Local Implementation of Building Energy Policies in China's Jiangsu Province

Xu Jinfeng and Zhang Haixi, Jiangsu Province Institute of Building Research, Ltd.
Joe Huang, White Box Technologies

ABSTRACT

Over the past 15 years, China's Ministry of Housing and Urban/Rural Development (MOHURD) has developed an impressive array of building energy standards, guidelines, and ratings with the aim of improving the energy efficiency of both new and recently also existing buildings. What is often overlooked is that the implementation of these policies is not the responsibility of MOHURD, but of local construction authorities, which is where "the rubber really meets the road". The Construction Bureau of Jiangsu Province, a prosperous area on China's eastern seaboard, has been very active in developing local policies that are consistent with, and often in advance of national policies, including the development and enforcement of 65% energy-saving design standards for residential and public, i.e., commercial, buildings, as compared to the 50% energy-saving national standard, as well as standards enforced during construction and prior to owner acceptance. Jiangsu's building energy standards have insisted on the principles of assimilation combined with "innovating from tradition". International exchanges are promoted and many advanced ideas from foreign building energy standards, energy-efficient products and technologies, introduced and incorporated into local standards, while attention is also paid to the local conditions and emphasis given to maintaining and reinvigorating traditional building practices and energy-saving techniques.

Introduction

Geographical and Climatic Characteristics of Jiangsu Province

Jiangsu province is located along the eastern coast of China, including the lower reaches of the Yangtze and Huai Rivers. The predominant topography of Jiangsu is a large alluvial plain with most of the province at an elevation of less than 50 meters above sea level, while the hilly areas are concentrated in the northern and southwestern parts of the province. Jiangsu has numerous lakes and a dense network of waterways. Situated in a transition from a subtropical to a temperate zone, the province has a typical monsoon climate. The Huai River can be used as an approximate demarcation, to the south of which is a subtropical monsoon climate and to the north a warm moist monsoon climate. The climate in Jiangsu is generally mild with moderate rainfall and four distinct seasons. The average annual temperature of the province is from 13ºC to 16ºC; the average annual hours of sunshine from 2000 to 2600 hours; the percent sunshine hours range from 48% to 59%, and the annual precipitation from 724 mm to 1210 mm. The annual average wind speed of the province is 3.5 meters per second.

Most of Jiangsu province is designated by the Ministry of Housing and Urban/Rural Development (MOHURD, formerly the Ministry of Construction or MOC) as being in the Hot-Summer Cold-Winter region, while Xuzhou and Lianyungang in the north are designated as being in the Cold region. During the hottest month, the average temperature in the province is

from 25ºC to 30ºC, with heat and moisture as the basic climatic characteristics since the average relative humidity is around 80%, and the extreme summer temperature can reach over 40 ºC. During the coldest month, the average temperature is from 0ºC to 10ºC, with cold and moisture are the basic climatic characteristics since the average relative humidity remains around 80%. The emphasis of thermal design are different between the Hot-Summer Cold-Winter and the Cold regions. In the Hot-Summer Cold-Winter region, minimizing heat gain during the summer should be the first priority, and adding insulation for the winter should be the second. In the Cold region, the priorities are switched.

Due to its humid climate, traditional houses have the following characteristics to help avoid heat gain and maximize natural ventilation: compact layout, high ceilings, thin walls, deep eaves, and tall windows and doors. The people in Jiangsu have a habit of opening windows for ventilation regardless of the season. An appropriate amount of windows is helpful to improve air quality by natural ventilation and to increase solar radiation into the house during the winter. At night or during the summer months when the weather is cool, an appropriate window area can also help dissipate indoor heat gain while bringing in cooler outdoor air. Landscaping and the use of water in the design of classical Suzhou gardens are also very well-known.

