Capital for Energy Efficiency in Buildings in Shanghai”. Besides, the municipal government founded a special capital on energy efficiency in buildings, in order to honor the project team or staffs which make contribution in “Four New” technology application in energy efficiency in buildings; meanwhile Shanghai will modify and improve the local standards for energy efficiency in buildings, to fulfill the goal of entirely energy efficiency in being-built projects.

Chongqing will reduce the taxation on projects that meet the requirement of 65% energy saving, and use sustainable technology such as freshwater heat pumps, or solar energy, and play as the demonstration projects. Meanwhile, the municipal government

will increase the input of special fund in energy efficiency in buildings annually, and to reach 30 million Yuan in 2010. In 2008, Chongqing will continue to advance the technology reformation as the key procedure in achieving the energy saving goal. By investing 5 billion Yuan in “Ten-Energy-Saving Projects”, it will achieve the “Double 100” goal—implement 100 key projects on energy efficiency, and save 1 million tons of standard coal.

The energy saving plan of Hubei in 2008 is to reduce the comprehensive energy consumption for per 10 thousand Yuan GDP by 4.4%, reduce the elimination of demanded chemical oxygen by 2.5%, and reduce the elimination of sulfur dioxide by 3.5%. In order to achieve these goals, Hubei will input 300 million Yuan, and strengthen the energy efficiency work.

Hunan will arrange a special capital of 30 million Yuan on energy efficiency annually from 2008, and the Provincial Construction Department as well as the Provincial Economy Department will discuss the use of the capital. In Nov 2007, Hunan Government issued “Implementation Plan of Comprehensive Work in Energy Saving in Hunan” (No. [2007]29 by Hunan Government), in which the taxation preferable policy on energy efficiency was raised; the provincial finance department also promised to arrange special capital to support.

In 2007, Anhui set a special capital of 10 million Yuan for energy efficiency, in order to support the energy saving and comprehensive usage in projects in 43 cities. From January 1, 2008, the newly-built, expansion and rebuild projects are required to pay for the special capital for new wall material. As for units who use the energy saving material, the payment for the special capital will be returned, and non-users of energy saving materials will no longer have their payment.

On the basis of implement the demonstration projects in energy efficiency in building, Zhejiang also founded a special capital fund for energy efficiency in buildings. In the beginning of 2007, the provincial finance department and the provincial construction department issued “Provisional Method for Management on Special Capital on Energy Efficiency in Buildings in Zhejiang”, in which it declares that more attention should be paid to develop on new technology on energy efficiency

in buildings, sustainable energy (solar energy, shallow-ground energy, wind energy, etc) in demonstration projects, and improvement in compiling the standards for technology, and the special subsidy for projects which match the condition. The provincial construction department will evaluate the listed demonstration projects and then recommend those who will be included into subsidy plan.

Guizhou provincial government strengthens the support for technology reform in energy saving projects in terms of capital supply, and arranged 574 million Yuan for energy efficiency projects. Organize the application for national subsidy projects, and 9 projects were chose into the list, with the total investment of 930 million Yuan; organize the application for national energy efficiency honor projects, and 12 projects were chosen, with a total investment of 970 million Yuan; after the implementation of projects, 253 thousand tons of standard coal will be saved annually, 117 thousand tons of petrol will be saved or replaced annually.

From 2007, Jiangsu arranges 100 million Yuan annually special capital for energy saving and cycling economy, and will carry out 10-key-energy-efficiency projects, such as save or replace petrol, energy efficiency in departments and teams; so as to make the energy consumption per unit GDP decrease to 1.73 ton of standard coal in the whole province by the end of 2010, which is 20% lower than that of 2005.

In conclusion, in order to set and improve the economic incenting policy in energy efficiency in buildings, and advance the carry out of energy efficiency work, up to now, places in hot summer and cold winter area have set different sum of special capital for energy efficiency in buildings, and the special capital for demonstration projects of sustainable resources have been launched; besides, local cities set and issue the related economic policies supporting the energy efficiency according the local status, e.g. "Method for management of special capital in energy efficiency in buildings", "Implementation plan in comprehensive work for energy saving and emission cutting", etc. Further more, places are making efforts to improve the economic incenting policy, e.g. the draft of "Method for management of approval of special capital in energy efficiency in buildings in Shanghai" is completed and assigned, and will come into use after the approving procedure. Besides, financial

support is given to research and demonstration in energy efficiency in buildings, so as to boost the whole society's passion in energy saving. However, the economic incenting policy in energy efficiency in buildings in hot summer and cold winter also has short-comings: the inspiring policy on taking part in energy efficiency in buildings needs setting and improving; a market-oriented system to boost the energy efficiency is not yet founded, thus it's hard to restrain the action of some parts, which leads to an insensitive attitude toward index change in energy saving. Meanwhile, due to the gap in economic development, there's also gap in energy efficiency in buildings; energy efficiency work in Shanghai, Chongqing, Sichuan, Hubei, Hunan, Zhejiang and Jiangsu is comparatively better than in Anhui and Guizhou.

### **3. Analysis on policy system in energy efficiency in buildings in hot summer and cold winter area**

Up to now, laws and regulation system of energy efficiency in buildings in hot summer and cold winter area has been founded, but still it can't satisfy the need of the energy efficiency in buildings. Mainly the existing problems are:

( 1 ) lack of systematic and professional regulations

The special laws and regulation about energy efficiency in buildings are rare in China. Though a paragraph on energy efficiency in buildings is added to the modified "Laws on energy efficiency", it's not a special law. There's no regulation on energy efficiency in buildings neither in "Laws of construction". Therefore, it's hard to restrain the energy efficiency action in the level of laws.

