

**Current Status of Energy Efficiency in Buildings in Hot Summer and
Warm Winter Zone
& Implementation of “Design Standard for Energy Efficiency in
Buildings in Hot Summer and Warm Winter Zone”
(EF Report on Technology of Projects in Hot Summer and Warm
Winter Zone)**

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Part One: Outline

In 1970s, the concept of energy efficiency in buildings was officially raised. Its essence is to reduce the energy consuming as well as raise the energy efficiency in building. After 30 years, the issue of petroleum and energy has once again drawn a lot of attention worldwide. In China, the issue of energy is so obvious that we all know we are facing a crisis of energy. Therefore it's urgent to raise energy efficiency in buildings.

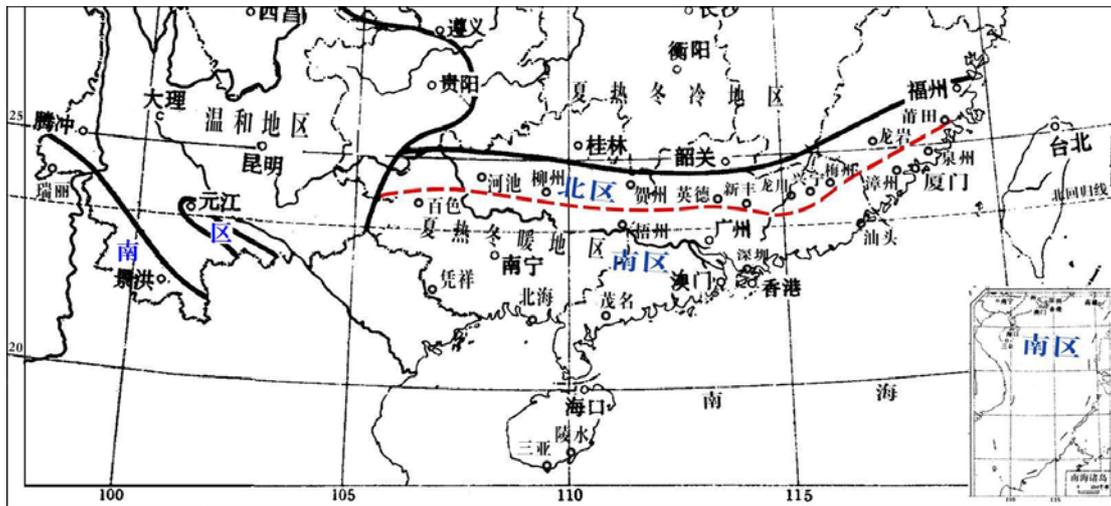
Hot summer and warm winter zone locates in the South of China, with a population of 150 million, and is the upfront of China's reform and opening policy with a comparatively higher level of living. After the reform and opening policy, economy there has boosted rapidly, and people's living standard is greatly increased. It now takes a portion of 17.4% in Chinese GDP, and 38.6% in Chinese sum total of foreign trade. Some municipals in costal areas are highlights of this fast-developing area, especially Zhujiang Triangle Area. Hot summer and warm winter zone is now the key point in energy efficiency in buildings in China.

I Administrative Divisions of Hot Summer and Warm Winter Zone

In terms of administrative divisions, hot summer and warm winter zone includes: Hainan Province, most of Guangdong and Guangxi Province, a small part of Yunnan Province, Hongkong, Macau and Taiwan, as illustrated in China map. See Picture 1.

Hot summer and warm winter zone can be further divided into the southern zone and the northern zone, on basis of the heating supply need of the northern zone. It is divided into the above two sub-zones according to the average temperature of January--11.5°C. We must consider both air conditioners in summer as well as heating supply in winter in northern part; whereas in the southern part, only air conditioners in summer are considered. The reason is: to lower the energy consumption, requirement of the primary structure differs from air conditioners and heating supply. Therefore,

this division can make the parameter requirements for primary structure more reasonable.



Picture 1 Administrative Divisions of Hot Summer and Warm Winter Zone

II Climatic Patterns in Hot Summer and Warm Winter Area

Hot summer and warm winter zone, a.k.a South China, is one of the division set by "Code for thermal design of civil buildings "GB 50176—93, and belongs to the IV climate zone set by "Standard for climatic regionalization for building and civil engineering ". It lies in the south part of China, and includes all of Hainan, Taiwan; south of Fujian, most of Guangdong and Guangxi, and southwest of Yunnan and Yanjiang. Tropic of Cancer crosses it in the north, and it belongs to the Southern Subtropical Climate. In these areas, there is a long summer, and no winter, with a high temperature and humidity. The yearly & daily temperature range is small. Due to the sun wind, people living there are used to the climate and seldom feel hot. The annual coldest month is above 10 degrees, while the hottest is between 25°C-29°C. The ultra highest is generally below 40°C, daily temperature above 25°C is about 100-200 days, annual humidity is about 80%. There is plenty of rain, and is the area with the most precipitation in China. Tropical storms and typhoon are quite often there; elevation angle is big, and with a big radiation.