Development of Building Energy Efficiency Standards in Jiangsu Province

Starting in the mid-90s, pilot projects on energy-efficient residential buildings have been carried out in Jiangsu province. At the same time, building energy-efficiency standards have also been established and implemented. For instance, Jiangsu's first energy-efficient building design standard, Implementation details of energy conservation design standard for residential buildings in Jiangsu province (DB32/T122-95) was published in 1995. The Design standard of thermo-environment & energy conservation for civil buildings in Jiangsu province (DB32/478-2001) was a mandatory standard that was promulgated in 2001 and increased the energy-saving rate from 30% to 50%[1]. In 2009, the Design standard of thermo-environment & energy conservation for residential buildings in Jiangsu province was officially issued and further increased the energy-saving rate from 50% to 65%. Since 2006, the compliance rate for the 50% energy-saving design standard for new civil buildings has been essentially 100% in the urban areas, i.e., all new buildings are being designed in accordance with the standard. By 2007, the building energy standard compliance rate, i.e., the percentage of buildings actually built in accordance to the standard, averaged 84%, which was higher than the national average of 71%. In 2008, the rate of buildings that passed testing and acceptance for the building energy efficiency design standards was 96.3%, again higher than the national average of 80%[2]. By the end of the Eleventh Five

[1] MOHURD has referred to building energy standards by their "energy saving rate", which is determined based on either steady-state heat loss coefficients prior to 1999, or after 1999, on computer simulations of a code compliant building compared to a baseline building of 1980s construction without insulation, nor any other building energy efficiency measures. These energy saving rates are theoretical values that do not account for changes in HVAC saturation, indoor comfort levels, or controls.

[2] In China, there is a step in the building regulatory process known as "testing and acceptance" (*yanshou*) before the building is turned over to the owner; in 2009, the Ministry has proposed to make testing mandatory for acceptance approval. Although the compliance rates quoted may seem high, we feel that they are reasonable and valid, because China now has a strict and comprehensive supervision and examination system for building and construction in which the drawings must be approved by the drawing examination centers before construction can begin, and the building inspected and approved by supervision stations for construction quality before it can be given to the owner and put into use.

Year Plan, Jiangsu province will gradually transition from the 50% to the 65% energy-saving design standard, with government-funded projects taking the lead in implementing the higher energy efficiency standard.

To achieve system-wide energy savings, the building energy efficiency standards have included site planning and design, building envelope requirements, and the use of renewable energy. They are enforced through various stages of a project, including project proposal and confirmation, planning, construction, acceptance testing, sale, and use. For instance, the government requires that the building's energy saving rate and energy rating be indicated during time of sale. The standards apply not only to energy efficiency in new construction, but also to energy-efficient retrofit of existing buildings, i.e., existing buildings undergoing retrofit must meet the requirements of the energy efficiency standard, energy-efficient operations and management of large public buildings, and building energy efficiency evaluation.

A report on *Research on Building Energy-Saving Technology Standard System of Jiangsu Province* was reviewed and approved in 2008[3]. According to the research and analysis of current domestic and international standards for energy conservation, especially of the current national and local energy standards in Jiangsu province, the research report summarized typical building energy-efficiency technologies that were suitable for the region, put forth the basic idea for developing building energy-efficiency techniques, and provided guidance on establishing building energy standards in Jiangsu province.

Characteristics of Building Energy Standards in Jiangsu Province

The general premise of Jiangsu's building energy standards is to meet the requirements of the national or industry standards, while incorporating local characteristics based on climate, culture and habit, and making some of the requirements more stringent.[4] From the start of the pilot project on building energy efficiency, Jiangsu's building energy standards have insisted on the principles of assimilation combined with "innovating from tradition". On one hand, international exchanges are promoted and many advanced ideas from foreign building energy standards, energy-efficient products and technologies, have introduced and incorporated into local standards; on the other hand, attention have been paid to the local conditions and emphasis given to maintaining and reinvigorating traditional building practices and energy-saving techniques.