( 2 ) The level of feasible laws and regulations is comparatively low, and has limited legal effect.

Most of the feasible laws and regulations in China are some methods, regulations and notifications set by the Ministry of Construction; they don't have legal restraints in practical use.

( 3 ) Some related laws and regulations lag behind

The range of some of the present laws and regulations are not exact, or lagging behind, which requires amendment, modification or abolishment. And for other laws and regulations, they are not complete, and in lack of coordination.

( 4 ) Short of related economic incenting policy

The lack of economic incenting policy in China leads to an imbalance in economic policy planning, and the market-oriented system can't run smoothly. There's no taxation restraint in constructing high energy-consuming construction, so the work of energy efficiency faces difficulties.

### **III The construction of standard system of energy efficiency in buildings in hot summer and cold winter area**

#### **1. Current status of the construction of standard system of energy efficiency in buildings in hot summer and cold winter area**

Standard system of energy efficiency in buildings is a technological guarantee of achieving the energy-saving goal, as well as the basis for practice such as designing, construction, check-and-accept, etc by staffs. In order to advance the energy efficiency in buildings smoothly, places in hot summer and cold winter area set related criteria and standard system, according to the national standards and the local situations. The details of some main provinces are as follows:

The criterion and standard of energy efficiency in buildings in Shanghai has been improved continuously. In the 10<sup>th</sup>-five-year period, the laws and regulations system of technology on energy efficiency in buildings is gradually forms. A series of criterion and standard are set and implemented: “Technological criterion of energy efficiency application in enclosure structure in residential buildings in Shanghai”, “Design standards of energy efficiency in public buildings in Shanghai”, “Evaluation standard of energy efficiency in residential buildings in Shanghai”, “Criterion of check-and-accept in energy efficiency in residential buildings”, etc, which are powerful technology support for the energy efficiency in buildings in Shanghai.



In 1999, the first systematical local standard of energy efficiency in buildings—“The design standard of thermal environment and energy efficiency in residential buildings in Chongqing” was completed in Chongqing. In 2002, after the national “Design standard of energy efficiency in residential buildings” was issued, Chongqing set the “Design standard of energy efficiency in residential buildings in Chongqing” at the first place; later it issued “Design standard of energy efficiency in public buildings in Chongqing”, “Criterion of check-and-accept in energy efficiency in residential buildings in Chongqing”, and a system of administration management and technological standard of energy efficiency in buildings is generally formed

In January 2005, Technology Supervision Bureau in Hubei and Provincial Construction Department issued the local standard “Design standard of energy efficiency in residential buildings”. Meanwhile, it compiled and launched a series of local standards—such as “Technological criterion in manufacturing autoclaved aerated-concrete block”, and some designing plots of energy efficiency in enclosure structure. These standards of energy efficiency technology offer a strong technology support for energy efficiency work in buildings throughout the whole province.

Technology Supervision Bureau in Zhejiang and Provincial Construction Department issued “Design standard of energy efficiency in residential buildings in Zhejiang” in December 22, 2003, and it came into effect in January 1 2004. “Construction Technology Criterion of Multi-holed and aerated-concrete Brick” is edited by Zhejiang Institution of Construction Designing and Office of New Wall Material Research in Zhejiang. Therefore, a system of laws and regulation is form in Zhejiang.

A comparatively complete system of criterion of energy efficiency in building plays an important part in practical use: the standard and criteria offer a scientific basis for energy efficiency in buildings; secondly, they are the important ways and powerful guarantees for energy efficiency technology and application of products; they offer a gurantee both in terms of technology and legality; thirdly, they will motivate the development of energy efficiency technology and products.

## **2. Some problems in standard system of energy efficiency in buildings in hot summer and cold winter area**

At present, the criterion system of energy efficiency in buildings in hot summer and cold winter area is not yet complete; the criterion for check at locale, evaluation and check-and-accept procedure is not perfect. The problems mainly are:

Firstly, the standard for energy efficiency in buildings are decentralized into systems of different majors, and hasn't formed an independent system, therefore can't take full control of amendment or modification.

Secondly, there's lack of related technology standards, e.g. technology guidance, standard plots, etc, therefore can't offer strong technological support for the implementation.

Thirdly, the lack of scientific foundation in compiling the standards for energy efficiency leads to the progress and quality of the standards setting, and the implementation of standards are short of related support from related technology and products.

Fourthly, there's lack of quality control during the process of energy efficiency in buildings and the ultimate standard for evaluation. So it's urgent to set and implement a labeling system of energy efficiency in buildings.

Fifthly, we should enhance the supervision work of implementation of technology criterion in energy efficiency in buildings, further perfect the supervision system and strengthen the supervision all over the procedure.

## **IV Current Statuses of Energy Efficiency in Newly-built Buildings in Hot Summer and Cold Winter Area**

### **1. General requirement of design standards of energy efficiency in newly-built buildings**

In July 2001, the Ministry of Construction issued “Design standard of energy efficiency in residential buildings in hot summer and cold winter area”, which is suited for the newly built, expanded, and modified buildings. The standard requires that: residential buildings should take measures of energy efficiency through strengthening the heat insulation of enclosure structure, and increasing the energy-effect rate in heating and cooling, so as to reduce the energy consumption by 50% compared with before, in condition that the same indoor thermal environment is maintained.

In April 2005, the Ministry of Construction conducted “Design standard of energy efficiency in public buildings”, which requires that: in condition to maintain the same indoor environment index, the energy consumption of heating, ventilation, lighting should be reduced by 50% compared with before.

