The Road to Success

Sino-German Technical Cooperation
— Energy Efficiency in Existing Buildings

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Sino-German Technical Cooperation — Energy Efficiency in Existing Buildings (EEEB)
Duration of Project Implementation: 2005 – 2011

Project Partners:
The Department of Building Energy Efficiency and Science & Technology of the Ministry of Housing and Urban-Rural Development (MoHURD)
Project Director: Tong Guichan

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
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www.eeeb.org.cn
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Sino-German Technical Cooperation

Introduction to the Results of the Energy Efficiency in Existing Buildings (EEEB) Project

Project Introduction

The EEEB project began in November, 2005, and was completed in March, 2011. The project encompassed five primary working areas: policy consulting, demonstration projects, technology introduction and transfer, industrial cooperation, and knowledge management.

The project’s main cooperative partners included:
- The Department of Building Energy Efficiency and Science & Technology of the Ministry of Housing and Urban-Rural Development (MoHURD), municipal governments, the China Academy of Building Research (CABR), the China Building Material Academy (CBMA), the MoHURD Institute of Standards and Norms, and other academic institutions;
- The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, as an organisation wholly affiliated with the German federal government, was commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) to represent the German side in project administration.

This cooperative project’s line of approach was to establish a series of demonstration projects to showcase energy efficiency retrofitting in existing residential buildings; develop technical approaches and retrofit solutions that are appropriate for China; summarize the experience gained from the demonstration projects to serve as recommendations for policymaking, build capacity through research institutes and relevant service organizations; and ultimately promote sustained progress in the field of energy efficiency retrofitting in China.

The project has achieved a series of remarkable accomplishments over the past five years:
- Completed three comprehensive energy efficiency retrofit projects in existing residential buildings: the Hebei #1 housing complex in Tangshan, the No. 12 Huaxinjiejie building in Beijing, and the Caochangxiang housing complex in Urumqi.
- Completed baseline surveys of existing buildings in four cities: Tangshan, Tianjin, Hebi, and Urumqi.
- Between 2008 and 2011, hosted six annual sessions on “Technologies and Engineering Practice for Energy Efficiency of Existing Buildings” at the International Conference on Green and Energy-efficient Building.
- Promoted energy efficiency retrofitting in existing residential building at lectures and live consultation events held in 15 provinces/states.
- Organized ten groups of building energy efficiency (BEE) technicians and managers to conduct site visits and trainings in Germany and other European countries.
- Compiled the Guidelines for Energy Efficiency in Existing Residential Buildings and 109 FAQs about Energy Efficiency in Existing Residential Buildings, as well as published over 20 types of technical documentation. Introduced the principle of comprehensive energy efficiency retrofitting.
- Import the advanced technology and products concerning heat metering and energy efficiency in buildings.
- Introduced and successfully implemented working mechanisms for public participation via a democratic decision-making process.

Measures Taken & Results Achieved

Demonstration projects were established to explore innovative energy efficiency solutions that meet China’s needs.

Between 2006 and 2009, the EEEB project completed three demonstration projects in Tangshan, Beijing, and Urumqi, conducted a series of dissemination events, and compiled guidelines covering every aspect of energy efficiency retrofitting, including project management, initial preparation, public participation, implementation management, cost budgeting, and project evaluation.

Tangshan Demonstration Project

After considering sites in Harbin, Shenyang, and Tangshan, the project office ultimately chose three five-story buildings made of precast concrete slabs in the Hebei #1 housing complex in Tangshan to serve as the first energy efficiency retrofit demonstration project. The following considerations were made in choosing Tangshan:
- The Hebei #1 housing complex was among the first group of residential buildings to be reconstructed in 1978 after the Tangshan earthquake. The structure of the buildings was wholly intact, but lacked thermal insulation and, after 30 years of use, was in serious disrepair.
- Construction using precast concrete slabs is common not only in Tangshan, but indeed across all of China, and therefore has significant demonstrative value.
- Most residents living in the buildings were underprivileged members of society.
- The buildings were located on a major traffic artery, enabling easy access for site visits.

The principle of comprehensive energy efficiency retrofitting was introduced for the first time during the implementation of the Tangshan demonstration project. This principle calls for energy efficiency retrofits to be conducted alongside other necessary measures.
The buildings average indoor temperature rose from 15°C to 21°C. Inward-opening windows with double-glazing greatly reduced dust and noise pollution. Residents in the demonstration buildings were delighted with the results, and residents in neighboring buildings were motivated to seek retrofits of their own.

The success of the Beijing demonstration project attracted widespread media attention, with China Central Television (CCTV) producing a special report on the project. On the basis of the successful retrofits at No. 12 Huixinxijie, the Beijing municipal government set a goal of retrofitting 30 million square meters of residential floor space in the period covered by the 12th Five Year plan, with a short-term goal of retrofitting 8 million square meters to achieve a high standard of energy efficiency in 2011.