The basic requirements of energy efficiency in buildings in hot summer and

warm winter area are: due to the climatic characteristic, the energy consumption mainly comes from temperature lowering in summer. Therefore the thermal design in energy efficiency should include anti-heat, dehumidify, and ventilation; while warm keeping can be ignored in winter.

III Thermal characteristics of buildings in hot summer and warm winter zone

The traditional buildings in hot summer and warm winter area always think high of ventilation and solid shading, and usually there are many stories. A lot of heavy materials are used in the roof or outside wall: 240 mm solid clay bricks are used at outside wall, while heat insulation is used on the roof, for example, the floor tile ventilation roof. In 1970s, 180 mm solid clay bricks were largely used in order to save the cost, but the thermal function can't satisfy the requirement of national thermal design. With the development of new construction material, light heat insulation materials are increasing day by day. Besides, as the parapet wall is higher, the ventilation roof can't function well; solid shading is seldom considered in outdoor windows. Therefore, the indoor thermal condition is not satisfying. In general, the thermal function in the area is bad, and thermal comfort data is not good. For example, the coldest month of Nanning in winter is January, with a poor PMV ranging from -2.3 to -1.7; even there is sunshine, PMV is only -1.5. In summer, the function of heat insulation is poor, and with a little damping factor of primary structure.

In recent years, air conditioners in building are developing rapidly. Despite the fact that air conditioners are used more, the scale of building is getting bigger, Thermal Performance of Envelope Structure is still quite below average level. Therefore the energy efficiency of air conditioners is low, and electric energy is being wasted, and also Indoor Thermal Comfort is not satisfying. Meanwhile, it's also one of the factors for the air pollution in cities, and has resulted in the increase of greenhouse gas.

IV Energy Consumption Status of Buildings in Hot summer and warm winter zone

As the statistics show, the electricity consumption in hot summer and warm winter area in winter don't differ, while there's a huge range in summer, which is resulted by the usage of air conditioner. Statistics show that the air condition in every family in Shenzhen is 1.2 in 1990, 2.5 in 1991, 40 in 1994. Now a lot of new buildings are built with air conditioners. What's worse is that some family even have 3 air conditioners. The energy consumption is surprising, it has take up one third of the whole electricity consumption, peak-to-valley difference is up to 2:1 which leads to an increase on investment of electricity supply. Since 2000, the above index has increased by 20%, along with the increase of residential area and the electronic equipment. The large energy consumption on air conditioners leads to a frequent electricity limitation when in peak; meanwhile, the thermal environment isn't improved obviously, and the energy is wasted.

Therefore, we can see the urgency to carry out energy efficiency in hot summer and warm winter zone. Energy efficiency is a necessity in the development of economy and society, and is the root to build an environment-friendly society, also a must-do to improve the residential environment.

Part Two: Current Status of Energy Efficiency in Newly-built Buildings in Hot Summer and Warm Winter Zone

With the development of Chinese legislation, from “Regulations on Management of Energy Efficiency in Residential Buildings” (No. 143 by MOC), to the to-be-issued laws, such as “Statutes of Energy Efficiency in Residential Buildings” and “Laws on Energy Saving”, we can see that a legislation system on energy efficiency in buildings has been set up.

Under the leadership of national laws and regulations on energy efficiency in buildings, the whole country is taking measures to launch related regulations; and considering the local status, a series of local laws and regulations on energy efficiency in buildings are set. Therefore, a complete system of national and local regulations on energy efficiency in buildings is set, which help boost the energy efficiency in China.

Due some reasons, though the energy efficiency in buildings in hot summer and warm winter zone was carried out a little late, we made progress through efforts. In recent years, institutions of energy efficiency have been founded in hot summer and warm winter zone, as well as the related supervision, new technology and new products, and a series steps of training and propaganda. Now the energy efficiency work is advancing day by day.