Design Standards

At present, the following building energy standards are in force in Jiangsu province: *Design Standard for Residential Buildings of Jiangsu* (DGJ32/J26-2006), *Thermal Design Code for Civil Building* (GB50176-1993), *Design Standard for Energy Efficiency of Public Buildings* (Gb50189-2005*), Design Standard for Energy Efficiency of Residential Buildings in Hot Summer and Cold Winter Zone* (JGJ134-2001), *Energy Conservation Design Standard for New Heating Residential Buildings* (JGJ26-1995), *and Design Standard of Thermo-Environment & Energy Conservation for Residential Buildings in Jiangsu Province* (DGJ32/J71-2008). Furthermore, there are also a number of technical requirements on building energy-efficiency, such as *Depth Regulation (Energy-saving Special Chapter) for Design Document Compiling of Civil*

[3] Standards and research findings in China are typically reviewed and approved by an expert committee.
[4] The highest level of standards are "national standards" (*guobiao*), followed by "industry standards" (*hangbiao*).

Engineering Construction Drawing in Jiangsu Province (2009 edition), *Reference Pattern for Special Section Designing of Building Energy-Saving in Jiangsu Province* (2009 edition), *Depth Regulation for Design Document Compiling of Solar Water Heating System Construction Drawing in Jiangsu Province* (2008 edition), *Measurement and Design regulation for Energy Consumption of Public Building in Jiangsu Province (Provisional),etc.*

Residential Building

The *Design Standard for Residential Buildings of Jiangsu* (DGJ32/J26-2006) is a mandatory standard on the energy-efficient design of residential buildings that includes a provision for calculating the building's heating and air conditioning energy consumption. The standard requires that energy-saving measures be taken for elevators, pumps, fans and other equipment, ensures that the building design and construction are compatible with the local climate and makes full use of natural ventilation and renewable resources such as solar energy.

There are three local energy-saving design standards for residential buildings that have been promulgated successively in the province. The first is the national industry standard *Design Standard for Energy Efficiency of Residential Buildings in Hot Summer and Cold Winter Zone* (JGJ134-2001). The second is the *Design Standard of Thermo-Environment & Energy Conservation for Civil Buildings in Jiangsu Province* (DB32／478-2001) which is fully compliant with the first, but takes into account local climate conditions and living habits, and emphasizes natural ventilation, reducing heat gains in the summer while utilizing passive heating and improving indoor comfort in the winter. The third standard is the *Design Standard of Thermo-Environment & Energy Conservation for Residential Buildings in Jiangsu Province* (DGJ32/J 71-2008), in which the energy-saving rate has been increased from 50% to 65% to reflect technological advances such as new types of shading devices and building-integrated photovoltaics (BIPV) and other improvements to the building envelope, while still regionalizing local climate characteristics and living habits.

Future design standards for residential buildings in Jiangsu province will continue to respect traditional lifestyles, utilize traditional design concepts such as *sun-facing and sun-shading, ventilation and wind shelter*, and also emphasize natural lighting, ventilation, and local traditions of building layout, plus the use of water and landscaping.

Public Buildings

The national *Design Standard for Energy Efficiency of Public Buildings* (GB50189-2005) is now being implemented in Jiangsu province and has an energy-saving rate of 50%. A local *Design Standard for Energy Efficiency of Public Buildings of Jiangsu Province* is being compiled with energy-saving rates of 50% and 65%. In the future, as more building energy consumption data for various types of public buildings, i.e., offices, retail, tourist, educational, communications, transportation, etc., different energy-saving design standards can be developed for each type of public buildings respectively.

Study of Building Energy-Saving Modes and Strategies

The current building energy efficiency trend in China has been to copy the experiences in western developed countries with fully air-conditioned buildings. While the air-conditioning

system is operating continuously to maintain comfort, efforts are made to improve the mechanical efficiency of the equipment. Such a mode of operation does not reduce actual energy consumption, and may produce an embarrassing situation with a high level of technical efficiency but low actual energy savings.

The local climate and environment has an impact on human comfort, and led to modes of building energy conservation with Jiangsu characteristics. Using the concept of "adaptive comfort", i.e., that the clothing thermal resistance is 0.5clo during the summer, 1.5clo during the winter, and 0.8clo during the spring and autumn, the human comfort index would be highest in the spring and autumn. Even during the summer, outdoor comfort levels are in the acceptable range most of the time, making it possible to control summer comfort levels using passive strategies. On the other hand, there is a comparatively long winter period outside of the comfort zone. Therefore, in considering passive strategies to control the thermal environment, emphasis should be placed first on reducing heat losses using insulation during the winter, and secondarily on controlling heat gain and cooling during the summer.