Urumqi Demonstration Project

Energy efficiency retrofitting in existing residential buildings was already underway on a large scale in the city of Urumqi, as part of a drive to implement the municipal government’s “Blue Skies” agenda and reduce soot associated with coal-fired winter heating. The Urumqi Municipal Commission of Housing and Urban-Rural Development, however, was still actively seeking opportunities for project cooperation, as it sought to improve retrofit and implementation quality and foster a corps of well-trained technical experts.

Urumqi chose eight six-story buildings in the Chaqchangying housing complex, all of which were constructed of brick, and suffered from bathroom leakage, wall erosion, condensation and mold. Indoor living conditions were extremely uncomfortable. The Urumqi Municipal Commission of Housing and Urban-Rural Development, however, was still actively seeking opportunities for project cooperation, as it sought to improve retrofit and implementation quality and foster a corps of well-trained technical experts.

Urumqi used 6-8 cm expanded polystyrene (EPS) boards for exterior insulation. In consideration of local climate conditions, German and Chinese experts developed minimum-, medium-, and maximum retrofit concepts. The maximum retrofit solution called for 14 cm EPS thermal insulation and inward-opening triple-glazing windows, greatly improving the building’s overall energy efficiency.

German experts were invited to provide guidance and constructive suggestions on how to best improve upon conventional but inefficient practices. The Urumqi Municipal Commission of Housing and Urban-Rural Development took stock of the issues highlighted by the demonstration project as well as the German experts’ recommendations, and released policy documents aimed at guaranteeing building and renovation quality.

The Urumqi demonstration project also invited experts from the Tangshan project to introduce effective mechanisms for encouraging public participation. After seeing the concrete benefits of the retrofits, an ethnic Hui family that had initially strongly opposed the project later turned into an enthusiastic advocate for energy efficiency.

Baseline Survey of Existing Buildings

Launching demonstration projects can help to drive forward an entire movement. But in the process of pushing energy-efficiency retrofits from the demonstration level to a city-wide undertaking, the drafting of effective, scientific plans and policies is of critical importance. A survey of the baseline conditions at a city’s existing buildings can provide scientific evidence for planning and policymaking.

Germany’s experience has shown the effectiveness of conducting baseline surveys prior to the implementation of large-scale retrofits. These surveys include:

- a census of existing building stock, classified according to building type
- an in-depth examination of individual buildings that are representative of their type
- the drafting of a standard energy-efficiency retrofit plan and the calculation of pre- and post-retrofit energy consumption and energy savings, as well as estimates of the cost and economics of retrofitting
- recommendations on energy-efficiency retrofit plans to be provided to policymakers

In 2007, the project office selected Tangshan, Tianjin, Hebei, and Urumqi to serve as test cities for baseline surveys of existing buildings.
Dissemination and Public Awareness

Energy efficiency retrofitting in existing residential buildings can benefit individual households, promote greater social harmony, and ensure the sustainability of economic development. It is a highly unprecedented opportunity—but organizers of the local level still lack the necessary conceptual grounding to promote retrofits. Business and the technical service sector have yet to realize the future market potential, and social residents still lack an understanding of how positive an impact retrofitting can have on their quality of life.

Energy efficiency public awareness and market education are important and urgent tasks. To promote this agenda, the project organized a series of promotional and exchange events, including three events in Beijing and Tangshan aimed at sharing the experience and knowledge gained during the Tangshan demonstration project, and between 2006 and 2011 held six times of the session, titled “Technologies and Engineering Practice for Energy-saving Renovation of Existing Buildings,” on the northern China, harmonize energy efficiency standards, and identify commonly occurring quality problems. EEEDC organized for a comprehensive evaluation of energy efficiency retrofitting in existing residential buildings.

In 2008, the project office drew on experts from China and Germany to conduct general evaluations of ten retrofit projects in the cities of Tangshan, Beijing, Tianjin, Baotou, Harbin, and Urumqi. These experts also provided on-site technical guidance and offered policymakers a series of recommendations on improving the quality and sustainability of energy efficiency retrofit.

Training and Implementation Quality

How well a thermal insulation system is installed is often a matter that leaves experts concerned. The quality of project implementation is not only a question of economics, but perhaps in even more an issue of energy efficiency. An external thermal insulation system can achieve real energy savings only if it functions properly for the duration of its lifecycle. After several years the thermal insulation system becomes partially or entirely ineffective due to poor implementation quality, the retrofitting not only fails to conserve energy but in fact will create a new burden on the state’s energy supply because many of the insulation materials used today are oil-based.

In accordance with MoHURD’s arrangements, the project provided a series of policy consulting services, including contributions to documents such as the Energy Conservation Ordinance on Civil Building; Guidelines for Energy Audit in Government Office Buildings and Large Public Buildings; Technical Specifications for Exterior Insulation and Fire Prevention in Buildings. In setting accounting standards for energy consumption in large public buildings, for example, project experts recommended focusing on differentiated building functions and climate compensation in order to facilitate future benchmarking among different building types and climate regions. The program also organized a technical seminar that brought together the world’s most experienced experts to discuss fire prevention measures for exterior thermal insulation and other recommendations on the drafting of technical standards.