In order to implement the design standard of energy efficiency in buildings more strictly an increase the implementation rate, the Ministry of Construction conducted “Notification of enhancing the check work on energy efficiency in civil buildings” in 2004. In 2005, the Ministry conducted “Notification of enhancing the implementation of standard for energy efficiency in newly built buildings”, “Notification of propaganda, implementation and supervision of ‘Design standard of energy efficiency in public buildings’”, which spread the supervision work to procedures like constructing, check-and-accept, sales, etc.

## **2. Implementation status of design standards of energy efficiency in buildings in hot summer and cold winter area**

( 1 ) Overview of design standards of energy efficiency in buildings in hot summer and cold winter area

In general, places in hot summer and cold winter area are advancing the 50%-energy-saving standard in newly built residential buildings and public buildings, and implementing “Notification of implementation of design standard on energy efficiency in newly-built buildings” (MOC (2005) No. 55) conducted by the Ministry of Construction, making strict access to designing, approving, supervising, checking-and-accepting, etc. For those public and residential buildings, which can't reach the standards of energy efficiency in buildings, no access will be given. All levels of administration department should examine the quality of new wall materials carefully, to avoid the un-qualified wall materials from being used. Therefore, the implementation of energy efficiency in buildings has made a lot of progress, with the standard rate of energy efficiency increasing steadily annually.

According to the research upon 3000 being-built projects in 16 provinces and cities in 2005, in the stage of designing document examine, the implementation rate of design standards for energy efficiency in newly built residential buildings is lower than 25%, while the rate in the construction stage is lower than 20%.

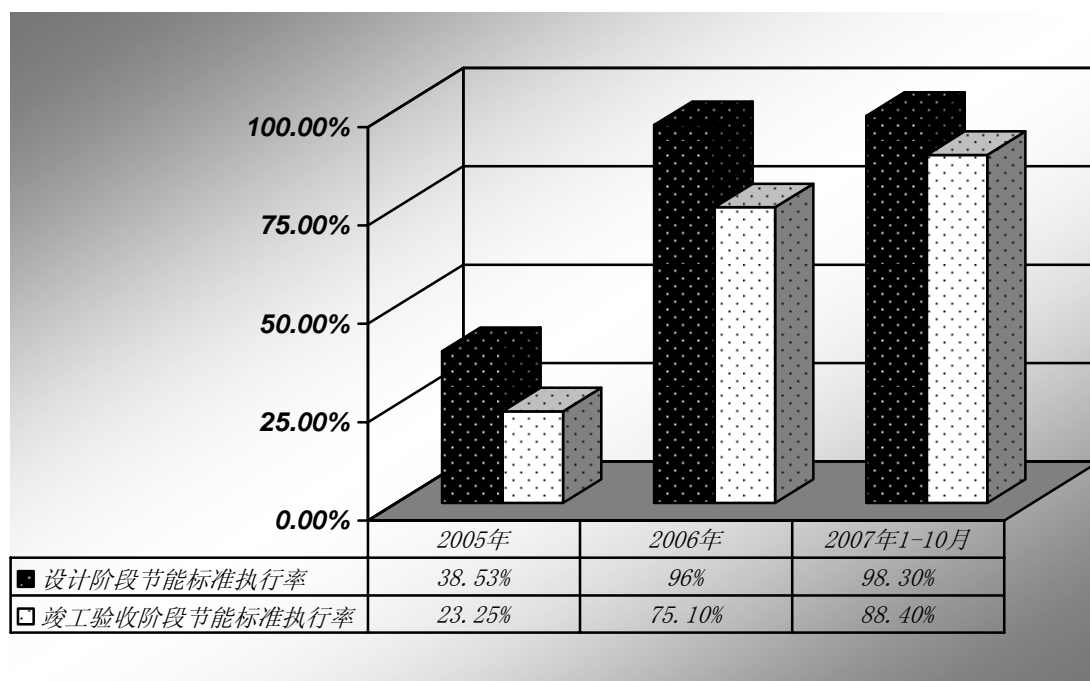
In the end of 2006, the check-up for national energy efficiency in buildings, which was carried out by the Ministry of Construction, showed that the newly built buildings have generally followed the design standards of energy efficiency and the ratio of energy efficiency in building is increasing. Up to the end of 2006, the implementation rate of design standards for energy efficiency in newly built residential buildings is about 90%, and the rate in the construction stage is 50%. Compared with the data of 2005, both indexes were increased by 30%.

In 2007, the statistics of check-up for energy efficiency in buildings by the Ministry of Construction show that, the implementation rates of energy efficiency in

newly built buildings in hot summer and cold winter area in both designing stage and constructing stage have been increased enormously. Among them, the implementation rates of energy efficiency in newly built buildings in Shanghai in both designing stage and constructing stage are 100%, so were the situations in other provinces and cities.

The implementation of standard for energy efficiency in newly built buildings in some main provinces and cities in hot summer and cold winter area are as follows:

In 2005, the implementation rate of design standards in buildings in Hubei was only 38.53%. In 2006, Hubei made a breakthrough. 2516 energy-saving projects were approved in cities, towns, with a total area of 32.4004 million square meters. the implementation rate of energy saving in designing stage reached 96%, and the rate in check up stage in newly built building was 75.1%, and 88.4% in the construction stage, the up-to-standard rate of "no-use-of-solid-clay-brick" was 100%。



**Illustration of implementation rate of newly built buildings design and construction standards in Hubei**

By the end of 2005, all the newly built buildings in 11 prefecture-level cities in Hunan Province have been designed according to the design standard of energy efficiency in buildings, and some of the projects were in the stage of constructing or finishing. The total constructed area of energy efficiency in buildings is 13 million

square meters, which took a portion of 38.6% of the total sum-33.691 million square meters. Among them, the total of energy efficiency design in Changsha reached 10.23 million square meters, and was on top place in Hunan province.