This study of building energy-saving modes and strategies is being carried out considering the above-mentioned factors. Based on user opinions and the three different modes of energy use, different energy-efficient technologies and strategies have been developed.

Traditional usage pattern. These occupants basically maintain a mode of energy use consistent with the traditional lifestyle in Jiangsu province, i.e., using natural ventilation in the summer and transitional seasons while using passive solar heating in the winter. In other words, they are basically relying on nature to provide as comfortable an indoor environment as possible without relying on mechanical energy for heating and cooling. Therefore, there is very little actual building energy consumption. The building energy efficiency strategy for this usage pattern is passive building design, in combination with utilization of climatic features and topography. The architectural master plan and single design should comply with passive energy-saving design strategies and methods, and the energy consumption of the building itself should meet the requirements of energy-saving rate 50%.

Modified traditional usage pattern. These occupants have a lifestyle and energy use mode that is a combination of the traditional and modern, i.e., they will use mechanical heating and air conditioning to moderate indoor comfort conditions during extreme summer and winter conditions, while still maintaining the traditional lifestyle at other times. The primary building energy strategy is still passive building design, with active energy-efficiency technologies playing a subsidiary role. The actual building energy consumption should meet the requirements of energy-saving rate 50%. The architectural whole plan and single design should firstly comply with passive energy-saving design strategies and methods.

The energy usage of the traditional and modified traditional usage patterns are very different from that in the West. The HVAC works mostly in the intermittent mode. The sensitivity of energy consumption to variations in building shape coefficient, window-to-wall ratio, and the thermal performance of building envelope are all different from buildings operated in a Western mode. For example, we can lower the requirements for thermal insulation of exterior walls while enhancing the requirement for heat insulation and natural ventilation.

Therefore, in studying energy-saving strategies and technologies, attention should be placed not only on traditional design concepts as orientation, shading, ventilation, and wind

shielding, but also on HVAC performance parameters when operating in an intermittent mode. The following points have been found when the HVAC works in an intermittent mode:

1) There is little relationship between the building shape coefficient and energy use.[5]
2) The window-to-wall ratio can be increased moderately; increasing the south-facing window area can reduce heating energy use, as well as increase natural light and natural ventilation throughout the year.
3) Equal emphasis should be placed on exterior internal wall insulation
4) Enhance the solar shading effects of exterior walls and roof.

Further analysis will be done on the impact of these design parameters on buildings with traditional and modified traditional usage patterns, and their relationship to air-conditioning use, and the results then incorporated into construction-related design standards for Jiangsu Province.

Modern Western usage pattern. These occupants have a high demand of building indoor comfort, so they basically operate the HVAC system throughout the year and all weather conditions, such as in some large public buildings. Active energy-saving technologies are used during design, e.g., increased R-values in the building envelope and improved efficiencies in the HVAC system in order to achieve an energy-efficient building with high comfort conditions.

Acceptance and Testing Standards of Construction Quality

Construction Quality Acceptance

Testing and acceptance of building energy efficiency in Jiangsu province is implemented following the construction standard *Accepting Specification for the Quality of Energy-Efficiency Project of Building* (DGJ32/J19-2007) and national standard *Code for Acceptance of Energy Efficient Building Construction* (GB50411-2007). Acceptance of the building's envelope is implemented according to the DGJ/J19-2007 standard, which includes the walls, door, roof, curtain walls, and ground. This standard is based on the national standard GB50411-2007, combined with technical data and experience accumulated when implementing the DGJ/J19-2006. The acceptance standard GB50411-2007 covers heating, ventilation and air-conditioner, resource of cold and heat, pipe net, power supply and distribution, light, supervision and energy control.