The project also compiled, translated, and published versions of Germany and the European Union’s laws on building energy efficiency and building insulation to serve as a reference for Chinese experts.

These local, in-depth promotional activities allowed participants and stakeholders to receive accurate, first-hand information and gave them the awareness and confidence necessary to begin working on heat metering and energy efficiency retrofitting in their own communities.

EEEB Project Evaluation

Energy efficient retrofitting and heat metering—supported and guided by a range of government policies during the 11th Five Year Plan—are already underway in many existing residential buildings in north China. While various retrofit projects have been completed, however, progress and quality remain uneven. In order to fully understand the current state of energy efficiency retrofitting across the northern China, harmonize energy efficiency standards, and identify commonly occurring quality problems, MoHURD arranged for a comprehensive evaluation of energy efficiency retrofitting in existing residential buildings.

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Effective Standards and Policy Consulting

Experts have noted that promoting energy efficiency in buildings requires three drivers: clear goals and initiatives, corresponding incentives, and restrictive and punitive measures. All of these relate to the design of energy conservation policy. Policy design requires consideration of larger national priorities, the realities of China’s unique circumstances, and the greater global environment. Policy design must also be based on practice and experience, with a focus not only on immediate impacts, but on transformational change as well.

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Demonstration Projects
China’s housing reforms in the early 1990’s converted 90% of public rental units into privately owned homes; retrofitting existing residential buildings, therefore, directly impacts millions of individual homeowners. In addition, many buildings have been subject to the wear-and-tear of decades of use, and the walls and roofs are often cluttered with an assortment of pipes, locks, and miscellaneous riggings that create new technical complications for retrofitting, while a lack of local experience can lead to a general fear and mistrust of retrofits in existing buildings.

Before beginning a large-scale retrofit campaign, therefore, smaller-scale demonstration projects can be an effective and instructive way to better understand the problems that often arise during the retrofit process, explore a variety of technical solutions and methods of public participation, test and prepare management and technical teams, develop energy efficiency products and technical markets, demonstrate the effectiveness of energy efficiency retrofitting, and address outstanding public concerns and misgivings.

With this in mind, the EEEB project adopted a demonstration-led approach, launching energy efficiency retrofit demonstration projects in Tangshan, Beijing, and Urumqi. The impact of these projects was enhanced by state-of-the-art German technology in the fields of exterior insulation and joint processing, automatic indoor climate control and heat metering, indoor ventilation, and high-rise insulation and fire prevention.

Guided by German experts, the demonstration projects introduced a new mechanism for public participation and democratic decision-making that effectively mobilized building residents, residents’ committees, and other key players, effectively transforming initial opposition to the retrofits into enthusiastic participation, cooperation, and investment. For example, the Beijing demonstration project was initially supported by less than 30% of building residents, but after touring the Tangshan demonstration and seeing first-hand the benefits of energy efficiency retrofitting, the project participation rate jumped to almost 90%. In the Tangshan demonstration, each household was willing to invest 5000 RMB in the retrofits, despite average monthly incomes of only 1500 RMB.

An effective method for motivating public participation and high retrofits outcomes were critical factors in the demonstration projects’ success, and provided valuable experience for follow-up projects in the future. This experience has subsequently been promoted in both foreign and domestic media, as well as at a series of high-profile live events. The project has also had an increasingly profound impact on policy. MOHURD and MOF have announced incentive measures to encourage heat metering and energy efficiency retrofitting, and the project office has compiled a summary of the demonstration projects’ experience as well as a Guide to Energy Efficiency Retrofits in Existing Residential Buildings and 100 FAQs about Energy Efficiency in Existing Residential Buildings to serve as reference guides for policymakers.

<table>
<thead>
<tr>
<th>Unit: kWh/m².a</th>
<th>Hebei #1 Housing Complex, Tangshan</th>
<th>No. 12 Huixinxijie, Beijing</th>
<th>Caochangxiang Housing Complex, Urumqi (max retrofit)</th>
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<td>140</td>
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Hebei #1 housing complex in Tangshan
No. 12 Huixinxijie in Beijing
Caochangxiang housing complex in Urumqi
Demonstration Projects

Capacity Building       Raising Awareness

Demonstration Projects

The Hebei #1 housing complex was among the first group of residential buildings to be reconstructed in 1978 after the Tangshan earthquake. The three buildings chosen for energy efficiency retrofitting were constructed with precast concrete slab sidings, making them highly earthquake-resistant. Each building had five floors, 45 units in three sections, and a total floor space of 2045 square meters. Most residents of the buildings were low-income families. The buildings ... heating system was poor, and residents reported that during winter months the indoor temperature reached only 8-9°C.

Actual recorded temperatures showed an average of only 15°C, with one-third of households suffering from condensation and mold.