I Regulations on Energy Efficiency in Buildings

In order to carry out the national policy of energy efficiency in buildings, most of Guangdong Province formulate related policies and take effective measures, and have made progress up to now. Firstly, assess system of energy saving shop drawing have been made and launched in places and cities in the province. Secondly, some cities are accelerating the legislation of energy efficiency in buildings: Shenzhen has launched

“Statues on Energy Efficiency in Buildings in Shenzhen” in July 2006. Guangzhou, Zhuhai, Qingyuan, Shaoguan and other cities have launched the Management of New Wall Materials in the name of municipal government. Shenzhen and Shaoguan set the Check and Accept Regulation on Energy Efficiency Projects, which plays an important role in restraining the related construction units. The management methods of energy efficiency in buildings has been included to the local governmental plan in Guangzhou and Zhuhai. Thirdly, a special scheme for energy efficiency in buildings is launched in some cities, e.g. “Long-term Scheme for Energy Efficiency in Buildings in Foshan”, “Outline for Energy Efficiency in Buildings in the ‘11th five years’ in Dongguan”, “Outline for Energy Efficiency in Buildings in the ‘11th five years’” of Shantou, “Outline for Energy Efficiency in Buildings in the ‘11th five years’ in Shenzhen”. Zhaoqing is drawing up “Plan for Energy Efficiency in Buildings in Zhaoqing”. Huizhou is also preparing for “Outline for Energy Efficiency in Buildings in the ‘11th five years’ in Huizhou”. Besides, Shantou has established an assessment system for energy efficiency in buildings, and handed out “Notification on printing ‘assessment system for energy efficiency in buildings’”, which clarifies target, task distribution, assessing contents, assessing procedures, and so on.

II Standard for Energy Saving Technology of Building

Guangdong Province has made a breakthrough in the renovation of wall materials. Firstly, “Regulations on development and application of new wall materials” was launched as a good example for laws and regulations of new wall materials spreading. Secondly, the product output in new wall material made obvious progress. There are about 400 enterprises in new wall materials, the productive rate of new wall material is about 32.3%, which surpasses 20% than the national rate; and in Guangzhou and Dongguan; thirdly, the application of new wall materials are progressing, and the rate is increasing tremendously. And in terms of special fund on wall materials projects, the special fund for wall materials reforming is collected in the whole province and is used for energy efficiency work.

Fujian Province has launched “Implementation details on design standard in energy efficiency in buildings in Fujian Province” since 2005, and has been enhancing the pace on research and development of new architecture materials and new products. In recent years, the sum of newly-developed materials and products on energy saving has reached about 100. Among them, there are 20 kinds which have passed the provincial checkup. For example, the aerated concrete by Fuzhou Houde Construction Materials Co, and the “Fuyao Glass”--a kind of energy saving glass.

In order to spread the renovation of wall material and energy efficiency in building, the Yunnan Provincial government commands that solid clay bricks are forbidden in use in all cities by the end of 2010. In 2010, the yield volume of new wall material will cover a portion of more than 50%, and its application in building will be more than 50%,

III Implementation and Supervision of Standard for Energy Saving Technology of Newly-built Building

1. Implementation status of Standard for Energy Saving in Newly-built Building

According to statistics, the implementation of energy efficiency

(1) Shenzhen City

	2006	2007
Total area of buildings (10,000m ²)	22500	24000
Area of newly-built buildings (10,000m²)	1500	1600
Newly built residential (10,000m ²)	950	1000
Newly built for public (10,000 m ²)	550	600
Rate of energy efficiency in building in design stage	65%	100%
Rate of energy efficiency in building in check & accept stage	50% (estimated)	100%
Sum area of 50% energy efficiency (10,000 m ²)	750	2350

(2) Guangzhou

	2006	2007
Total area of buildings (10,000m ²)	28585.19	30116.79
Area of newly-built buildings (10,000m²)	1410.61	1531.6
Newly built residential (10,000m ²)	748.77	881.6
Newly built for public (10,000 m ²)	661.84	650
Rate of energy efficiency in building in design stage	80%	100%
Rate of energy efficiency in building in check & accept stage	50%	80%
Sum area of 50% energy efficiency (10,000 m ²)	1889.1	3114.38

(3) Fuzhou

	2006	2007
Total area of buildings (10,000m ²)	23500	24220
Area of newly-built buildings (10,000m²)	1076	720
Newly built residential (10,000m ²)	1028	598
Newly built for public (10,000 m ²)	48	67
Rate of energy efficiency in building in design stage	100%	100%
Rate of energy efficiency in building in check & accept stage	100%	100%
Sum area of 30% energy efficiency (10,000 m ²)	3080	3800
Sum area of 50% energy efficiency (10,000 m ²)	1280	2000

2. Supervision of energy saving in newly-built buildings

In April 15, 2007, Office of Construction in Guangdong approved "Implementation details of 'Design Standard for energy efficiency in public buildings' in Guangdong". This "Details" adds the energy consumption of window and walls into the category, and forbid to use mass glass wall. On condition to make sure the thermal comfort index, the total energy consumption included heat-supply, ventilation, air-conditioner and lighting in public buildings should reduce by 5%. According to the "details", in hot summer and warm winter area in Guangzhou and Shenzhen, the outer window (transparent wall included) must take a portion of below 70%. The area of

transparent roof should take a portion of the total roof area below 20%. In order to lower the temperature, it's suggested that the outer wall should be painted light in public buildings, so as to reflect the sunshine.