Testing

Building energy efficiency testing is divided into lab and site tests. A lab test means that a test specimen is supplied to, and the relevant test parameters are acquired by the lab; site tests are done in the field.

Laboratory tests. Insulation, doors and windows should be tested according to related product standards or technical regulations. According to the standard *Accepting Specification for the Quality of Energy-Efficiency Project of Building* (DGJ32/J19-2007), the density, thermal

[5] *Building shape coefficient* refers to the ratio of the wall area to the building volume, and is controlled in many Chinese building energy standards, particularly in the colder regions.

conductivity, strength, contraction and stability of insulation must be re-inspected in laboratory. The windows' air leakage, thermal conductivity also must be re-inspected in laboratory.

Site tests. Jiangsu Province has developed methods and devices for site testing the energy efficiency of newly-built, extensions, and renovation projects. *In-situ Inspection on Energy Conservation for Civil Buildings* (DGJ32/J 23-2006) has been promulgated and implemented in Jiangsu province. In Nantong, Huaian, Zhenjiang, and Suzhou where the testing procedure are widely used, the quality of exterior wall insulation have improved greatly compare to before, which has also great benefited the market for such products. The testing is usually done by a third party laboratory paid by the owner and covers the thermal transfer coefficient and performance of the exterior wall and roof, the insulation structure of the exterior wall, and the air leakage of the external windows.

Energy Efficiency Evaluation and Labeling

Building energy efficiency evaluation provides an information mark on the building's energy consumption and its system efficiency as determined through testing and calculations. The building energy efficiency label sends the message of building energy efficiency and consumption not only to the house owner, but also to the society and government. Therefore, it resolves the problem of information asymmetry, and helps government to regulate the market for energy efficiency buildings.

Jiangsu Province is now implementing the *Technical Guideline of Energy Efficiency Evaluation Labeling of Residential Buildings*, which was promulgated recently by the national MOHURD. The large variations in climate, types of residential buildings, and lifestyles, has led to a diversity of energy use models and estimated energy usages. The lack of raw data on existing building energy use and the difficulty of measurement make it hard to evaluate energy use levels. Research is now being done on monitoring and analysis of building energy use, depending on the building's climate division, residential building type, and living habits. This will eventually make the labeling standard more objective and accurate.

Standards and Technical Policy on Renewable Energy Utilization

As the subsidiary of the Jiangsu Construction Bureau, the Standards Office for Construction Projects in Jiangsu is responsible for planning and establishing building energy standards, with the costs paid by public monies. During the design stage, the standards are to be followed by the design companies and consultants and examined by plan check offices that represent the governments. During the construction stage, the standards are to be followed by the construction companies and supervised by supervision offices for construction quality that represent the government.

Solar water heating system. Acceptance testing for solar heat water systems are in accordance to the national standards *Solar Water Heating Systems-Design, Installation and Engineering Acceptance* (GB/T 18713-2002), *Technical Code for Solar Water Heating System of Civil Buildings* (GB50364-2005), and the local standards *Acceptance Specification for Design and Installation of Solar Water Heating Systems Integration in Residential Building* (DGJ32/TJ08-2005) and Standard drawings of solar water heating system and building integrated design.

The Jiangsu Construction Bureau has promulgated a regulation *Notification for Promotion and Management of Solar Water Heating System* saying that new construction, including residential buildings, hotels and restaurants that are less than 12 floors, that supply hot water should design and install a central solar hot water system. For those buildings that do not plan on installing a solar hot system, the construction and design companies must apply for permission to the government, with the decision made by a government-appointed experts committee. All new buildings with more than 12 floors in urban areas should all design and install solar hot water systems. Buildings in the rural areas are also encouraged to use solar hot water systems.

Solar photovoltaic systems. Solar photovoltaic systems are regulated according to national and industry standards. A local standard *Technical Specification for Building Integrated Photovoltaic* has been promulgated for the use of photovoltaics in buildings. The *Industry Planning Framework for Photovoltaic Power Generation of Jiangsu Province* has been completed, including the uniform application of solar photovoltaic systems.