The implementation rate of energy efficiency design in buildings in 2006 was 100% in Anhui, and the rate of constructing was 64.7%. In national special check-up of energy efficiency in buildings, the energy efficiency in buildings in Anhui was at the third place in all the 16 provinces in hot summer and cold winter area.

Up to 2005, the design standard rate of energy efficiency in the implementation stage in Gansu province has reached 97.11%, and the rate in the check-and-accept stage has reached 71.76%. The covering rate of energy efficiency standard implementation in residential and public buildings is 100% in Lanzhou. The design standard in energy efficiency in prefecture-level city or above is all covered.

( 2 ) Implementation of design standards of energy efficiency in buildings in cite cities

The implementation of design standard for energy efficiency in buildings of the Four Cite Cities, which belongs to the project of “Advance the implementation of design standard for energy efficiency in residential buildings in hot summer and cold winter area in China”, is as follows:

Since 2005, the newly built buildings in Shanghai have all followed the design standards, and energy efficiency in public buildings or have-been-built buildings also began. Up to the first half of 2007, the have-been-built buildings in Shanghai covered a total area of 557.01 million square meters, among which a total sum of 78.55 million square meters were 30% energy efficiency. From January to October 2007, the newly built buildings covered an area of 51.5308 million square meters and the newly built residential buildings covered 28.8783 million square meters, the newly built public buildings covered 7.8022 million square meters, and the implementation rate for design standard of energy efficiency in buildings both in design stage and check-up stage is 100%.

By the first half-year of 2007, the have-been-built buildings in the whole city

covered 425.18 million square meters in Chongqing; and the area of 30% energy efficiency or above was about 51.2755 million square meters. From January to October in 2007, the newly built buildings covered an area of 44.8 million square meters, among them: the area of newly built residential buildings was 29.5 million square meters, the area of newly built public buildings was 15.32 million square meters, and the implementation rate for design standard of energy efficiency in buildings in design stage was 90%, and the rate was 58% in the check-up stage.

Since June 2003, Wuhan has put the energy efficiency in buildings into the range of checking stage. In January 2005, it was officially added into the range of special audit of construction document. In recent years, 3988 construction documents have been audited, with the total area of 24.2619 million square meters. The implementation rate of energy efficiency design in buildings has increase from 20% in 2001 to 80% in 2005. In 2006, all the newly built civil buildings, including residential and public buildings, have reached the energy efficiency standard.

From January to October 2007, Changsha has audited 12.49 million square meters of civil buildings, among them there were 10.34 million square meters of residential buildings, 2.15 million square meters of public buildings, and the area of energy efficiency buildings of final acceptance was 8.13 million square meters. At present, the implementation rate of energy efficiency in buildings at design stage and check-and-accept stage are both 100%.

### **3. Implementation of standard of 65% energy-saving in hot summer and cold winter area**

The 50% energy-saving standard of Stage Two in China “Design standard for energy efficiency in civil buildings” ( JGJ26-95 ) & “Design standard for energy efficiency in residential buildings in hot summer and cold winter area” ( JGJ134-2001 ) were issued in 1996 and 2001 separately, and the related technology is mature. However, standard of 65% energy saving in Stage Three hasn’t made.

While 50% energy saving standard was carried out in hot summer and cold winter area, the 65% energy saving standard is also being researched and tried.

Shanghai Municipal Government regulated that when the land of Jiading is auctioned, the 65% energy-saving will be a must requirement, and to sign the related item in the contract. As for those projects which are set as 65% energy efficiency, if the check wasn't approved, no approval will be given.

From 2007, in order to raise the consciousness of energy efficiency in Chongqing, Department of Construction made a decision to carry out the demonstration project of 65% energy-saving, and will give a tax relief to 65% energy-saving projects. Furthermore, Chongqing has implemented the 65% energy-saving standard in newly built residential buildings in the downtown since January 1 2008; and newly built public buildings will implement the 50% energy-saving standard from July 1 2008; other districts in downtown and other preferable counties will take the 50% energy-saving standard.

“Plot of Energy Efficiency in Buildings in The 11<sup>th</sup>-Five-Year in Hunan Province” demanded “the newly built civil buildings should implement energy efficiency standard to 50% energy-saving. By 2010, a complete system of energy efficiency in newly built civil buildings should be established. In 2010, 65% energy-saving standard will begin in Changsha.”

In its plot of development of construction and technology in the 11<sup>th</sup>-Five-Year, Jiangsu declared that “By the year of 2010, 65% energy-saving should be fully implemented in residential buildings.”

#### **4. Problems of implementation of energy efficiency in buildings in hot summer and cold winter area.**

Due to the lag off of China's standardization of energy efficiency in buildings, although we have made progress in the past 20 years, in generally, it's not compatible to the situation and tasks of the energy efficiency in buildings, and there're gaps on implementation of energy efficiency in different places. Besides, there are still some



defects in our work. Mainly the defects are four:

Firstly, there's no adequate standards of energy efficiency in buildings, and lack of energy efficiency in industrial buildings and suburb buildings; also lack of standards for checking and assessing.

Secondly, no enough research has been done on energy efficiency in buildings, thus there's not adequate scientific base.

Thirdly, systems of standards for energy efficiency in buildings are confusing, there's not an outline. And cross each other.

Fourthly, the supervision of energy efficiency in buildings lags behind badly, and can't keep pace with energy efficiency work, which is a big handicap at present.