In order to reduce the energy consumption, Guangxi Province has launched a series of regulations, such as: "Design Standard for Energy Efficiency in Residential Buildings in Guangxi Zhuang Autonomous Region", "Design Sample for Energy Efficiency in Public Buildings in Guangxi Zhuang Autonomous Region", "Assessment of Energy Efficiency in Civil Buildings in Guangxi Zhuang Autonomous Region", and "Assessment for Air Conditioners and Ventilation in Guangxi Zhuang Autonomous Region". According to these new regulations, any public or civil buildings which can't pass won't be checked and accepted, nor can they be sold or used.

The Office of Construction in Hainan has launched "Scheme for energy saving and pollutants discharge reducing in construction in Hainan". It is required that: from Oct 1, 2007, projects that can't reach the standard of energy saving are forbidden to go through the checkup procedure; From Jan 1, 2008, all the newly-built commercial residential buildings must list clearly in contracts the energy consumption volume and measures of energy saving.

IV Energy efficiency management on national office buildings and large public building

Guangdong Province has followed the requirements set by "Implementation Suggestions on strengthen the Energy efficiency management on national office buildings and large public building ", and carried out the construction on supervision system of national office buildings and large public buildings. Among them, national office buildings and large public building in Shenzhen is on a leading level, the reasons are: "Implementation scheme on energy efficiency in national office buildings and large public building" is of leading level, and with maneuverability; and all working of national office buildings and large public building in Shenzhen is

progressing smoothly, investigations on 1139 buildings are finished, and about 600 key buildings are preparing for the energy consumption public notification. Besides, Guangzhou, Dongguan and some other cities have done some related investigations.

Following by the requirement set by Ministry of Construction, Hainan Province also have takes measures. Firstly, "Implementation Scheme on Energy efficiency management on national office buildings and large public buildings in Hainan Province" is made after research. Secondly, a supervision system of the Energy efficiency management on national office buildings and large public building in Hainan is generally made. Thirdly, National Investigation Team was appointed to do energy consumption calculation of national office buildings and large public buildings in Hainan Province. It is progressing so far smoothly.

V Application of sustainable resources in buildings

Guangdong Province has made great achievement in massive application of sustainable resources in building. First, it carries out an investigation on solar energy, and draft out "report on usage of solar energy in Guangdong Province". Secondly, many model projects on application of sustainable resources are constructed in the province; for example, Boyu Center Hospital in Guangzhou is listed as model project "the 3rd serious of sustainable recourses" issued by Ministry of Construction and Ministry of Finance. Thirdly, topic researches on massive application of energy efficiency in buildings are carried out gradually. Other cities, such as Zhongshan, Foshan, Meizhou, Yangjiang, also research and practice a lot in application of sustainable resources

Meanwhile, Hainan province is also disseminating the application of sustainable resource in construction. First, the solar heating integrated building system is used throughout the province, new-built or modified building under 12 floor are required to use this technology. Up to now, the total area of solar energy integrated building is about 2.5 million square meters. Secondly, the energy efficiency work is carried out by ways of energy saving in buildings, green construction and model projects of solar

energy. Thirdly, to carry out comprehensive usage of solar energy. Solar photovoltaic technology is widely used in high way traffic lights. Solar air conditioners are used in Mazda Auto Company, and are being designed in Hainan University and Huaqiao Middle School. Besides, solar energy drier is used in Oriental Salt, and solar energy; desalination is being used.

Part Three: Summary on energy efficiency in buildings in hot summer and warm winter area

I Summary on work of energy efficiency in buildings in hot summer and warm winter area

Since the energy saving in buildings in hot summer and warm winter zone began, a lot of effective measures were carried out, and a lot of progress has been made in cities.