The demonstration project received considerable attention from MoHURD and the Tangshan municipal government, as well as support from German companies including Bayer, BASF, Heimeier, Minol, ISTA, STO, and Hydrometer.

The city organized a special team to follow and guide the demonstration project from start to finish, and coordinated with relevant municipal departments to ensure successful implementation. The project often invited German design companies and local designers from Tangshan to design the retrofit plan, and sent German supervisors to conduct on-site implementation quality control and training.

In addition to extensive energy efficiency retrofits, the demonstration project at the Hebei #1 housing complex also completely renovated the building roof, removed overly water-absorptive layers of slag, and installed new vapor barriers. Cornices were removed, and a 75 centimeter parapet was constructed. Inward-opening double-glazing windows with low E were installed. Solar panels were installed on the roof to power lighting in stairwells. Squat toilets were replaced with sitting toilets to provide convenience for elderly residents. Radiator covers were removed to allow for automatic temperature control and heat metering. The three buildings were fitted with three different types of heating systems: a vertical double-pipe system, a single-pipe system with bypass, and indoor circular system with bypass. It was demonstrated that the vertical double-pipe system provided the most effective heating, while single-pipe system with bypass required the least intensive retrofitting.

A baseline survey and building evaluation was conducted at the beginning of the demonstration project and tracking and measurement continued for three years after the retrofitting was completed. These measurements provided comprehensive data on the heat energy consumption and after building characteristics.

The retrofits made the buildings noticeably more energy efficient. In the first year, average indoor temperatures rose to over 22°C, giving residents a warm home for the first time in 30 years. The heat energy consumption dropped from 110 kWh/m².a to 68 kWh/m².a. After heat metering was officially implemented in 2009, indoor temperatures dropped to around 20°C, while energy costs dropped to 49 kWh/m².a. Retrofitted windows also helped to keep homes clean, quiet, and comfortable by blocking dust and noise pollution from outside. Residents expressed that the retrofits made their houses seem brand new, and helped them save money on heating bills to boot, a win-win for both individual households and society at large. Practically every resident in the community is now volunteering as an advocate for energy efficiency.

After 30 years of wear-and-tear, buildings in the Hebei #1 housing complex suffered from severe deterioration. Indoor condensation and mold were commonplace, and an out-of-date heating system failed to meet residents’ heating needs. The buildings were not only uncomfortable to live in, but were highly inefficient in their energy consumption as well.
Entrance doors were dilapidated or even missing entirely. Roofs were cluttered with various self-rigged contraptions, complicating efforts to implement comprehensive retrofits.
German experts provided on-site guidance and trained a team to ensure the progress and quality of project implementation. The picture on the left shows workers applying mortar to insulate the building’s exterior. The wet adhesive must be applied in sync across the face of the building to ensure an even distribution.
The demonstration project at Hebei #1 featured a transparent mechanism for democratic decision-making, effectively winning the support and cooperation of local residents. The success of the retrofits at the three demonstration buildings motivated residents in neighboring buildings in the complex to ask the head of the residents’ committee to approach the director of the Department for Energy Efficiency in Buildings and request retrofits in their own buildings (02). Each household was willing to invest 5000 RMB in the retrofit project (01).
Demonstration Projects

The three demonstration buildings at the Hebei #1 community all had their heating systems upgraded and modernized. Heat metering was achieved with a vertical double-pipe system (D3), automatic temperature control valves, and electronic heat allocation meters (04-05). Heat meters were installed in the building with indoor circular heating. The old heating pipes leading into the building were also replaced.
Single-pane horizontal sliding windows were replaced with inward-opening windows. Residents requested that windows with upper fixed sashes be replaced with lower fixed sashes, freeing up windowsill space and reducing the risk of bumping one’s head on an open window. A self-closing entrance door provided greater building insulation, and an entrance canopy not only eliminated an unwelcome thermal bridge, but also gave the building a smart new look. After a retrofit makeover, the building looks better than ever!
"The temperature in the rooms at the north end of the building increased from 8-9°C to over 20°C after the retrofits. I turned the heating off over a month ago and it’s still 21 degrees inside," says a proud Wang Baohua. The newly retrofitted windows not only look good, but also insulate against cold, dust, and noise pollution, making the entire house cleaner and more comfortable to live in.
Demonstration Projects    Capacity Building       Raising Awareness

The Huixinxijie housing complex in Beijing was built in 1988, and is comprised of four structurally similar residential buildings constructed with in-situ concrete cores fitted with prefabricated concrete slabs. Each building has 16 stories and 114 units, with a total floor space of 11,800 square meters. The community is heated on-site by a gas boiler house. The buildings in the Huixinxijie housing complex all suffered from a series of common problems, including leaks in junction of the concrete slabs, condensation and mold on the walls, uncomfortable indoor temperatures, etc. The property management company responsible for the community received constant complaints from residents about poor heating during the winter months.