In general, energy efficiency work in places in hot summer and cold winter area are not balances. Energy efficiency in Shanghai, Chongqing, Hunan and Hubei are carried out satisfying. One of the reasons for the imbalance is that economic level in these areas are higher, so the local government and residence have a stronger consciousness for energy efficiency in buildings'; while in other areas, due to the limitation of economical level and geographic position, the energy efficiency in buildings is comparatively weaker.

## **V Application of technology and materials of energy efficiency in buildings in hot summer and cold winter area**

The industry of construction materials in hot summer and cold winter area is of a high level, and the rapid development of new wall materials make way for energy efficiency in buildings. With the development of energy efficiency in buildings, new products and new technology of energy efficiency are coming out fast, e.g. shale multi-hole brick, hollow brick, ceramsite, hollow glass, heat-insulated aluminum alloy windows, self thermal wall system, solar shading system, etc. The industry of energy efficiency in buildings is enlarging more and more.

## **1. Application of technology and materials of energy efficiency in buildings in hot summer and cold winter area**

( 1 ) Technology system and technology standard of energy efficiency in buildings.

In order to strengthen the guidance of energy efficiency in buildings as well as the application of new wall materials, and to strengthen the management of energy efficiency in buildings, places in hot summer and cold winter area carry out research and application on energy efficiency technology and standard. Many places neaten the mature technology on energy efficiency, and compile a local index of energy saving technology.

Chongqing compiled and issued “Notification of restrict or deny laggard technology in construction field in Chongqing” (No. 1 & 2), and made regulation of restrict or deny 82 types of laggard technology. It issued 85 types of qualified technology on energy efficiency, and recommended more than 20 energy-saving technologies to 30 projects.

Hunan compiled and issued local technology standards, e.g. “Design standard of energy efficiency in residential buildings in Hunan”, “Technology code for concrete multi-hole bricks in construction”. It organized the Science of Construction Institute, University of Hunan to conduct a design and audit software, which can calculate and audit thermal characteristics exactly.

Department of Construction in Hubei issued “Index of application of new wall materials and energy efficiency in Hubei”, “Index of energy efficiency and restricted wall materials”. In terms of ground heat, it has now begun to compile “Technology code for technology of heat pump”, and has been doing demonstration projects. Meanwhile, it is assigning for demonstration project of ground heat in cities.

Zhejiang People’s Government issued “Methods of management of development and application of new wall materials in Zhejiang”, which came into power since May 1 2004. The office of new wall material development conducted “Recognition

methods for new wall material (products) in Zhejiang” (〔2002〕 No.3); on May 24, Department of Finance as well a Economy and Trade Committee in Zhejiang conducted “Suggestions on collection and utilization of special capital for new wall material in Zhejiang” (〔2004〕 No.42); In 2003, “Technology code for concrete multi-hole brick” (DB33/1014—2003) was officially issued.

Department of Construction in Gansu compiled the local standards of energy efficiency in buildings and the collection of design standard of energy efficiency in buildings, which offers a lot of fundamental technology code for energy efficiency in buildings. Some of the works are: “Design and Construct Code for rock wool external thermal insulation”, “Design and Construct Code for external insulating polyphenyl plate”, “Technology code for fly ash in construction”, etc. Gansu also developed technology and products on exterior heat insulation, e.g. “Research on exterior heat-insulated wall”, “Compound dope of heat insulation”, etc.

## ( 2 ) New wall material

The traditional enclosure structure in hot summer and cold winter area is 240-mm clay brick, and the heat transition index  $K$  is  $2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$ . Clay brick is made of earth, which is unrenewable, and in the process of producing, it will let out a lot of harmful ash, which leads to pollution to environment and reducement of land. The whole nation is strengthening the ban for clay brick. While banning clay brick in use, places in hot summer and cold winter area are enhancing technology progressing, implement technology renovation projects, and organize the production of new wall material and demonstration projects. Within a short tie, a dozen of new wall material enterprises were cultivated and reformed, which offers technological guarantee for the wall material renovation. New wall materials refer to wall materials with light weight, high strength, sound insulation, and heat insulation, etc, mainly include: multi-hole brick, hollow brick, grey ash brick, and concrete multi-hole brick, etc.

In Hubei, there are 1005 enterprises of new wall materials, compared with 2005, 394 enterprises are added. The annual productivity is 24.183 billion standard bricks.

Up to now, they have produced 11.375 billion standard bricks—18.77199 mu of land were saved, 705.3 thousand tons of energy was saved, and 15.5 thousand tons of waste gas was reduced.

Hunan developed a dozen of enterprises of exterior heat insulation in enclosure structure. 5 concrete brick producing enterprises are newly built or rebuilt. 36 types of heat insulation of exterior wall and roof were imported. Thus they guarantee the application of heat insulation projects in exterior wall and roof in Hunan.

Since 1990s, Zhejiang began to advance the reform of wall material and energy efficiency in buildings. By the end of 2000, it has constructed 836 producing enterprises, and formed a product system of multi-hole clay brick and concrete hollow blocks. In the past 5 years, 31.19 billion standard bricks were made, and the annual increase rate is 20%. The area of new wall material is 60.47 million square meters; the application rate is 51.8%. By way of wall material renovation, the province saved 50 thousand mu of land, 2.124 million tons of standard coal, and 7.379 million tons of waste sludge was utilized.

### ( 3 ) Technology system of heat insulation of exterior wall

In hot summer and cold winter area in China, the ultra-hot period lasts long in summer with a big radiation. So the thermal design requirement set by national standard is that “heat insulation should be satisfied and keep warm in winter as well”. The technology system of heat insulation of exterior wall puts the heat-insulated layer outside. Due to the big heat insulation, it can stop the hot air coming into the buildings effectively, so as to lower the temperature of buildings, therefore the indoor thermal environment is improved and energy for air conditioner or heat supplier is saving. So, hot summer and cold winter area should adapt this kind of heat insulation technology.