1. A working system of energy efficiency in building is generally established.

The head construction department launched a team of energy efficiency. Meanwhile, some cities boosted the energy saving using wall material reforming as the grasp

2. Strengthen the legislation of energy efficiency in buildings and related policy

Through the legislation construction, hot summer and warm winter zone has made the energy efficiency in building both legal and standardize. For example, Shenzhen and Hainan set up "Regulations on management of energy efficiency in buildings". These laws and regulations become a solid base for the energy efficiency in building.

3. Strengthen the supervision of energy efficiency in buildings

By way of enhance the supervision of newly-built construction in hot summer and warm winter area, the implementation rate of "Design standards for energy efficiency in residential buildings in hot summer and warm winter zone" (JGJ75-2003) is increasing yearly. Meanwhile, places carry out special check-up of energy efficiency, and take measures to punish those newly-buildings which can't

meet the requirements of the regulations.

4. Strengthen the set-up of standards for energy efficiency and spread of application of energy-saving materials

Places in hot summer and warm winter zone all pay attention to the set-up of standards for energy efficiency, and draw up the design, construction and check-and-accept technology. Meanwhile, places carry out many activities to respond to the nation's command.

5. Carry out creativity work in energy efficiency in buildings.

Considering both the local situation and the development of society, a series of renovation work on energy efficiency are carried out in hot summer and warm winter area. In terms of making use of sustainable resources, Shenzhen and other cities made laws and regulations on application of sustainable resources. In terms of operation and reform of large public buildings, Hainan enhanced its management over mass buildings, such as hotels, resorts in Hainan. A check-in system on energy consumption was made to supervise the public building over 10,000 square meters and office building over 5,000 square meters. A special capital of 200,000 was input to reform on energy saving in office buildings in province, which resulted in 300,000kWh of electricity were saved per year.

6. Enhance the propaganda and training of energy efficiency in buildings.

In terms of public propaganda, the hot summer and warm winter area pay attention to use all kinds of media. By ways of organizing features, knowledge competitions, charity advertisement, column setting, brochure handing-out, many activities on energy efficiency are organized; the idea of energy efficiency and related laws and regulations are well spread, and the society's consciousness of energy efficiency is raised.

II Suggestions on energy efficiency in buildings in hot summer and warm winter area

1. Improve the legislative system of energy efficiency in buildings.

The governmental department should improve the system, mechanism and legal system: Firstly, to establish a managing organ of energy efficiency, and make clear each department's task; Secondly, to make a policy of economic boosting, and to launch capital; Thirdly, to advance the legal construction of energy efficiency, and make an maneuverable system of law, making surrounding as part of work.

2. Establish and improve the technology on energy efficiency in building.

Despite the fact that more than 100 types of new construction material are explored annually in hot summer and warm winter region, all in all, the development of energy efficiency in building is facing many handicaps, and far beyond the market's need. Further more, the price of new material is comparatively high, thus have a bad influence on the dissemination of energy efficiency in buildings. Also, there are huge gaps in different regions, in terms of new material of energy efficiency and new technology. Therefore, research on energy saving technology and new materials should combine with the local climatic characteristics of the south, local resources should be made full use of, thus to form the ability of creativity. Secondly, related departments should set the standards for energy efficiency industry. Thirdly, we should form related taxation policy to encourage the energy efficiency industry.

3. Enhance the supervision of energy efficiency in newly-built buildings

We should improve the supervision system upon designing, constructing and supervising the energy efficiency in newly-built buildings, and make implementation of energy efficiency as one of the standards for an honest deed in construction market. Any act that can't follow the energy efficiency standards should be punished.

4. Strengthen the supervision system of energy efficiency in large public building

On basis of "Implementation of Supervising System on Office Building of National Departments and Large Public Building", we should research on more maneuverable methods and related details on implementation; accelerate the audit of energy and publicize on energy efficiency, so as to increase the level of energy efficiency management of large buildings. At the same time, a manage system of building office should be used as a breakthrough, and to boost the management and

reform of energy efficiency.

5. Enhance research and develop of energy saving in buildings and spread its usage and application.

Firstly, units at different places should cooperate with institutions or universities on construction, and arrange experts to research on the topic. Secondly, strengthen research on mass application of sustainable resources in construction. each unit should make the surrounding in good terms , choose model, and form related laws and regulations, so as to form a system under leadership of government. Thirdly, each unit should form a service system for energy saving, taking service from government, market, finance and technology, thus to make full use of the market in energy efficiency field.

6. Strengthen the leadership, and improve the assessing system of energy efficiency

A harmonious and smooth system of energy efficiency in buildings should be formed at different places, combined with the goal of energy consumption per GDP. By way of setting task breakdown and annual goals, implementation of energy saving should be added to the staff's performance review, so as to achieve the goal of energy efficiency in buildings.