From 2007 to 2008, with the support of the Sino-German Technical Cooperation project Energy Efficiency in Existing Buildings, the Beijing Municipal Commission of Housing and Urban-Rural Development arranged for the BUCC Group to implement comprehensive energy efficiency retrofits to No. 12 Huixinxijie. This project utilized MAXIT's full range of exterior insulation joint processing technology, including base brackets, aluminum alloy window boards, expanded sealing strips, inner and outer corner profiles, and water-drop profiles on upper window openings. The No. 12 Huixinxijie demonstration utilized for the first time a mineral wool fire barrier in window openings to offer fire prevention in high-rise buildings. The project included a decentralized under-pressure fresh air system, also a first in energy efficiency retrofitting, to realize the principles of environmentally friendly eco-building. Solar room retrofitting optimized the climate compensation system, and an electric three-way valve was installed at the building’s thermal inlet to allow for automated heat flow adjustments in accordance with real-time indoor temperature measurements.

After completing the retrofit, average indoor temperatures rose from 17°C to over 25°C (without heat cost account at that time), while heat energy consumption dropped from 82 kWh/m²·a to 54 kWh/m²·a over the winters of 2008-2009. Energy savings amounted to 54,454 cubic meters of natural gas and 46,410 kWh of boiler house electricity (not including additional energy savings achieved by residents’ reduced use of air conditioning). All told, the retrofit at No. 12 Huixinxijie will result in an annual CO₂ emissions reduction of 249 tons.

After the success of the retrofits at Building No. 12, the BUCC Group went on to conduct energy efficiency retrofits on the remaining three buildings in the Huixinxijie complex in 2010.

The Beijing municipal government, using this demonstration project as a model, set a goal of retrofitting eight million square meters of floor space in old residential buildings in 2011, with a cumulative thirty million square meters to be completed in 2015.

No. 12 Huixinxijie, Beijing

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The Beijing municipal government, using this demonstration project as a model, set a goal of retrofitting eight million square meters of floor space in old residential buildings in 2011, with a cumulative thirty million square meters to be completed in 2015.
Demonstration Projects
Capacity Building
Raising Awareness

Retrofit Plan
This project drew on German technologies, experience, and concepts of comprehensive energy efficiency retrofitting in existing buildings, and built upon the successful experience gained in the Tangshan demonstration project. Retrofits implemented in the Huixinxijie project focused on the building envelope, the heating system, and the fresh air system. Seven major retrofit technologies were employed in the following areas:

1. Exterior Wall thermal Insulation
2. Roofing thermal Insulation and Waterproofing
3. Energy Efficient Doors and Windows
4. Indoor Heating Systems
5. Outdoor Heat Supply Systems
6. Heat Source Retrofitting
7. Fresh air system

Residents in the Huixinxijie complex initially lacked an understanding of the benefits of energy efficiency retrofitting, with less than 30% of residents supporting the project. The Beijing Municipal Commission of Housing and Urban-Rural Development organized a delegation of over thirty residents to visit the Hebei #1 housing complex in Tangshan; through site visits, first-hand sharing of experience between residents, and the patient, hard work of the residents’ committee and the project office, support among Huixinxijie residents rose to a full 90% of households.
Huixinxijie No. 12 installed MAXIT’s exterior thermal insulation compound system, in which mineral wool was used for the first time as a fire barrier in the window openings of high-rise buildings. The retrofits also featured external base bracket and stainless steel window boards, with a water-drop profile installed along the top of window openings. The use of inner and outer corner profiles and expanded sealing tape ensure the long-term effectiveness of the exterior thermal insulation system.
Based on the success of the energy efficiency retrofits at Huixinxi No. 12, the BUCC Group conducted further retrofits on the three other buildings in the complex. With a fully retrofitted on-site heating system there was a noticeable decrease in the boiler’s consumption of natural gas. Meanwhile, a marked improvement in resident satisfaction translated into a heating bill collection rate of 100%.
Thanks to the dedication and support of the Ministry of Housing and Urban-Rural Development (MoHURD), the city of Urumqi had a relatively early start on energy efficiency retrofitting in existing residential buildings and was in many respects a national pioneer in the field. In 2003, for example, the Urumqi municipal government arranged a special fund to incentivize energy efficiency retrofit projects.

In order to implement the central government’s policy of developing China’s western region, as well as to further improve the standards and quality of Urumqi’s energy efficiency retrofitting, MoHURD invited German supervisors to provide on-site guidance and made recommendations on quality improvement. For example, insulation was fitted 10 cm above the building apron to keep the opening clean and ensure long-term effectiveness. Another example lies in the chaotic on-site management in the early days of retrofit implementation, during which insulation materials were strewn about in disorderly fashion and waste piled up in the buildings’ corridors. Fortunately, the project office and German experts offered timely guidance, effectively clearing the mess, eliminating potential fire hazards, and ensuring convenient passage for the buildings’ residents.

In addition, many of the building roofs lacked an effective water drainage system, and because the terrain tilted slightly toward the buildings’ entrances, dangerously large icicles would often form during the winter months, occasionally dropping and hurting people below. Experts suggested building a parapet to drain water safely away. The parapet and cornice angles were engineered on a slant to prevent the formation of icicles.