Heat pumps. Ground source heat pump system construction are regulated according to the national standard *Technical Code for Ground-Source Heat Pump System*. Air source heat pump system construction are regulated according to the local standard *Installation of Air-Source Heat Pump Water Heater*. Since Jiangsu has rich water resources, relevant institutions are conducting research and developing a standard on water source heat pump systems.

Thermal insulation made of cement-based mortar mixed with expanded polystyrene pellets. There is a mandatory local standard on *Technical Specification of Thermal Insulating Rendering System Made of Cement Based Mortar Mixed with Expanded Polystyrene Pellets or Pear Sand as Aggregate* (DGJ32/J22-2006). Compared with the (national) industry standard, the local standards added performance requirements, such as the percentage of volume water absorption and the anti-crack mortar linear shrinkage rate, that reflect the local climatic characteristics of frequent rain and high humidity.

Technical specifications on XPS board external insulation system. A *Technical Specification on XPS Board External Insulation System* (su JG/T016-2008) is the recommended technical regulation for this product. This specification is the criterion for the application of XPS board external insulation system.

Technical code for rigid polyurethane foam insulation and waterproof engineering. *Technical Code for Rigid Polyurethane Foam Insulation and Waterproof Engineering* (su JG/T001-2005) is the recommended technical regulation for this product.

Non-load-bearing self-isolation system with compound insulation concrete blocks (bricks). The *Technical Specification for Application of Non-Load-Bearing Self-Isolation System with Compound Insulation Concrete Blocks (Bricks)* (DGJ32 TJ85-2009) has been promulgated and implemented.

Self-isolation system with aerated concrete block. The *Technical Specification for Application of Self-Isolation System with Aerated Concrete Block* is being compiled. The standard will cover aerated self-isolation block with fly ash and sand.

Self-isolation masonry structures with combusted silt brick. Jiangsu has numerous lakes and a dense network of waterways, with billions of cubic meters of silt from annual dredging and about two million cubic meters of sludge from sewage treatment plant. The self-isolation energy-saving bricks are made from silt and municipal sludge which have a high calorific value and light weight. It can make use of waste silt and municipal sludge, protect the environment and save arable land, so that it is the revolutionary innovation for traditional building materials as sintered clay brick. *Construction Technical Regulation for Self-Isolation Masonry Structure with Combusted Silt Bricks* (DGJ32/TJ78-2009) has been promulgated and implemented.

Thermal insulation system with flexible thermal insulation coating. *Technical Specification for Application of Thermal Insulation System with Flexible Thermal insulAtion Coating* (su JG/T026-2008) is a recommended technical regulation and has been promulgated.

Architectural heat insulating glass-film. *Technical Specification for Architectural Heat Insulating Glass-Film Engineering* (su JG/T022-2006) is a recommended technical regulation. The standard includes the application and installation of architectural heat insulating glass-film.

Aluminum alloy doors and windows. *Technical Specification for Aluminum Alloy Doors and Windows* (DGJ32/J07-2005) is a mandatory standard.

Plastic door and window. *Technical Specification for Plastic Door and Window Engineering* (DGJ32/J62-2008) is a mandatory standard.

Standards of Green Building and Eco-City Construction

Green Building

As a basis for green building design and evaluation in Jiangsu province, a local standard *Evaluation Standard for Green Building* (DGJ32/TJ 76-2009) has been promulgated and implemented. This standard adopts the same green building rating system from the national standard. The national standard contains six sections of saving energy, land, water, and materials, environmental protection, and operations management. The rating system covers the entire construction process, including planning, design, construction and management, and focuses on integrating ecology, energy saving, environmental protection, health and comfort. The local standard increases and revises various items in the national standard in accordance to the characteristics of climate, environment, resources, industrial concentration, economic development level, and the social and cultural lifestyle of Jiangsu province. For instance, it has more stringent requirements for greening and the use of renewable energy, but cancels the requirement for recycling water. An *Evaluation Method for Green Building Award of Jiangsu Province* has also been promulgated, and work begun on a green building award program.