By ways of carrying out research on technology, provinces and cities in hot summer and cold winter area organize universities and science institutions to research on heat insulation, and conduct a series of code and technology system for heat insulation of exterior wall. At present, the main heat insulation system of exterior wall are: Expansion Polyphenyl Board Thin-plastering Exterior Wall and Exterior

Insulation System; External Insulating system of exterior wall with rubber powder poly-phenyl granule , and system of thermal insulation polymer mortar.

By the end of 10<sup>th</sup>-five-year, Hunan has completed a series of research, such as “improving the quality fired hollow brick”, and “Analysis on application of EIFS”, and has disseminated the exterior heating insulation system of exterior wall.

The capability of producing heat insulation materials in Chongqing has been strengthened. At present, enterprises for producing or selling insulation system of exterior wall are about 100, with a total area of 1 million square meters.

By way of widely investigation and practical approval, the Department of Construction in Jiangxi proved that, in hot summer and cold winter area in Jiangxi, utilization of EPS board, XPS board of exterior heating insulation system can fully satisfy the requirements of standard for energy efficiency in civil buildings in hot summer and cold winter area, and can obtain a good quality of water insulation. In terms of both heat insulation and security factor, it gained authorized approval. On the basis, Jiangxi compiled “Construction structure of heat insulation system of cement outer wall”.

Meanwhile, some types of new wall materials of energy efficiency, such as aerated concrete masonry used for exterior wall, fly ash, or other non-clay brick, are used widely in hot summer and cold winter area.

#### ( 4 ) Self Thermal Insulation System of Exterior Wall

Self thermal insulation system of exterior wall is a kind of energy saving technology on basis of the self heat insulation of the wall material. Materials such as lightweight autoclaved aerated concrete block can be used as a kind of wall material of self thermal insulation. At present, lightweight autoclaved aerated concrete block is seldom used in low residential buildings, and most multi-storey buildings use steel frame-reinforced concrete infill slit wall, therefore, the application of lightweight autoclaved aerated concrete block is quite limited. While the nation is encouraging the use of lightweight structure in residential buildings, the application rate of thermal insulation of exterior wall is increasing. Places in hot summer and cold winter area

also made a lot of practice on the research and application on the self thermal insulation system of exterior wall.

The “Accepting specification for the quality of energy-efficiency in residential buildings” ( DGL08-113-2005 ) of Shanghai appoints lightweight autoclaved aerated concrete block as the self thermal wall material, and “Recommended construction materials in Shanghai” also recommends it. In terms of products, Yuchen Self Thermal Wall Products by Yuchen Science & Technology Company Ltd, is a new technology of self thermal material with many good characteristics, and is considered one of the options to take place of traditional technologies in heat insulation.

In recent years, in order to research and develop the self thermal wall technology in energy efficiency in buildings, Department of Construction in Hubei has listed “Research on high-strength shale ceramsite in self thermal system of exterior wall” into the research projects of Provincial Construction Department. Up to now, the research has been finished and approved by experts. Xiaogan invested 120 million Yuan to import the automatic product line of V3-12 of Besell Co. in US, which will produce concrete hollow block with the self thermal function; and was now widely used after approval from the provincial construction department.

#### ( 5 ) window and door of energy efficiency

The energy consumption of window and door in building takes up 49% in the total consumption of enclosure structure. As the weakest part of heat insulation and one of the superficial maintenances of buildings, window and door will affect the energy efficiency directly. The traditional material of window and door in hot summer and cold winter area is single-glassed metal-cover window, with the heat transmission index  $K$  of  $6.4 \text{ W}/(\text{m}^2 \cdot \text{K})$ . The air-tightness of this kind is bad, and isn't capable to keep warmth or insulate heat, which leads to a bad indoor thermal environment. So it's essential to disseminate the utilization of energy saving materials in door and window. Mass use of new window and door of energy efficiency has been used in provinces and cities in hot summer and cold winter area. A lot of progress has been made in low-e glass, high-quality shallow glass and other energy-saving glasses.

Plastic window and door and aluminum alloy window and door are widely used in the main town in Chongqing. There are 200 product lines of plastic windows and the total productivity is about 3 million square meters. The hollow glass producing enterprises is now about 40, while two years ago the number was only 2; now the productivity is more than 16 million square meters. Hunan Province encouraged enterprises, which produce energy saving doors and windows, now it has more than 20 product lines for hollow glass, 100 product lines for plastic windows and doors. There are more than 100 product lines of product windows and doors, more than 500 enterprises of plastic windows and doors in Sichuan, with the annual productivity of 70 thousand tons and 1500 million square meters.

## **2. Problems in application of energy efficiency technology and materials in buildings in hot summer and cold winter area**

( 1 ) the technology standard system is not complete

Energy efficiency in buildings refers to quite a lot of majors; in order to achieve the energy saving goal, the technology standard system should make full use of all majors, to maximize the energy saving effect. At present, majors that are taking part in energy efficiency design are mainly construction, heating, and air-conditioners. In terms of structure, automatic, there is no adequate technological supply.

Besides, the scientific research by engineers is not enough, which leads to the lack of consecutiveness of energy efficiency in different professions, and the lack of technology-related documents. Therefore, technology support is inadequate. The research work in compiling standards is comparatively weak, and affects the quality of standards. Also, there is no related technology or product support. And be in lack of the control of energy efficiency process, as well as the final approval, evaluation and assessment standards.