The retrofit project also included waterproofing of the buildings’ bathrooms and renovation of eroded walls, ensuring that the insulating inner wall would remain leak-free. Inspired by the Caochangxiang demonstration project, the Urumqi Municipal Commission of Housing and Urban-Rural Development issued new policy documents aimed at improving energy efficiency retrofit quality and launched pilot projects in passive house construction.

The eight buildings in Urumqi’s Caochangxiang housing complex were constructed with brick. Bathrooms were not waterproofed, leading to severe efflorescence and erosion of the walls. Hollow profile steel windows let in cold winter drafts, prompting residents to plug the window cracks with tape to provide rudimentary insulation. The building interiors suffered from severe condensation and mold.

Caoshangxiang Housing Complex, Urumqi

The buildings were six stories high, and were constructed of brick. The buildings suffered from leaking, efflorescence, and erosion in the walls, backed water-proofing in the bathrooms, suffered indoor condensation and mold, and were highly uncomfortable to live in. The complex was made up of residents belonging to different ethnic groups, living in a mix of private homes and public rental units.

Urumqi is in a region subject to extreme cold, with the winter season lasting up to six months each year. In light of these conditions, Chinese and German experts drafted and implemented minimum, medium, and maximum retrofit solutions to compare the effectiveness of different concepts. The maximum retrofit solution utilized 14 cm EPS boards and inward-opening windows with triple glazing. The project invited German supervisors to provide on-site guidance and make recommendations on quality improvement. For example, insulation was fitted 10 cm above the building apron to keep the opening clean and ensure long-term effectiveness. Another example lies in the chaotic on-site management in the early days of retrofit implementation, during which insulation materials were strewn about in disorderly fashion and waste piled up in the buildings’ corridors. Fortunately, the project office and German experts offered timely guidance, effectively clearing the mess, eliminating potential fire hazards, and ensuring convenient passage for the buildings’ residents.

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## Retrofit Plan

<table>
<thead>
<tr>
<th>System</th>
<th>Minimum Retrofit</th>
<th>Medium Retrofit</th>
<th>Maximum Retrofit</th>
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<tr>
<td>Exterior Wall</td>
<td>10 cm EPS</td>
<td>12 cm EPS</td>
<td>14 cm EPS</td>
</tr>
<tr>
<td>Window</td>
<td>inward-opening windows with double-glazing</td>
<td>inward-opening windows with triple glazing</td>
<td>inward-opening windows with triple glazing</td>
</tr>
<tr>
<td>Roof (Insulation)</td>
<td>6 cm polyurethane(PU) spray atop original roofing</td>
<td>6 cm polyurethane(PU) spray atop original roofing</td>
<td>8 cm polyurethane(PU) spray atop original roofing</td>
</tr>
<tr>
<td>Roof (Waterproofing)</td>
<td>Integrated insulation and waterproofing</td>
<td>Integrated insulation and waterproofing</td>
<td>Integrated insulation and waterproofing</td>
</tr>
<tr>
<td>Basement Ceiling</td>
<td>6 cm EPS</td>
<td>8 cm EPS</td>
<td>8 cm EPS</td>
</tr>
<tr>
<td>Ground Level Building Entrance</td>
<td>steel door at vestibule entrance for insulation and added security</td>
<td>Steel door at vestibule entrance for insulation and added security</td>
<td>Steel door at vestibule entrance for insulation and added security</td>
</tr>
<tr>
<td>Heating System</td>
<td>Horizontal single-pipe with bypass, each with manual temperature control valves</td>
<td>Horizontal single-pipe with bypass, each with manual temperature control valves</td>
<td>Vertical double-pipe system, each with thermal static valve</td>
</tr>
<tr>
<td>Heat Metering</td>
<td>Heat meter for every building entrance</td>
<td>Heat meter for every building entrance</td>
<td>Heat meter for every building entrance</td>
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<tr>
<td>Fresh air system</td>
<td>Open windows</td>
<td>Under-pressure fresh air system</td>
<td>Under-pressure fresh air system</td>
</tr>
</tbody>
</table>
Residents reported that large icicles formed easily on the cornices of the roof, posing the danger of ice falling on people walking below. Project experts recommended constructing a parapet to drain water safely away, and the parapet and cornice angles were engineered with slanted steel sheets that not only eliminated the danger of falling icicles but also enhanced the building’s aesthetic appeal.
The Caochangdi demonstration used an indoor under-pressure fresh air system similar to the one used in Beijing’s Huixinxijie project. This system ensured a well-regulated supply of fresh air and helped to achieve the project’s goal of energy efficient green building.
The retrofit gave Caochangxiang a great new look, delighting this elderly Hui woman. She initially had reservations about the project, but is now an enthusiastic advocate for energy efficiency retrofitting.
The success of the demonstration project attracted great attention among relevant organizations and institutions. Representatives of the National People’s Congress, the CPPCC, MoF, and MoHURD made regular reports on the project’s progress, and several international organizations sent representatives to conduct live site visits.