Eco-City Construction

As early as in 2005, Jiangsu Province promulgated the *Planning Outline of the Ecological Province Construction of Jiangsu*, while large and medium-sized cities in the province have completed the compilation of eco-city planning, and launched eco-city construction.

For instance, Nanjing's ecological planning includes six major construction tasks: protection of ecological functions, development of recycling economy and ecological industry, protection of related resources, enhancement of pollution prevention, construction of harmonious living environment and building up the eco-cultural system. A series of important works have been started and Nanjing has made great achievements in water environment management, relocation of polluting enterprises, energy conservation, and emissions reduction.

The construction of a new ecological urban district has been launched in Nanjing with the purpose of building a new town and creating an ecological island in the southwest of the city.

The new town in the southwest of the Qinhuai river. The planned new town is surrounded by waters on three sides, and has an area of 14.18 square kilometers. To the west is the Yangtze River, to the south the Qinhuai New River, and to the east the Nan River. The goal is to build the new town into a new eco-city with sustainable development, high energy efficiency, beautiful environment and rich cultural characteristics of Nanjing. All new buildings will be built in accordance to the 65% energy-saving standard, and 10% of them will also comply with the green building standard; renewable energy will account for more than 10% of the total energy consumption in the residential buildings, and 5% of that in the public buildings.

Jiangxinzhou Island. The goal of the Jiangxinzhou Eco-Island Planning is to maintain a good ecological environment, build more wetland parks around the island, protect and restore the large areas of tidal flat and wetlands, promote a sustainable development lifestyle such as promoting solar street lighting and water heater, promote green and sustainable transportation such as green energy cars, natural gas buses, trams, and avoid high-emission vehicles and high-polluting facilities. Community construction is proposed as a "walking community" to facilitate the residents and to make them safe. The public service facilities are in a service radius of 400 meters so that people can reduce the reliance on cars. At the same time, green buildings and tree-lined streets provide a comfortable environment for the residents.

Conclusions

Over the past decade, building energy efficiency policy in Jiangsu province has achieved outstanding results, and is still being improved step by step. The pilot and demonstration projects for the modified traditional usage pattern have shown that it is a highly energy efficient mode of building operations that is both technologically feasible as well as economical. Furthermore, this usage pattern fits with the local lifestyle and has widespread support among the population. The next step is to incorporate this usage pattern into the local building energy standards.

References

There is a local provincial legislation, research report, local standard drawing collection, twelve local standards, and three local technical policies.

Local Legislation

Administrative measures for building energy conservation in Jiangsu Province

Research Report

Research on building energy-saving technology standard system of Jiangsu province

Local Standard Drawing Collection

Local collection of standard design drawings for the integration of solar water heating system and buildings

Local Standards

1. Implementation details of energy conservation design standard for residential buildings in Jiangsu province (DB32/T122-95)
2. Design standard of thermo-environment & energy conservation for civil buildings in Jiangsu province (DB32/478-2001)
3. Design standard for residential buildings of Jiangsu (DGJ32/J26-2006)
4. Design standard of thermo-environment & energy conservation for residential buildings in Jiangsu province (DGJ32/J71-2008)
5. Design standard for energy efficiency of public buildings of Jiangsu province DGJ32/J96-2010）
6. Accepting specification for the quality of energy-efficiency project of building (DGJ32/J19-2007)
7. In-situ inspection on energy conservation for civil buildings (DGJ32/J 23-2006)
8. Technology code in integration of building and photovoltaic (DGJ32/J 87-2009)
9. Acceptance specification for design and installation of solar water heating systems integration in residential building (DGJ32/TJ08-2005)
10. Evaluation standard for green building (DGJ32/TJ 76-2009)
11. Code for design, installation and acceptance of construction solar water heating system (DGJ32/J08-2008)
12. Code for engineering testing for construction solar water heating systems (DGJ32/TJ90-2009)

Local Technical Policies

1. Technical guideline of energy efficiency evaluation labeling of residential buildings
2. Local technical rule for the construction and design drawings
3. Technical guidelines for eco-city construction of the new town in the southwest of the Qinhuai River