( 2 ) the planning design lacks consciousness of energy efficiency

At present, the design for energy efficiency in buildings are mainly according to

design standard of energy efficiency in buildings, and focus on energy-saving measures in a single unit. However, there's no consciousness of energy efficiency in the planning. If advanced planning design, methods and used, we can lower the energy consumption. If we don't take energy efficiency into consideration in the planning stage, extra technology will be added in the construction design, in order to fulfill the standards for energy efficiency; therefore, it will be more difficult in the implementation, and block the way in energy efficiency.

Therefore, we must consider making use of the natural environment, greening of residential area, direction of buildings and overall arrangement, and the currency flow, etc, in order to achieve energy efficiency goal.

### ( 3 )Misunderstanding of choosing the technology for energy saving in buildings

With the development of science and technology as well as our practice of energy saving, all types of technology, equipment and materials on energy efficiency have come into being. As for the design staff, they should avoid the patch-up of technologies and think in a scientific as well as reasonable way. Architectures should keep a clear mind. On one hand, they should further study to master advanced technology; on the other hand, they should seek truths from facts.

## **VI Application of sustainable resources**

Application of sustainable resources refer to application of heating and cooling, hot water supplying, electricity supplying, energy for cooking supplying in buildings, by ways of making use of solar energy and shallow-ground energy.

In hot summer and cold winter area, there are various kinds of sustainable energy. And there's great potential for the use of solar energy and shallow-ground energy. In September 2007, the National Develop and Reform Committee issued "Medium and Long Term plan for sustainable energy", which requires that "Make use of geothermal resources reasonably; spread the technology of heat/hot water supply by geothermal energy and ground-source heat pumps which can both meet the environment and water resources protection; advance the ground-source heat pumps in hot summer and



cold winter area, in order to meet the need of heat supply in winter." At present, there are some site and demonstration projects on application of sustainable energy in hot summer and cold winter area.

At the end of 2005, Chongqing firstly raised suggestions of making use of water in Changjiang and Jialing River for freshwater heat pump, to the Ministry of Construction. Up to now, the freshwater heat pump technology base along Jialing River was founded; and the freshwater heat pump technology base along Changjiang River is being built; and the freshwater heat pump technology base along Jinke-TianhuMeizhen has been finished. Projects like hotel of Hilton, New district in tea garden are listed into the demonstration projects, with a total area of 150 thousand square meters.

Hunan Province actively cultivate and support a series of demonstration projects of application of sustainable resources, lower energy consumption and green ecology, such as freshwater heat pump, ground heat pump, and integrated application of solar energy, so as to advance the energy efficiency in buildings. By way to model sites, the level and ability of implementing energy efficiency standards are raised. A technology system of energy efficiency in civil buildings and public buildings is established, and is disseminated in the whole province.

In the process of leading energy efficiency via technology renovation, Hubei Province enhances the application of sustainable resources. "Methods for management of demonstration projects of application of sustainable resources" is conducted; organize Wuhan, Yichang and Xiangfan to assign for national demonstration projects of sustainable resources--34 projects are approved with the total area of 4.8651 million square meters. In terms of the application of ground heat, Hubei has now carried out the compiling work of "Technology code for ground heat pump used in air conditioners", and is doing sites models. In recent years, the whole province has implemented more than 40 projects of ground heating with a total area of more than 400 thousand square meters. Among them, "Technology on central air-conditioner of ground heat pump and technology of thermal recycling" in Qingjiang Garden won the "Renovation awards of national green construction". "Rixin Technology industrial

district" is a demonstration project of application of renewable resources.

## **VII Propaganda and training of energy efficiency in buildings**

The knowledge toward the importance of energy efficiency in buildings is a gradual process, and it's hard to achieve our goal simply by restraining measures. Therefore, besides using laws and regulations on policy and technology, it's also essential to enhance the propaganda and training work.

In order to raise the consciousness of energy efficiency in building in the whole society, places in hot summer and cold winter area takes multi-ways in media propaganda, such as newspapers, internet, TV, radio, charity advertisement, etc. On the other hand, by way of organizing the educational training, experts are invited to give lectures and trainings to administration staff and related technology staff on policy, standard, software, technology and products.

In the 10<sup>th</sup>-five-year, Shanghai carried out professional training and dissemination propaganda, targeting at different audience. Also "Technology and management of energy efficiency in residential buildings in Shanghai" was compiled for professional need, while "Fifty questions on energy efficiency in buildings" was compiled for ordinary readers.

In July 2003, Chongqing organized some experts and related staff to give consultancy on energy efficiency in buildings at the main town and rural suburb. Thousands of posters were put up in main streets and the walls of being-built projects, and more than 100 thousand handbooks on energy efficiency were handed out. Since June 2006, the city organized a contest on knowledge of energy efficiency in buildings. "People's Daily" and Xinhua.net also reported the energy efficiency activities in Chongqing.

From the 2<sup>nd</sup> half year of 2004, Science and Technology Office in Hunan Department of Construction carried out propaganda and trainings on energy efficiency in buildings. Propaganda was made in 14 cities throughout the province. The meeting on energy efficiency policy and technology were held for four times. And the training

of design standard for energy efficiency was give to administrative, designing staff for 14 times. Altogether, there were 2160 staffs that got trained.

## **Part Three: Conclusion and Suggestion on Implementation of Energy Efficiency in Buildings in Hot Summer and Cold Winter Area**

### **I Conclusion of energy efficiency in buildings in hot summer and cold winter area**

Most of the construction administration department in hot summer and cold winter area pay attention to energy efficiency work, and have made some achievements. Especially in 2005 and 2006, a majority of places strengthen the working power, and there have been great progress in energy efficiency in buildings. However, there are also a lot of problems.