The demonstration project also received attention from all levels of government and from the domestic building sector at large. Deputy Director Han Aixing of MoHURD’s Department of Energy Efficiency in Buildings and Science & Technology and Dr. Skala-Kuhmann, the chief representative of GIZ’s China office, were guided by the vice-mayor of Tangshan to visit the project work site. Section Chief Kang Bingqian and Mr. Liu Xiang of the Ministry of Commerce’s Department of International Relations visited together with the representatives from the German Embassy the Huixinxijie project. The Parliamentary State Secretary of German Federal Ministry of Transport, Building and Urban Development Mrs. Karin Roth visited the Hebei #1 housing complex in Tangshan. Li Hongbin, the vice-mayor of Urumqi, and Feng Ruiyu, director of the Urumqi Municipal Commission of Housing and Urban-Rural Development, visited the project site and offered valuable guidance and support.
Demonstration Projects    Capacity Building       Raising Awareness

Capacity Building
An important goal of the Sino-German Technical Cooperation project Energy Efficiency in Existing Buildings was to train a corps of Chinese technicians and managers and improve their BEE retrofit skills, with an aim to shorten and eventually eliminate the gap in knowledge and technology in this area that exists between China and the world at large. Over the five years of project implementation, the project office organized technical trainings and out-of-country site visits to enable Chinese practitioners to fully understand and learn from international experience in building energy efficiency. Great efforts have been made to help China grasp global, cutting-edge technology and implementation methods, to both improve theoretical foundations and develop actual operational skills.

Over the course of implementing demonstration projects in Tangshan, Beijing, and Urumqi between 2006 and 2008, the project office selected experienced German design and engineering supervisors to provide on-site guidance. These experts not only ensured implementation quality, but also worked toward capacity building and served as models for project supervisors. Follow-up technical trainings continued after project completion. Between 2008 and 2010, the project office trained approximately 3000 professional managers and technical staff. The topics of these training programs covered every aspect of energy efficiency retrofitting in existing residential buildings. For example, German experts were invited to lead trainings on building energy efficiency inspection and evaluation, external insulation, heating, and ventilation technology, theory and practical use of thermal imaging, range finders, and blower doors, etc. These training programs were rich in content, highly targeted, and featured an organic integration of theoretical and practical knowledge. They were therefore highly popular among participating managerial and technical trainees, who indicated they gained significant knowledge and skills via the trainings.

The project office also drew on its own inherent strengths, organizing groups of Chinese technicians and managers to go abroad and conduct site visits and training sessions in Germany and other European countries; over 100 trainees participated in these programs over a five year period. These technicians and managers received training in various aspects of sustainable building, including energy efficiency policy and law, energy management, energy certification, retrofit projects, energy efficiency products, energy efficiency in public buildings, and passive housing. Live site visits and training sessions allowed trainees to learn first-hand the advanced technical know-how and overseas experience of energy efficiency retrofitting in existing residential buildings, giving them a deeper understanding of the field, from its theoretical basis down to its technical details.

The promotion and improved quality of retrofitting in China will ultimately rely on a core of talented practitioners armed with cutting-edge ideas and technologies. Over a five-year period, the project office has invested a tremendous effort in capacity building and managerial and technical training. A large group of talented and well-equipped Chinese practitioners have already become the main force driving China’s energy efficiency retrofitting in existing residential buildings today, and will continue to play an important role in the future. The Sino-German Technical Cooperation project Energy Efficiency in Existing Buildings, and its ongoing efforts to train these managers and technicians, have been widely praised as an important contribution to the development of energy efficiency retrofitting in China.
Chinese and German experts conduct on-site energy efficiency retrofit quality evaluations and technical exchanges.
MAXIT provides initial training for engineers from the BUCC Group, giving a detailed briefing on the specifics of exterior walls insulation.
Raising Awareness
Raising Awareness

Conducting energy efficiency retrofitting in existing buildings across China is a staggering task in both its scope and complexity, and will require a strong committed effort going forward. Raising awareness and sharing successful experiences in BEE will help to further promote this movement, which is why the Sino-German Technical Cooperation project Energy Efficiency in Existing Buildings has always looked upon raising awareness as an important part of its mission. Raising awareness includes promoting successful management techniques, technical experience, public participation methods, energy savings benefits, and energy efficiency products, etc.

While the demonstration projects were still under implementation, efforts to raise awareness were already underway. The project office sent experts to attend a series of seminars to introduce the demonstration projects and the experience gained from them, and in 2007 hosted promotional events such as the Tangshan Demonstration Project Dissemination Conference and the Tangshan Demonstration Project Best Practices Workshop. These activities played a positive role in promoting energy efficiency retrofitting in existing buildings.

Between 2009 and 2010, the project office’s main efforts shifted from demonstration project implementation to the compilation and dissemination of successful project experience. A series of speaking tours was organized, a total of nine “Sino-German Technical Cooperation Energy Efficiency in Existing Buildings” lecture conferences were held, and speakers promoted the project at events in 15 provinces/cities, including Harbin, Heilongjiang Province; Urumqi, Xinjiang Autonomous Region; Taiyuan, Shanxi Province; Hebi, Henan Province; Baoji, Shaanxi Province; Tianshui, Gansu Province; Lhasa, Tibet Autonomous Region; Xining, Qinghai Province; Hulunbuir, Inner Mongolia Autonomous Region; and Changchun, Jilin Province. These events were attended by over 2000 industry practitioners, technicians, managers, designers, supervisors, and representatives of academic institutions and construction companies. The lecture circuit helped to provide front-line technical and management personnel with a deeper understanding of comprehensive energy efficiency retrofitting in existing residential buildings. All of the events aimed to improve retrofit quality and broaden the public base of support for energy efficiency retrofitting.

For six consecutive years beginning in 2006, the project office has held an annual side-forum titled “Technologies and Engineering Practice for Energy-saving Renovation of Existing Buildings” at the International Conference on Green and Energy Efficient Building & New Technologies and Products Expo. This high-level platform has amplified the impact of energy efficiency retrofitting and further disseminated best practices.

In order to better raise awareness, the project office created 200 speaking modules and compiled and published 13 handbooks on subjects such as the advanced international experience in BEE and the collected experience and implementation status of demonstration projects in China. The project office also took full consideration of the role the media can play in promoting energy efficiency retrofitting in existing buildings. The media, for its part, was equally enthusiastic, with national and local media conducting widespread coverage of the project, its benefits, and the experience and results gained. Foreign media such as the Berliner Zeitung, Süddeutsche Zeitung, Time Magazine, Deutsche Welle, and the German television stations ARD and ZDF all conducted very positive coverage of the project.

Promotion of the project has been multifaceted and penetrating, demonstrating its benefits and achievements while disseminating its experience and methodologies. Residents have gained a better understanding of energy efficiency retrofitting, technicians and managers have improved skills and know-how, and the concept of comprehensive energy efficiency retrofit has found a place in the public consciousness. All of this will have a positive impact on China’s drive to implement energy efficiency retrofitting in existing buildings on a larger scale.
MoHURD’s Department of Energy Efficiency in Buildings and Science & Technology arranged for the project office to conduct dissemination events and live consultation in 15 cities/provinces. These events helped to disseminate advanced concepts, effective public participation methods, implementation technologies, and quality management experiences among practitioners at the local level.
Since 2006, the EEEB project office has held six annual side-forums on “Technologies and Engineering Practice for Energy-saving Renovation of Existing Buildings” at the International Conference on Green and Energy Efficient Building & New Technologies and Products Expo.
The demonstration projects were widely covered in the media. China Central Television, Beijing TV, Germany’s ARD and ZDF, as well as many print publications conducted widespread positive coverage of the demonstration projects, bringing energy efficient building and climate protection deeper into the public consciousness.
The EEEB project office combined demonstration experience with special topical issues to produce a series of summary reports on the projects’ results and industry data.
Energy efficient buildings improve the quality of life of the residents living in them, contribute to the development of a harmonious society, promote social and economic sustainable development, and help to protect the environment and our climate. Each smiling face in the communities we serve fills us with pride and joy, and reminds us of the important task that we bear.
Demonstration Projects    Capacity Building    Raising Awareness

Final Words

When we look at the bright new facades of the buildings we’ve worked on, or the bright smiles of the residents that live in them, our hearts are truly filled with pride and joy. Energy efficiency retrofitting in existing buildings is especially beneficial to the underprivileged, and makes an important contribution to the development of a harmonious society.

Energy efficiency retrofitting in existing residential buildings in north China has enormous potential in terms of market, energy savings, and emissions reductions:

- North China has 3.5 billion square meters of floor space in existing residential buildings that need and deserve retrofitting; at an energy savings rate of 10 kg of coal/retrofit square meter, there is the potential for energy savings at 35 million tons of coal equivalent and an emissions reduction of nearly 100 million tons of carbon dioxide.
- At an average cost of 350 RMB/retrofit square meter plus additional furnishing expenses, the economy could benefit from a potential 2 trillion RMB increase in domestic demand.
- Retrofitting could create up to 5 million new jobs.
- The demonstration in Tangshan indicates that for every 2 square meters of retrofitting, enough energy will be saved to heat 1 square meter of newly built floor space; this can help to reduce the heating and energy burden on regions that are already struggling with excessive pollution caused by the burning of coal.

Implementing energy efficiency retrofits in existing residential buildings in China is an undertaking of unprecedented importance and complexity, one that will benefit humanity today as well as for many generations to come.

The task before us is challenging, but our prospects are bright and our hearts determined — let us join hands as we continue down the road to success, giving warmth and comfort to all families, in all seasons!