The consciousness of energy saving is increased compared to before in hot summer and cold winter area. But in general, it's not enough; and due to the difference in economic status, the progress in energy efficiency in buildings is not balanced between big cities and small cities, or between urban areas and suburb. The concrete situations are:

1. The laws and regulation system on energy efficiency in buildings is roughly founded

Laws and regulation system on energy efficiency in buildings in hot summer and cold winter area is roughly founded, but still needs to be improved, and is lack of economic incenting policy; the systematic construction is of a considerate scale, and a system of design, construct, check-up and technology standards is built; the technology of residential and public buildings are compiled; the technology of reform on have-been-built buildings on energy efficiency are compiled.

2. "Design standards of energy efficiency in residential buildings in hot summer and cold winter area" is well launched

Since 2005, "Design standards of energy efficiency in residential buildings in hot summer and cold winter area" is well launched. The energy efficiency rate at both designing stage and construction stage is increased. Still there are some problems:

One is that understanding towards energy saving standard is not exact, while the enclosure structure is paid a lot of attention, the system of energy efficiency in buildings are not taken into consideration fully; secondly, the staff such as designing, approving, construction and supervision are not professional enough; thirdly, not strict enough in the check and accept stage; fourthly, the energy efficiency rate in the construction stage is comparatively low.

3. A technological system of energy efficiency in buildings has been generally formed

A technological system of energy efficiency in buildings has been generally formed, and technologies such as new wall materials and heating insulation of wall are widely used. However, there is no technological system of energy efficiency in buildings suited for hot summer and cold winter area. In the past, places in hot summer and cold winter area took reference to some experience in the North China, e.g. using the technology in heating insulation of wall used in the North. So the next step should be to solve all kinds of technological problems in local conditions, e.g. the longevity and security factor of heat insulation of wall. At the same time, the climatic pattern in hot summer and cold winter should be taken into consideration, such as to utilize ventilation or solar shading in energy saving.

## **II Suggestions of energy efficiency in buildings in hot summer and cold winter area**

1. Further improve the laws and regulation system, technology standards, and economical incenting policy on energy efficiency in buildings

Further improve the laws and regulation system, technology standards, and economical incenting policy on energy efficiency in buildings in hot summer and cold winter area. According to the local climate and environment, set the local standards and regulations which are higher than the national standards, and carry out them strictly; strengthen the cooperation and coordination between related departments, and boost the setting and launching of economical incenting policy on energy efficiency,

so as to support the implementation of energy efficiency in buildings.

## 2. Boost the reform in accounting system

Charging for heating and air-conditioning in buildings is a basic measure in energy efficiency in buildings and an important part in energy efficiency. By charging the heating and cooling, the energy-saving action of owners and users can be boosted, thus will bring forth economic benefit, and motivate owner and users to construct and buy residential buildings with energy efficiency, also it will boost the reform of energy efficiency in the have-been-built buildings. At present, the accounting system of heating and cooling in developed countries are quite mature; according to statistics, the energy saving rate ranges from 8%-15% after the accounting for air-conditioners are applied.

## 3. Take reasonable measure in energy efficiency technology in buildings

Relatively speaking, the enclosure structure doesn't take a great portion in energy efficiency in hot summer and cold winter area. When running the building designing work, besides insuring the thermal characteristics of enclosure structure in buildings, such as heat insulation, we should also define the orientation of building, plane form, cubic structure, outside form, storey height, and choose the energy saving material, also do green design for the surroundings, the design should be helpful to construction and maintenance, try to use heat insulation window and door, keep the window-door rate reasonably, reduce the energy consuming, to get a satisfying energy-saving effect. Meanwhile, the air-conditioner system should also be considered, avoiding the over-size designing; as for the vertical wall, solar shading methods, natural ventilation, green in surrounding and cooling technology should be used.

## 4. Mass application of sustainable energy in buildings

We should actively carry out mass application of sustainable energy in buildings, include solar energy, geothermal energy, photovoltaic/thermal integrated buildings solar system, and heating/cooling in buildings by low-ground energy. "The development plot of sustainable energy in medium-term and long-term", which was issued in September 2007 by National Develop and Reform Committee, requires that "Make use of geothermal resources reasonably; spread the technology of heat/hot

water supply by geothermal energy and ground-source heat pumps which can both meet the environment and water resources protection; advance the ground-source heat pumps in hot summer and cold winter area, in order to meet the need of heat supply in winter." Therefore, the demonstration projects of sustainable energy application, lower-energy-consuming and green ecological demonstration projects should be cultivated, so as to the boost the energy efficiency industry in buildings.

#### 5. Construct an evaluation system for energy consumption in buildings

The lack of an evaluation system for energy consumption in buildings is a main obstacle why energy efficiency in newly-built buildings can't run smoothly under market-oriented system. The reason is that it needs the right evaluation whether the buildings match the energy efficiency standard or have the capability of energy saving, and how much energy can be saved. Therefore, we should collect and perfect basic data for energy consumption in buildings, and set an evaluation system for energy consumption in buildings. The research on a Market Admittance System in newly-built buildings requires that: all commercial buildings should bring forth the energy consumption index given by evaluation institutes, and they must explain to the consumers all meanings of all indexed, in order to boost the energy efficiency in buildings.

#### 6. Carry out construction of pilot and site projects actively

Carrying out construction of pilot and site projects is an effective way to boost energy efficiency in buildings by government under market-oriented economy, as well as a carrier of spreading new technology, new products and new equipment of energy-saving. All places should carry out site project in better cities, so as to turn scientific fruits into productivity, and to spread new technology and energy efficiency buildings, which will accumulate experience for energy efficiency work in other places.